(Un)Conventional Monetary and Fiscal Policy

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COVID-19 responses

Fed

- doubled its balance sheet to $9 trillion

Treasury

- Paycheck Protection Program: $800 billion
- Economic Impact Payments: $800 billion

How do we compare all the emergency monetary and fiscal policy?

A Tractable NK Model

Features an IS and a Phillips curve

- Constrained and unconstrained HH
- Segmented Financial Market: short and long term bonds
- Financial intermediary: maturity transformation + leverage constraint

Policy

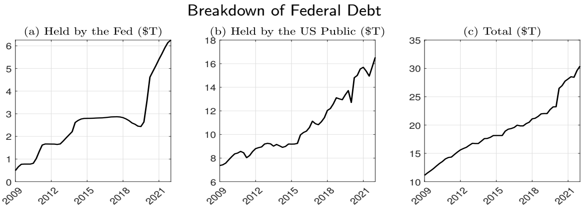
1. Conventional MP
2. QE: central bank's holding of long-term bonds
3. Lump-sum transfer: to constrained HH
4. G

Main Results

1. QE and tax-financed fiscal policy have the same aggregate implications
2. Conventional monetary policy is more inflationary than other policies
3. QE and transfers have redistribution effects, but not G or conventional MP
4. Ricardian equivalence breaks
   Fiscal policy is more stimulative when tax financed than when debt financed
5. We also study optimal policy coordination

Outline

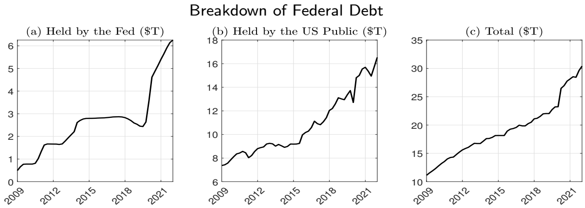
Discrepancy 1: Balance Sheet Policy



- **Empirics:**
  - focus on the central bank's balance sheet
  - argue QE has been expansionary
- **Theory:**
  - should focus on the joint balance sheet
    e.g., Gertler and Karadi (2011), Carlstrom et al. (2017), Sims and Wu (2021)
  - balance sheet policy since the GR would have been contractionary

Lemma 1

Discrepancy 1: Balance Sheet Policy



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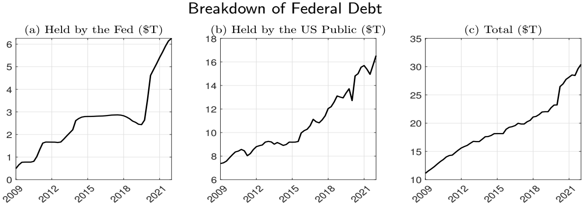
Discrepancy 1



Questions

- Does the empirical literature miss the dominant piece?
- Or does rapid debt growth by the Treasury not matter?

Discrepancy 2: Fiscal Multiplier

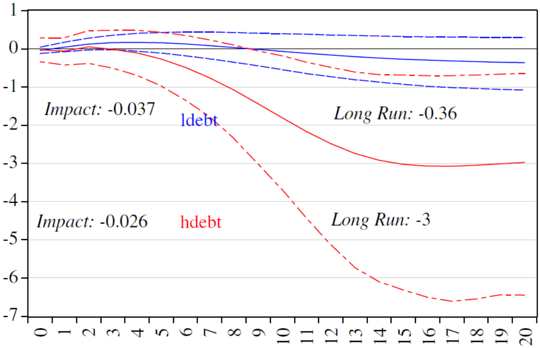
Empirics: *The estimates of the fiscal multiplier display a wide range*

Method/Sample	*Multipliers*	*Comments*
A: Time series analysis		
Updated implementation of Blanchard and Perotti (2002) identified SVAR		The tax response is positive for the 1939Q1–2015Q4 period, but is essentially 0 for the later periods.
1939Q1–2015Q4	0.6 to 0.8	
1947Q1–2015Q4	0.6 to 0.7	
Military news shocks, local projections Ramey and Zubairy (2018) military news		Tax response is positive for 1939Q1–2015Q4 period.
1889Q1–2015Q4	0.6 to 0.8	SE from 0.04 to 0.06
1939Q1–2015Q4	0.7 to 0.8	SE from 0.05 to 0.1
1947Q1–2015Q4	0.5 to 0.7	SE from 0.15 to 0.2
Ben Zeev and Pappa (2017) news, 1947Q1–2007Q4[a]	1.1 to 2	SE from 0.6 to 1
Hall (2019), Barro and Redlick (2011)—based on regressions using annual defense spending.	0.6 to 0.7	The Barro–Redlick analysis nets out effects of changes in tax rates.
Mountford and Uhlig (2009), SVAR with sign restrictions	0.65	Deficit-financed increase in government spending.
Iltzetzki, Mendoza, and Végh (2013), Blanchard–Perotti identification in SVAR, quarterly data, 1960–2007, 44 countries high-income countries	0.3 to 0.7	
Corsetti, Meier, and Müller (2012)	0.7	Based on unconditional model results reported in their Figure 1.
Leigh et al. (2010), Guajardo, Leigh, and Pescatori (2014), 17 OECD countries, 1978–2009, narrative method identification of spending-based fiscal consolidations	0.3	
Alesina, Favero, and Giavazzi (forthcoming). Narrative analysis of austerity plans, 16 OECD economies from 1978–2014.	0.3	

Mostly between 0.3 and 0.8: Table 1 of Ramey's (JEP 2019)

Discrepancy 2

Empirics: *The fiscal multiplier decreases with the debt-to-GDP ratio.*



Source: Figure 8 of Ilzetzki, Mendoza and Végh (JME 2013) ▸ Proposition 4

Theory: a constant multiplier

Discrepancy 3: Transfers

- **Theory:** transfers are neutral
  COVID-19 emergency fiscal programs have no consequences?!
- **Empirics:**
  - *Fiscal transfers stimulate aggregate demand* Proposition 1
    Parker et al. (AER 2013), Parker et al. (NBER wp 2022)
  - *Constrained households increase their consumption more* Proposition 3
    Broda and Parker (JME 2014)

Outline

1. Empirics-Theory Discrepancies

2. Linear Model and Its Properties

3. Full Model

Model Structure

1. Unconstrained (standard) household:
   save via one-period deposits + pay taxes
2. Constrained household:
   issue long-term bonds to finance consumption + receive transfers
3. Financial intermediary:
   maturity transformation + leverage constraint
4. Firms: Calvo sticky price
5. Central bank: QE + conventional MP
6. Government:
   - transfers to *constrained* HH + G
   - tax *unconstrained* HH or issue long-term debt

Full model

A Tractable NK Model

$$IS: \quad \hat{y}_t = \mathbb{E}_t \, \hat{y}_{t+1} - \frac{\vartheta}{\sigma}\left(\hat{i}_t - \mathbb{E}_t \, \hat{\pi}_{t+1}\right)$$

$$PC: \quad \hat{\pi}_t = \beta \, \mathbb{E}_t \, \hat{\pi}_{t+1} + \gamma\zeta\hat{y}_t$$

- Standard text-book model
  hat: log deviation from the steady state
  σ, β, γ, ζ: standard parameters
  ϑ: steady-state share of the unconstrained household's consumption in output

A Tractable NK Model

$$
\begin{aligned}
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\end{aligned}
$$

- Blue: additional policy instruments
  $\widehat{qe}_t$, $\hat{\tau}_t^C$, $\hat{g}_t$: deviation relative to steady-state output
  - QE: relaxes the financial intermediary's leverage constraint
  - Transfers: to the constrained household, increase their consumption

  $\rightarrow$ stimulates aggregate demand
- $0 \leq \eta \leq 1$: fraction of fiscal policy financed by lump-sum taxes

Proposition 1: QE vs. Fiscal

Proposition

The effects of QE, government expenditures, and lump-sum fiscal transfers on output and inflation are the same when fiscal policy is fully tax financed.

When $\eta = 1$

$$\begin{aligned}
\hat{y}_t &= \mathbb{E}_t\, \hat{y}_{t+1} - \frac{\vartheta}{\sigma}(\hat{i}_t - \mathbb{E}_t\, \hat{\pi}_{t+1}) \\
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All of them affect both supply and demand

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Proposition 2: Inflation

Proposition

To provide the same amount of stimulus, conventional monetary policy is more inflationary than QE and tax-financed fiscal policy.

Consistent with the literature

- Comparison between conventional MP and QE
  Sims, Wu and Zhang (*ReStat* forthcoming)
- Empirical literature: fiscal policy is not that inflationary
  Nakamura and Steinsson (2014), Pennings (2021), Jørgensen and Ravn (2022), and Liu and Xie (2022)

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Proposition 2

Why is conventional MP different?

- All policy tools enter the IS curve
- All but conventional MP also enter PC, which puts downward pressure on inflation

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Why do they put downward pressure on π?

- They crowd out consumption of unconstrained household
- HH supplies more labor → puts downward pressure on wage

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2021–2022 Inflation Surge

Logical order of Fed's tightening

- unwind balance sheet and then raise the policy rate

In response to persistently high inflation,

- raised policy rate from [0, 0.25] to [3.75, 4]
- barely winded down balance sheet

Model prediction: tightening the policy rate is more effective at combating inflation.

Fiscal authority

- provided another round of stimulus to help alleviate increased cost of living
- in late 2022, 17 states sent out inflation-relief checks

Model prediction: this policy combination can lower inflation without large contraction.

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Proposition 3: Redistribution

Proposition

- *QE and tax-financed transfers redistribute wealth from the unconstrained household to the constrained household*
- *The policy rate and tax-financed government spending do not have a redistribution effect*

Why

- QE and transfers relax the constrained HH's BC
- Policy rate and government spending stimulate aggregate demand

Discrepancy 3: transfers discrepancy

- Proposition 1: transfers are not neutral
- Proposition 3: transfers redistribute wealth from unconstrained to constrained HH

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Lemma 1: Debt Finance

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When $\eta = 0$

$$\begin{aligned}\hat{y}_t &= \mathbb{E}_t\,\hat{y}_{t+1} - \frac{\vartheta}{\sigma}(\hat{i}_t - \mathbb{E}_t\,\hat{\pi}_{t+1}) \\ &\quad + \left[\widehat{qe}_t + \eta(\hat{\tau}_t^C + \hat{g}_t)\right] - \mathbb{E}_t\left[\widehat{qe}_{t+1} + \eta(\hat{\tau}_{t+1}^C + \hat{g}_{t+1})\right] \\ \hat{\pi}_t &= \beta\,\mathbb{E}_t\,\hat{\pi}_{t+1} + \gamma\zeta\hat{y}_t - \frac{\gamma\sigma}{\vartheta}\left[\widehat{qe}_t + \eta(\hat{\tau}_t^C + \hat{g}_t)\right]\end{aligned}$$

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\end{aligned}$$

Lemma 1

Why

- Transfers and G are stimulative
- Issuing long term bonds is contractionary

Two effects cancel out

Discrepancy 1: balance sheet policy discrepancy

- Contractionary effects of issuing debt = expansionary effects of G and transfers
- CB's balance sheet (QE) is relevant
- Supports the practice in empirical literature

Proposition 4: Ricardian Equivalence

Proposition

Ricardian equivalence breaks: when a larger fraction of fiscal policy is tax financed, government expenditures or transfers are more stimulative.

$$\hat{y}_t = \mathbb{E}_t \hat{y}_{t+1} - \frac{\vartheta}{\sigma}(\hat{i}_t - \mathbb{E}_t \hat{\pi}_{t+1}) + \left[\widehat{qe}_t + \eta(\hat{\tau}_t^C + \hat{g}_t)\right] - \mathbb{E}_t \left[\widehat{qe}_{t+1} + \eta(\hat{\tau}_{t+1}^C + \hat{g}_{t+1})\right]$$

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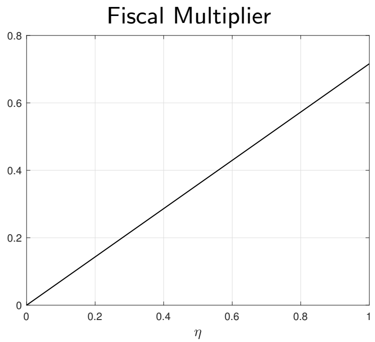
Proposition 4

Discrepancy 2: fiscal multiplier ▸ discrepancy

- Model implied multiplier $[0, 0.72] \leftrightarrow [0.3, 0.8]$ in the data
- It increases with η ($1-\eta$ proxy debt-to-GDP ratio)
- Both consistent with empirical literature



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Model Structure

1. Unconstrained (standard) household
2. Constrained household
3. Financial intermediary
4. Firms
5. Central bank
6. Government

Unconstrained Household

- Utility

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left[\frac{C_t^{1-\sigma} - 1}{1-\sigma} - \psi \frac{L_t^{1+\chi}}{1+\chi} \right]$$

- Budget constraint

$$P_t C_t + D_t = W_t L_t + I_{t-1} D_{t-1} + P_t T_t^U$$

D_t: one-period deposits; T_t^U includes dividends, transfers, and taxes

- FOCs

$$\psi L_t^{\chi} = C_t^{-\sigma} w_t$$
$$C_t^{-\sigma} = \beta I_t \mathbb{E}_t \left[\frac{C_{t+1}^{-\sigma}}{\Pi_{t+1}} \right]$$

Constrained Household

- Does not work: for tractability only
- Less patient than unconstrained HH: makes it the borrower
- Finances its consumption by issuing long term bonds
- "Constrained"
  - its borrowing is limited due to the leverage constraint of the financial intermediary
  - it behaves similarly to the hand-to-mouth household in the TANK model although they are structured differently

Constrained Household

- Utility

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \left(\beta^C\right)^t \left[\frac{\left(C_t^C\right)^{1-\sigma} - 1}{1-\sigma}\right]$$

$\beta^C < \beta$: makes constrained HH borrower

- Budget constraint ▸ Perpetuity

$$P_t C_t^C + B_{t-1}^C = Q_t \left(B_t^C - \kappa B_{t-1}^C\right) + P_t X_t^C + P_t T_t^C$$

B_{t-1}^C: coupon; $Q_t\left(B_t^C - \kappa B_{t-1}^C\right)$: new issue; T_t^C: government transfer

- FOC

$$\left(C_t^C\right)^{-\sigma} = \beta^C \, \mathbb{E}_t \left[\frac{\left(C_{t+1}^C\right)^{-\sigma} R_{t+1}}{\Pi_{t+1}}\right]$$

R_{t+1}: holding period return

Financial Intermediary

- FI lives for one period: Sims, Wu, and Zhang (*ReStat* forthcoming)
- Balance sheet condition

$$Q_t B_t^{FI} + RE_t^{FI} = D_t^{FI} + P_t X_t^{FI}$$

where $P_t X_t^{FI}$ includes new equity & outstanding from previous intermediary

$$P_t X_t^{FI} = P_t \bar{X}^{FI} + \kappa Q_t B_{t-1}^{FI}$$

- Leverage constraint Optimal Policy

$$Q_t B_t^{FI} \leq \Theta P_t \bar{X}^{FI}$$

- Dividends

$$P_{t+1} \Phi_{t+1}^{FI} = \left(R_{t+1} - I_t\right) Q_t B_t^{FI} + \left(I_t^{RE} - I_t\right) RE_t^{FI} + I_t P_t X_t^{FI}$$

Financial Intermediary

FI maximizes the dividends discounted by the unconstrained HH's SDF subject to the leverage constraint

- FOCs

$$\mathbb{E}_t \Lambda_{t,t+1} \left(R_{t+1} - I_t \right) = \Omega_t$$
$$\mathbb{E}_t \Lambda_{t,t+1} \left(I_t^{RE} - I_t \right) = 0$$

Ω_t: the Lagrange multiplier on the leverage constraint

Central Bank

- Taylor rule

$$\ln I_t - \ln \bar{I} = \phi_\pi(\ln \Pi_t - \ln \bar{\Pi}) + \phi_y(\ln Y_t - \ln \bar{Y}) + \delta_{i,t}$$

- Balance sheet condition

$$Q_t B_t^{CB} = RE_t$$

- Define QE

$$QE_t = Q_t b_t^{CB}$$

where $b_t^{CB} \equiv B_t^{CB}/P_t$

- Return surplus

Fiscal Authority

- Budget constraint

$$P_t T_t^C + P_t G_t + B_{t-1}^G = Q_t(B_t^G - \kappa B_{t-1}^G) + P_t T_t^G$$

B_{t-1}^G: coupon; $Q_t\left(B_t^G - \kappa B_{t-1}^G\right)$: new issue ▸ Perpetuity

- Taxes

$$T_t^G \equiv T_t + \xi Q_{t-1} b_{t-1}^G$$

  - T_t : finance fiscal stimulus

$$T_t \equiv \eta(T_t^C + G_t)$$

  - $\xi Q_{t-1} b_{t-1}^G$: fiscal responsibility; similar to Bianchi and Melosi (JME 2019)
  - To guarantee determinancy:

$$\frac{1}{\beta^C} - 1 < \xi < \frac{1}{\beta^C} + 1$$

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Equilibrium

- Goods market

$$Y_t = C_t + C_t^C + G_t$$

- Asset market

$$B_t^G + B_t^C = B_t^{FI} + B_t^{CB}$$

- Convenience assumption of transfer from unconstrained to constrained HH yields

$$C_t^C = \Theta \bar{X}^{FI} + QE_t + T_t^C - (1-\eta)\left[T_t^C + G_t\right]$$

Constrained HH consumption depends on QE, transfers, and G

- The system has 24 equations and 24 variables and can be reduced

QE vs. G vs. Transfers

Constrained HH consumption ($\eta = 1$):

$$C_t^C = \Theta \bar{X}^{FI} + QE_t + T_t^C - (1-\eta)\left[T_t^C + G_t\right]$$

- QE allows it to increase consumption by issuing more bonds
- Transfers also increase consumption
- Both QE and transfers have a redistribution effect

Aggregate resource constraint

$$Y_t = C_t + \Theta \bar{X}^{FI} + QE_t + T_t^C + G_t$$

- G enters the same as QE and transfers
- But G does not affect constrained HH

They have the same aggregate effects but different redistribution consequences

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Breakdown of the Ricardian Equivalence

The aggregate resource constraint ($\eta = 0$):

$$Y_t = C_t + \Theta \bar{X}^{FI} + QE_t$$

- G and transfers drop out
- Debt-financed fiscal policy has no aggregate impact

Why

- Fiscal policy itself is stimulative
- Issuing bonds is contractionary
  - Total bond demand is exogenous (leverage constraint + QE)
  - Gov bonds crowd out private bonds issued by constrained HH
  - Lower their consumption

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We propose a tractable model featuring four types of government policy

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Our model reconciles with three empirics-theory discrepancies

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4. Optimal Policy Coordination

The First-Best Efficient Allocation

A social planner maximizes

$$W = \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left\{ \left[\frac{C_t^{1-\sigma} - 1}{1-\sigma} - \psi \frac{L_t^{1+\chi}}{1+\chi} \right] + \delta \frac{(C_t^C)^{1-\sigma} - 1}{1-\sigma} \right\}$$

subject to

$$C_t + C_t^C + G_t = A_t L_t$$

FOCs

$$\begin{aligned} C_t^{-\sigma} &= \delta (C_t^C)^{-\sigma} \\ \frac{\psi L_t^{\chi}}{C_t^{-\sigma}} &= A_t \\ G_t &= 0 \end{aligned}$$

Efficient output

$$\hat{y}_t^e = \frac{1+\chi}{\sigma+\chi} \hat{a}_t$$

Steady State and Flexible-Price Equilibrium

Steady state is efficient

- Standard: government subsidy to correct distortion from monopolistic competition
- New: impose steady state policy instruments to correct financial market distortion

Flexible-price equilibrium (with only $\hat{a}_t$ shock) output

$$\hat{y}_t^f = \frac{(1+\chi)(1-z)}{(1-z)\chi+\sigma}\hat{a}_t$$

- is only equal to efficient output

$$\hat{y}_t^e = \frac{1+\chi}{\sigma+\chi}\hat{a}_t$$

when $z \equiv \frac{\bar{C}^C}{\bar{C}+\bar{C}^C} = 0$

- because of the financial friction

Dual Stability

Dual stability

- $\hat{\pi}_t = 0$ and $\hat{y}_t = \hat{y}_t^e$

Three shocks

- productivity shock $\hat{a}_t$, demand shock $\hat{\xi}_t$, and credit shock $\hat{\theta}_t$ FI

Dual stability requires

$$\widehat{qe}_t + \eta \hat{\tau}_t^C = \frac{1-z}{\sigma}\left[\zeta \hat{y}_t^e - (1+\chi)\hat{a}_t\right] - \mathcal{Q}\hat{\theta}_t$$

$$\hat{i}_t = \frac{\sigma}{1-z}\hat{\xi}_t - \sigma(1-\rho_a)\frac{1+\chi}{\chi+\sigma}\hat{a}_t$$

- QE and transfers are isomorphic
- δ doesn't affect optimal policy

Divine Coincidence

Dual stability

$$\widehat{qe}_t + \eta\hat{\tau}_t^C = \frac{1-z}{\sigma}\left[\zeta\hat{y}_t^e - (1+\chi)\hat{a}_t\right] - \mathcal{Q}\hat{\theta}_t$$

$$\hat{i}_t = \frac{\sigma}{1-z}\hat{\xi}_t - \sigma(1-\rho_a)\frac{1+\chi}{\chi+\sigma}\hat{a}_t$$

Divine coincidence (DC): CB achieves dual stability with only i_t

- DC holds for $\hat{\xi}_t$ and the policy rate can fully stabilize it
- DC breaks for $\hat{a}_t$
  because it acts as a cost-push shock
- QE or transfers can fully stabilize credit shock $\hat{\theta}_t$

Triune Stability

Period welfare loss

$$\mathcal{L}_t = \hat{\pi}_t^2 + \lambda_{agg}(\hat{y}_t - \hat{y}_t^e)^2 + \lambda_{disp} var(\hat{c}_t^i)$$

Dual stability:

$$\widehat{qe}_t + \eta\hat{\tau}_t^C = \frac{1-z}{\sigma}\left[\zeta\hat{y}_t^e - (1+\chi)\hat{a}_t\right] - \mathcal{Q}\hat{\theta}_t$$

$$\hat{i}_t = \frac{\sigma}{1-z}\hat{\xi}_t - \sigma(1-\rho_a)\frac{1+\chi}{\chi+\sigma}\hat{a}_t$$

which also imply

$$var(\hat{c}_t^i) = 0$$

Two types of policy can stabilize three types of shocks and achieve three targets

Perpetual Bonds

- Coupons: decay at rate $\kappa \in [0, 1]$
- Total coupon liability at t: B_{t-1}
- New issues: $B_t - \kappa B_{t-1}$
- Price for new issues: Q_t; price for $t - j$ issues is $\kappa^j Q_t$
- Total value of all past issues: $Q_t B_t$
- Holding period return

$$R_t = \frac{1 + \kappa Q_t}{Q_{t-1}}$$

Constrained HH