

---

# Lecture 5: Monetary policy

Adrien Auclert

---

Fiscal and Monetary Policy with Heterogeneous Agents  
Bank of Portugal Minicourse  
June 2026

---

# This lecture

---

- ❖ So far: canonical HANK model, fiscal policy, sequence-space Jacobians
- ❖ **Now:** monetary policy! (in closed economy for now)
  1. Review of transmission in the RANK model
  2. Monetary policy in the canonical HANK model
  3. Direct and indirect effects of monetary policy
  4. Additional topics

# Monetary policy in the RANK model

# Representative agent NK model

❖ Separable preferences, sticky prices or wages, linearized + perfect foresight:

❖  $c_t = c_{t+1} - \frac{1}{\sigma} (i_t - \pi_{t+1})$  Aggregate demand: Euler equation

❖  $\pi_t = \kappa c_t + \beta \pi_{t+1}$  Inflation: New Keynesian Phillips curve

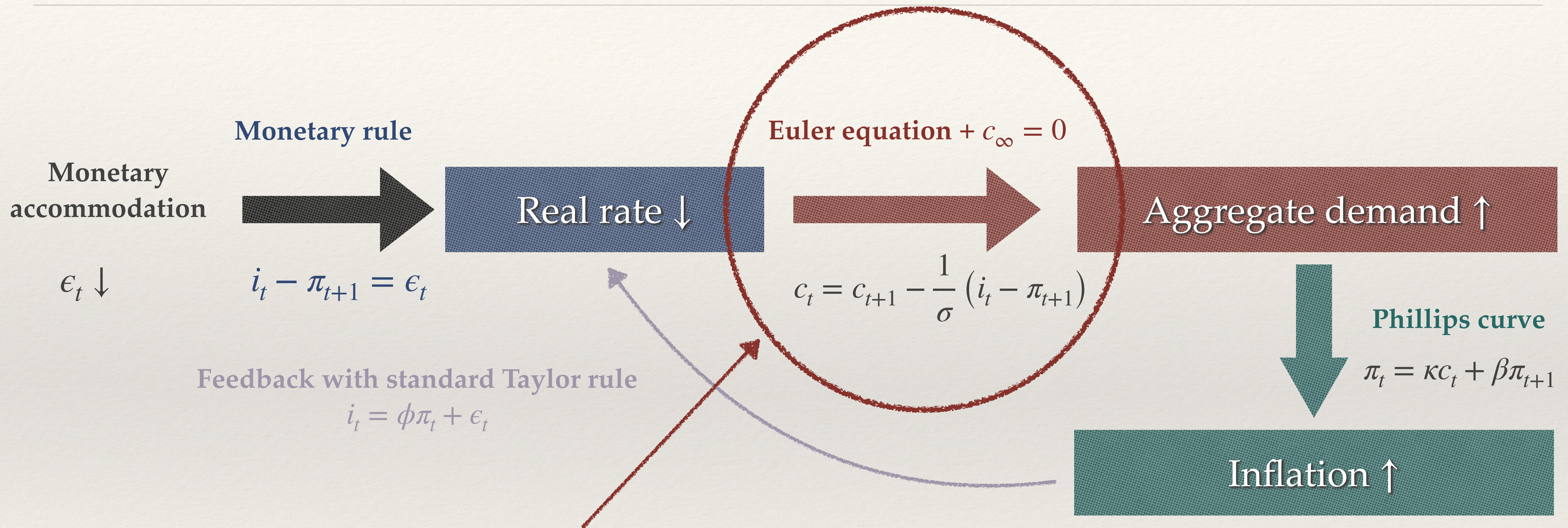
❖  $i_t = \pi_{t+1} + \epsilon_t$  Monetary policy: real interest rate rule

Can also use more standard Taylor rule:

$i_t = \phi \pi_t + \epsilon_t$



# Monetary transmission in RANK

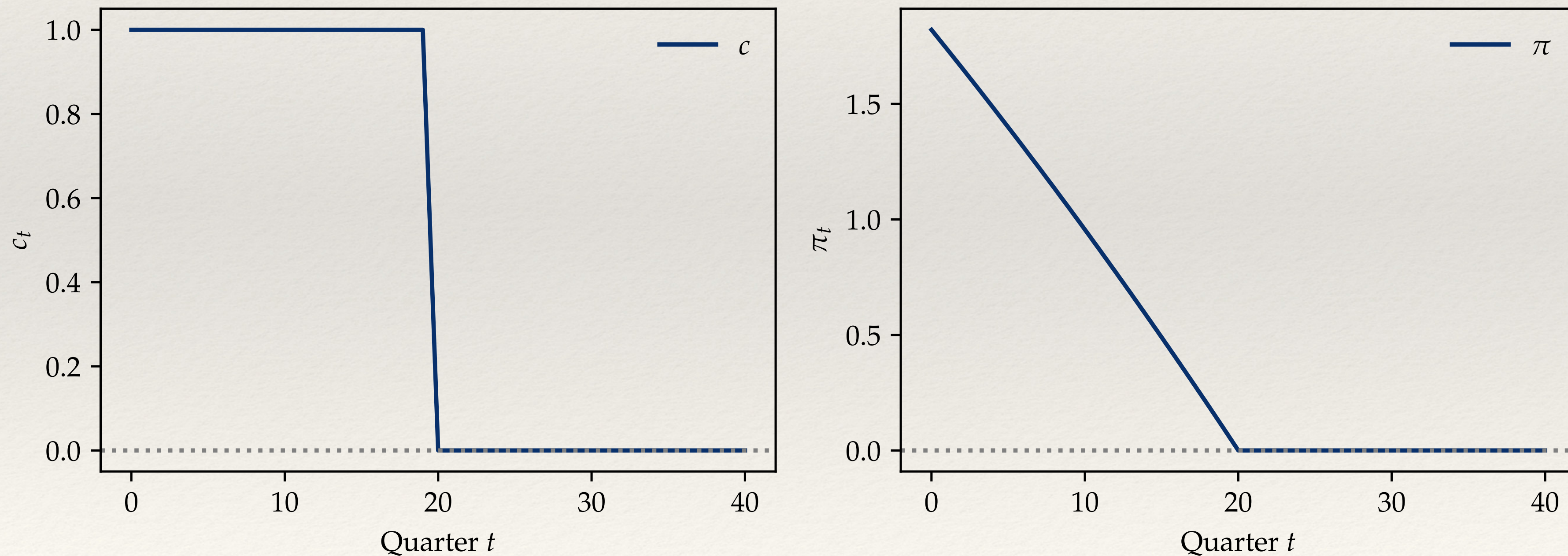


HANK revisits this link! Two key questions:

- (1) Is transmission through Euler equation alone plausible?
- (2) Is aggregate effect plausible?

# Forward guidance puzzle in RANK

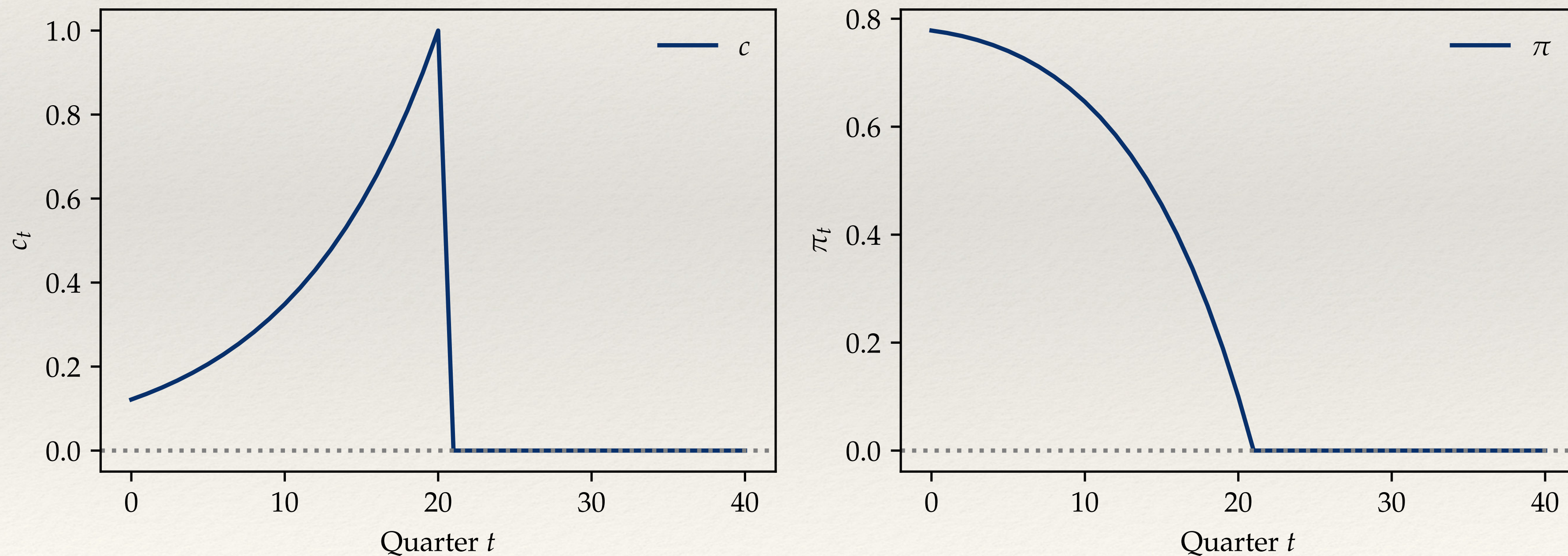
- ❖ Solving RANK with this policy rule: 
$$c_t = -\frac{1}{\sigma} \sum_{s=0}^{\infty} \epsilon_{t+s} \quad \pi_t = \kappa \sum_{s=0}^{\infty} \beta^s c_{t+s}$$
- ❖ Impulse response from date 0 to shock  $\epsilon_{20} = -1$ :



- ❖ Implausible? “Forward guidance puzzle”. Euler just too forward looking?

# Discounted Euler equation

- ❖ Suppose we introduce **discounting**  $\delta$  in Euler equation:  $c_t = \delta c_{t+1} - \frac{1}{\sigma} (i_t - \pi_{t+1})$
- ❖ Now impulse response to  $\epsilon_{20}$  shock is:



- ❖ Perhaps the borrowing constraints in HANK deliver something like this?

# Monetary policy in the canonical HANK model

# Review: canonical HANK model

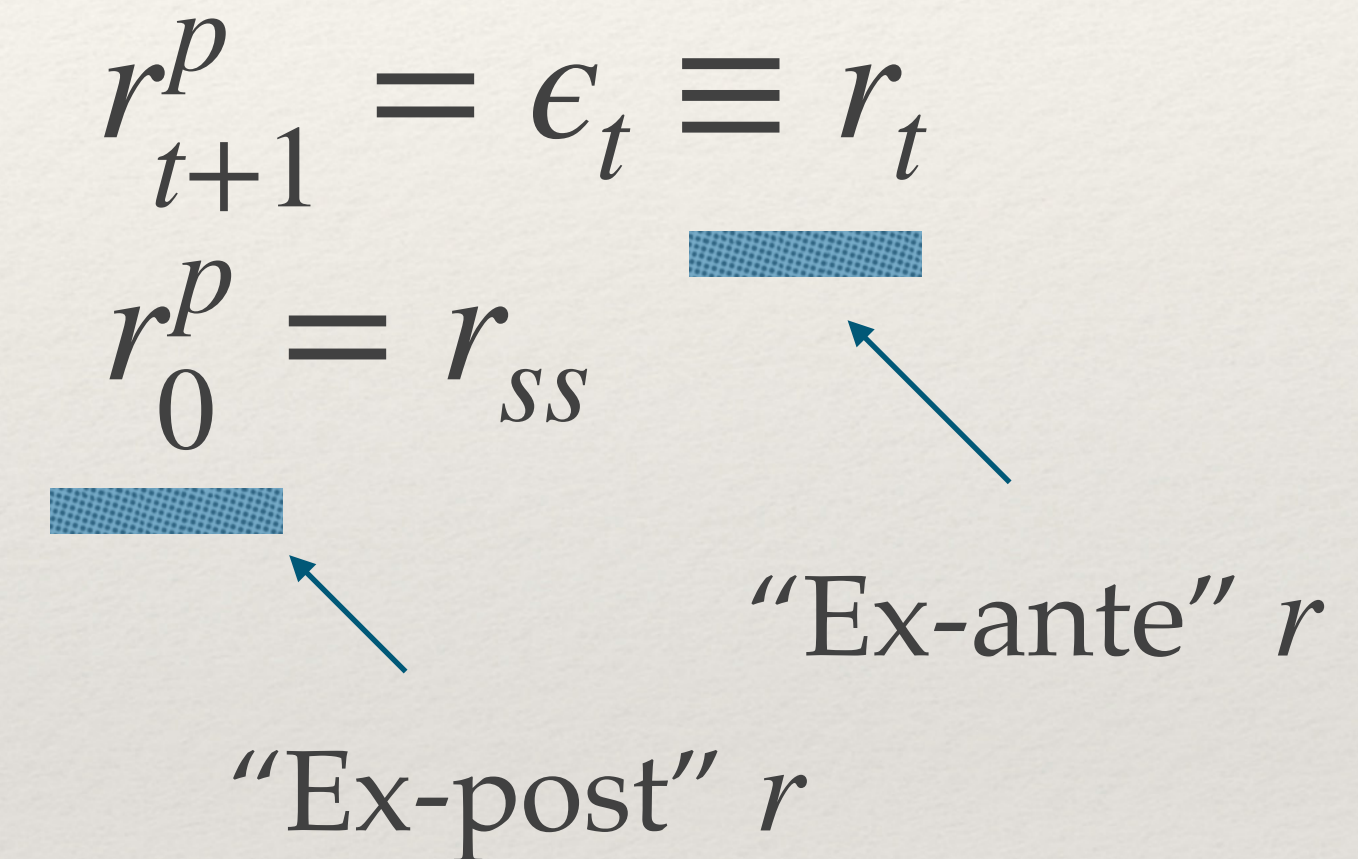
- ❖ Household  $i \in [0,1]$  solves:

$$\begin{aligned} \max_{c_{it}} \quad & \mathbb{E}_0 \sum_{t=0}^{\infty} \beta_{it} \left( u(c_{it}) - v(N_t) \right) \\ c_{it} + a_{it} & \leq (1 + r_t^p) a_{it-1} + Z_t e_{it} \\ a_{it} & \geq 0 \end{aligned}$$


- ❖ Given  $e_{it}$ ,  $r_{ss}$ ,  $Z_{ss}$ , we calibrated  $\beta_{it}$  to match aggregate  $A_{ss}$  and MPCs
  - ❖ Pick calibration with  $Z/Y = 0.7$  and  $B/Y = 1$  annually
- ❖ Assume no markups  $\mu = 1$ , so all assets are real government bonds,  $A_{ss} = B_{ss}$
- ❖ **Q:** What happens after a monetary policy shock?

# Interest rate changes: timing and fiscal consequences

- ❖ Monetary policy rule:  $i_t = \pi_{t+1} + \epsilon_t$
- ❖ Real interest rate between  $t$  and  $t + 1$  is  $\epsilon_t$ , for all  $t \geq 0$
- ❖ Real interest rate between  $t = -1$  and  $t = 0$  is  $r_{ss}$  !



- ❖ **Government budget constraint** with this notation:

$$B_t = (1 + r_{t-1}) B_{t-1} + G_t - T_t$$

- ❖ **Fiscal rule:** keep  $G_t = G_{ss}$ , adjust  $T_t$  to keep  $(1 + r_t) B_t = (1 + r_{ss}) B_{ss}$  constant

# IKC revisited: monetary policy

- ❖ Model in sequence space:

$$\mathbf{Y}_t = G_{ss} + \mathcal{C}_t \left( \{r_s, \mathbf{Y}_s - \mathbf{T}_s\} \right) \quad T_t = T_{ss} + \frac{r_t - r_{ss}}{1 + r_t} B_{ss}$$

- ❖ Linearize:

$$d\mathbf{Y} = \mathbf{M}^r d\mathbf{r} + \mathbf{M} d\mathbf{Y} - \mathbf{M} d\mathbf{T}$$

$$d\mathbf{T} = B_{ss} d\mathbf{r}$$

- ❖ New sequence space Jacobian:  $M_{t,s}^r \equiv \frac{\partial \mathcal{C}_t}{\partial \log(1 + r_s)}$ , write  $d\mathbf{r} \equiv \frac{1}{1 + r}(dr_0, dr_1, \dots)$

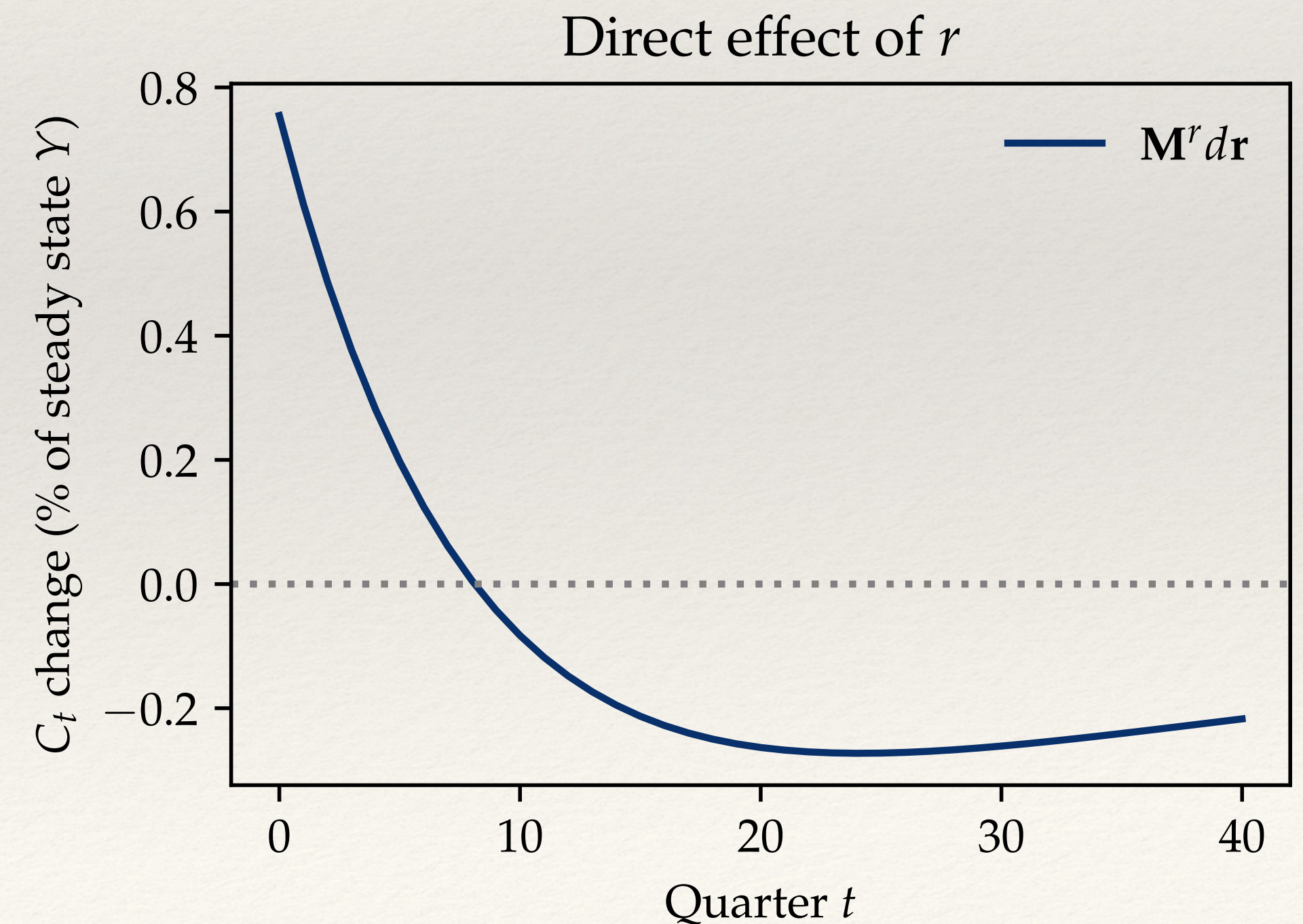
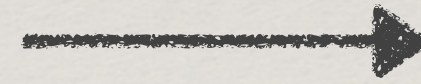
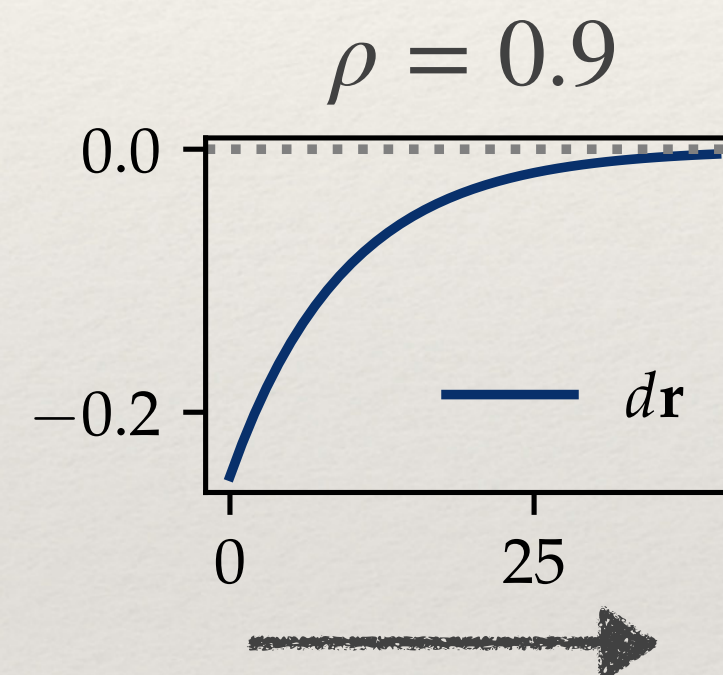
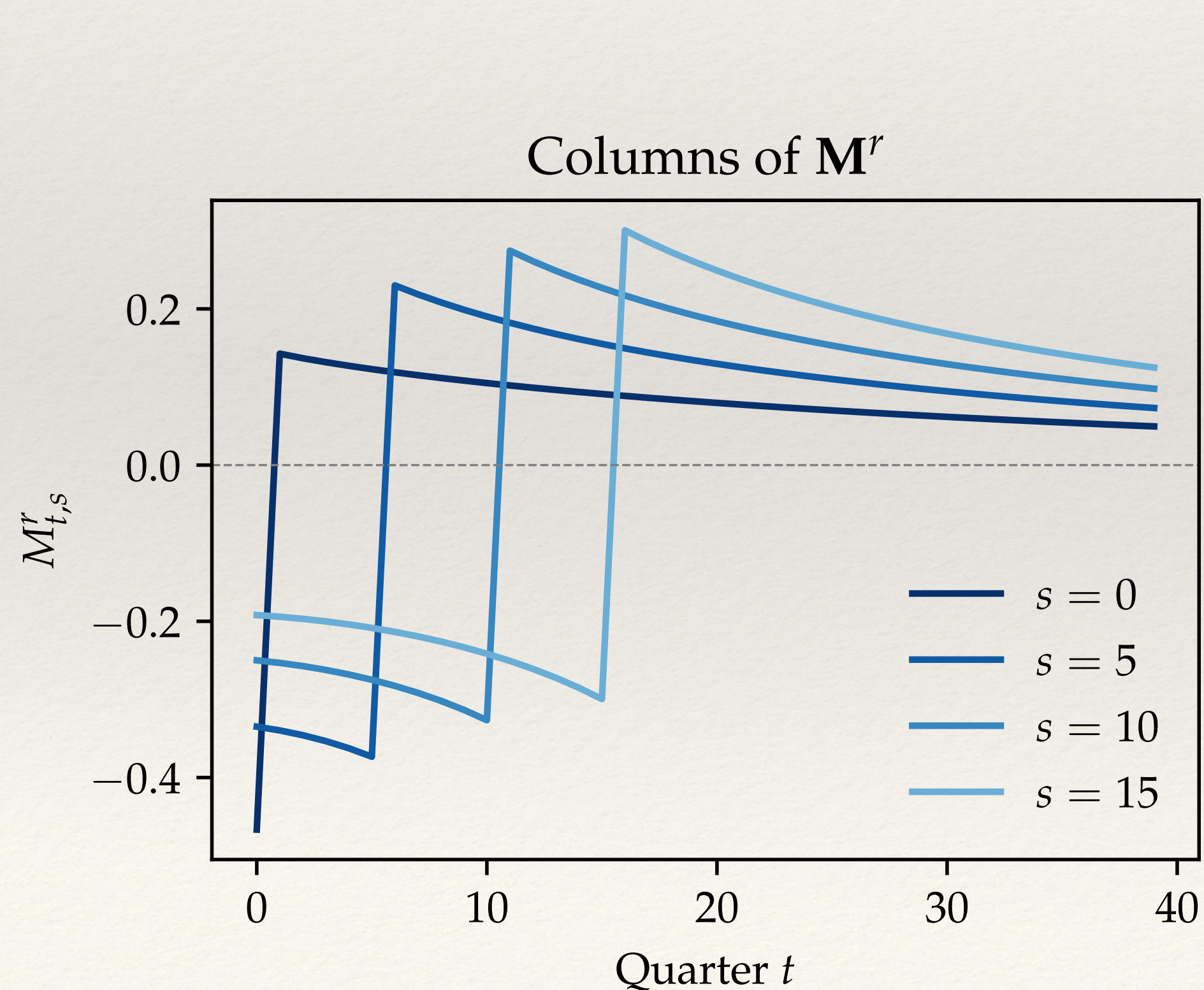
# Visualizing $\mathbf{M}^r$ and $\mathbf{M}^r d\mathbf{r}$

$$M_{t,s}^r \equiv \frac{\partial \mathcal{C}_t}{\partial \log(1 + r_s)}$$

$$d\mathbf{r} = -0.25/(1+r)(1, \rho, \rho^2, \dots)$$



$$(\mathbf{M}^r d\mathbf{r})_t = \sum_{s=0}^{\infty} \frac{\partial \mathcal{C}_t}{\partial \log(1 + r_s)} \frac{dr_s}{1 + r}$$



# Solving the IKC with monetary shocks

❖ Monetary policy shocks:

$$d\mathbf{Y} = (\mathbf{M}^r - \mathbf{M}B_{ss})d\mathbf{r} + \mathbf{M}d\mathbf{Y}$$

❖ Fiscal policy shocks:

$$d\mathbf{Y} = d\mathbf{G} - \mathbf{M}d\mathbf{T} + \mathbf{M}d\mathbf{Y}$$

❖ **Same logic:** zero NPV impulse (why?)

$$\mathbf{q}'(\mathbf{M}^r - \mathbf{M}B_{ss}) = 0$$

❖ Same approach to solving:

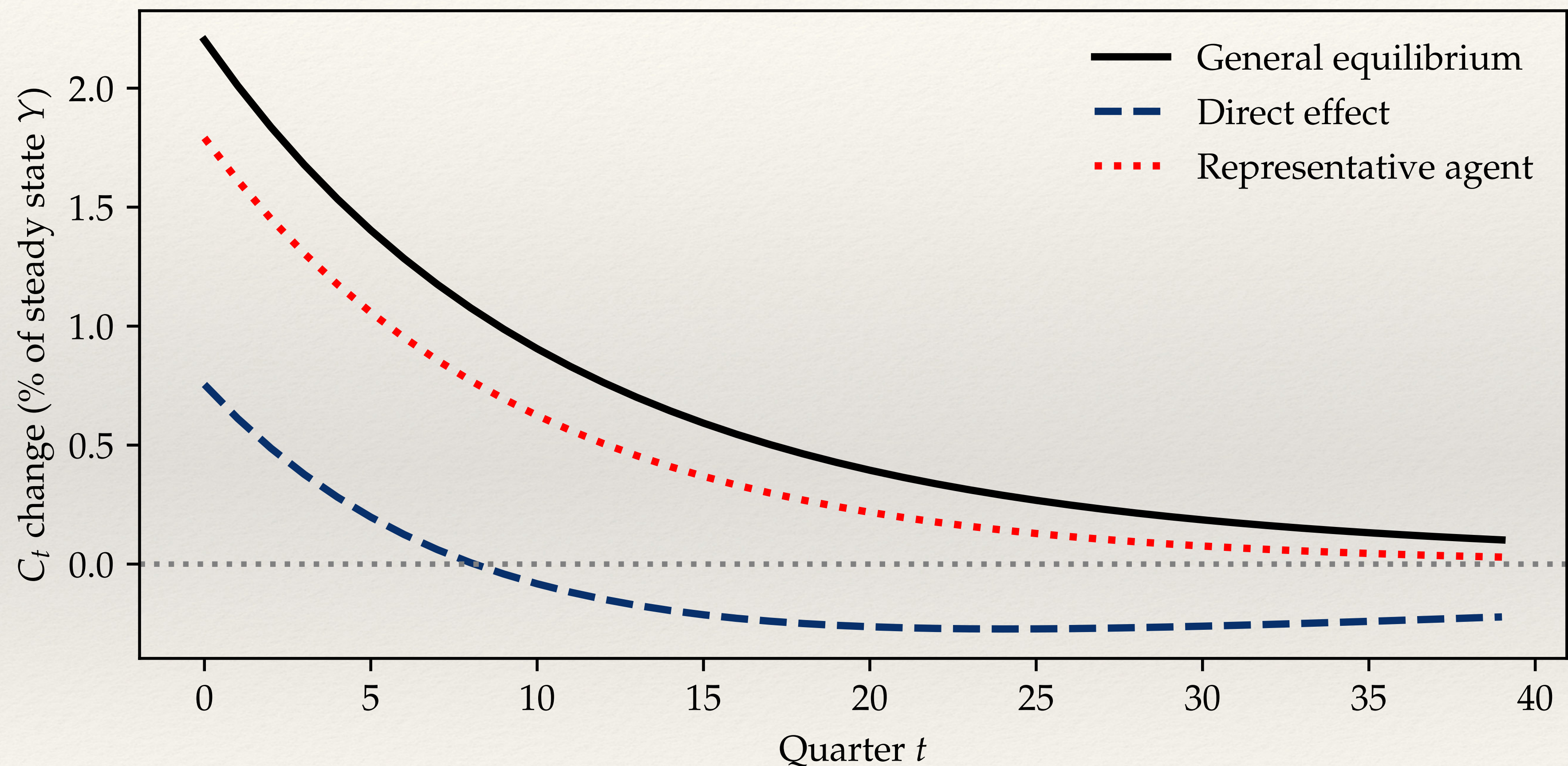
❖ in goods space, using  $\mathcal{M}$  from lec 2:

$$d\mathbf{Y} = \mathcal{M} (\mathbf{M}^r - \mathbf{M}B_{ss}) d\mathbf{r}$$

❖ in asset space, linearizing asset market clearing  $d\mathbf{Y} = -\mathbf{A}^{-1}\mathbf{A}_r d\mathbf{r} + (\mathbf{I} - \mathbf{A}^{-1})B_{ss}d\mathbf{r}$

$$\mathcal{A}_t \left( \{r_s, \mathbf{Y}_s - T_s\} \right) = B_s \quad T_t = T_{ss} + \frac{r_t - r_{ss}}{1 + r_t} B_{ss} \quad B_t = \frac{1 + r_{ss}}{1 + r_t} B_{ss}$$

# Impulse response to AR(1) monetary shock



❖ Equilibrium response ends up above rep agent! Why?

# Direct and indirect effects of monetary policy

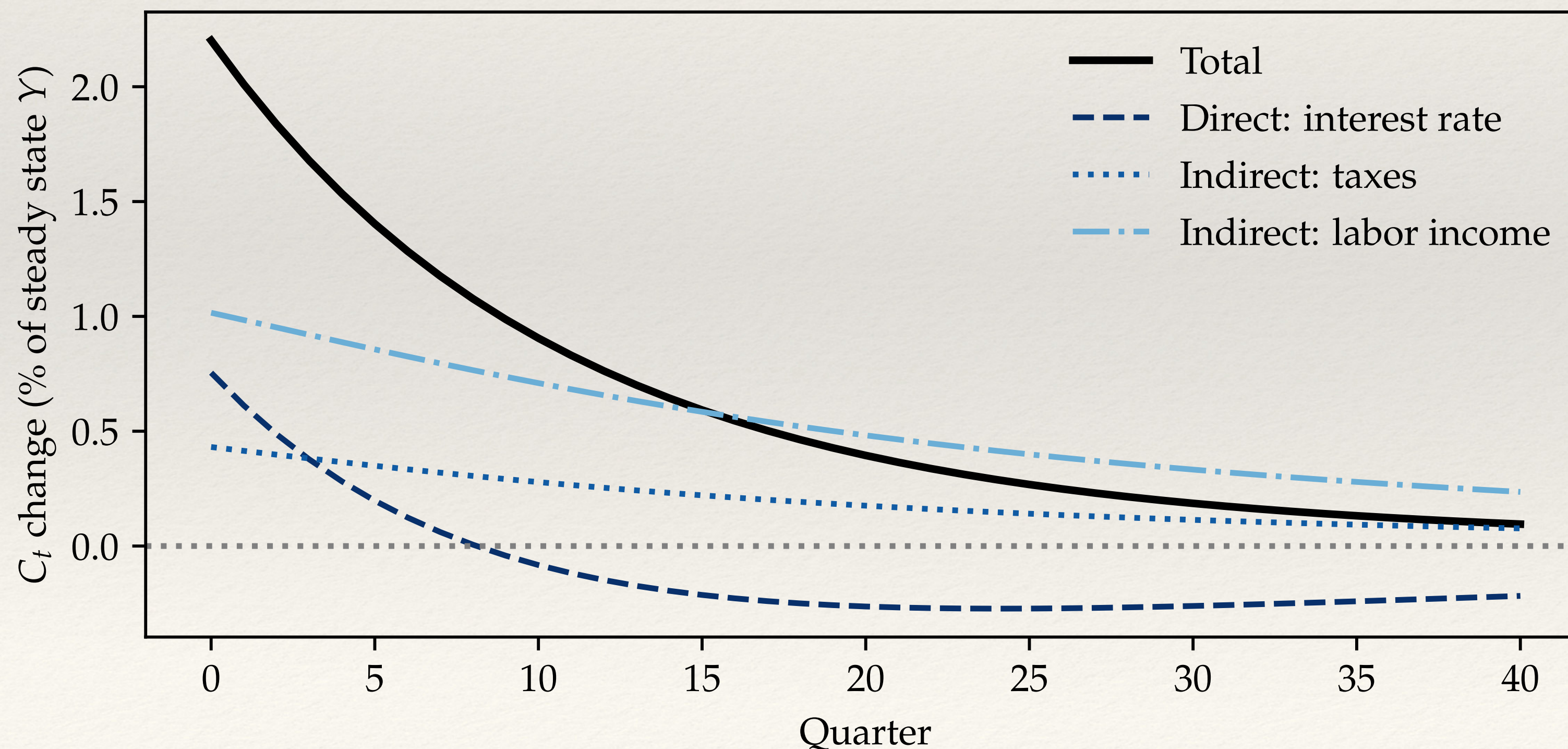
# Decomposition and interpretation

$$d\mathbf{Y} = \underbrace{\mathbf{M}^r d\mathbf{r}}_{\text{Direct interest rate effect}} - \underbrace{\mathbf{M}B_{ss} d\mathbf{r}}_{\text{Tax effect}} + \underbrace{\mathbf{M}d\mathbf{Y}}_{\text{Labor income effect}}$$

Direct interest rate effect

Tax effect

Labor income effect



- ❖ Monetary-fiscal interactions important!
- ❖ Indirect effect on labor income accounts for large part of the effect [Kaplan-Moll-Violante]
- ❖ Can we understand why?

# Summary: effects of market incompleteness

$$d\mathbf{Y} = \underbrace{\mathbf{M}^r d\mathbf{r}}_{\text{Direct effect}} + \underbrace{\mathbf{M} (d\mathbf{Y} - B_{ss} d\mathbf{r})}_{\text{Indirect effects}}$$

- ❖ What does market incompleteness do?
  - ❖ Raise MPCs:  $\mathbf{M} \uparrow$
  - ❖ Lower sensitivity to interest rates:  $\mathbf{M}^r \downarrow$
  - ❖ Unclear how this affects the overall sensitivity of  $d\mathbf{Y}$  to  $d\mathbf{r}$
- ❖ **Next:** make progress by taking a limit where  $\mathbf{M}$  is “large”

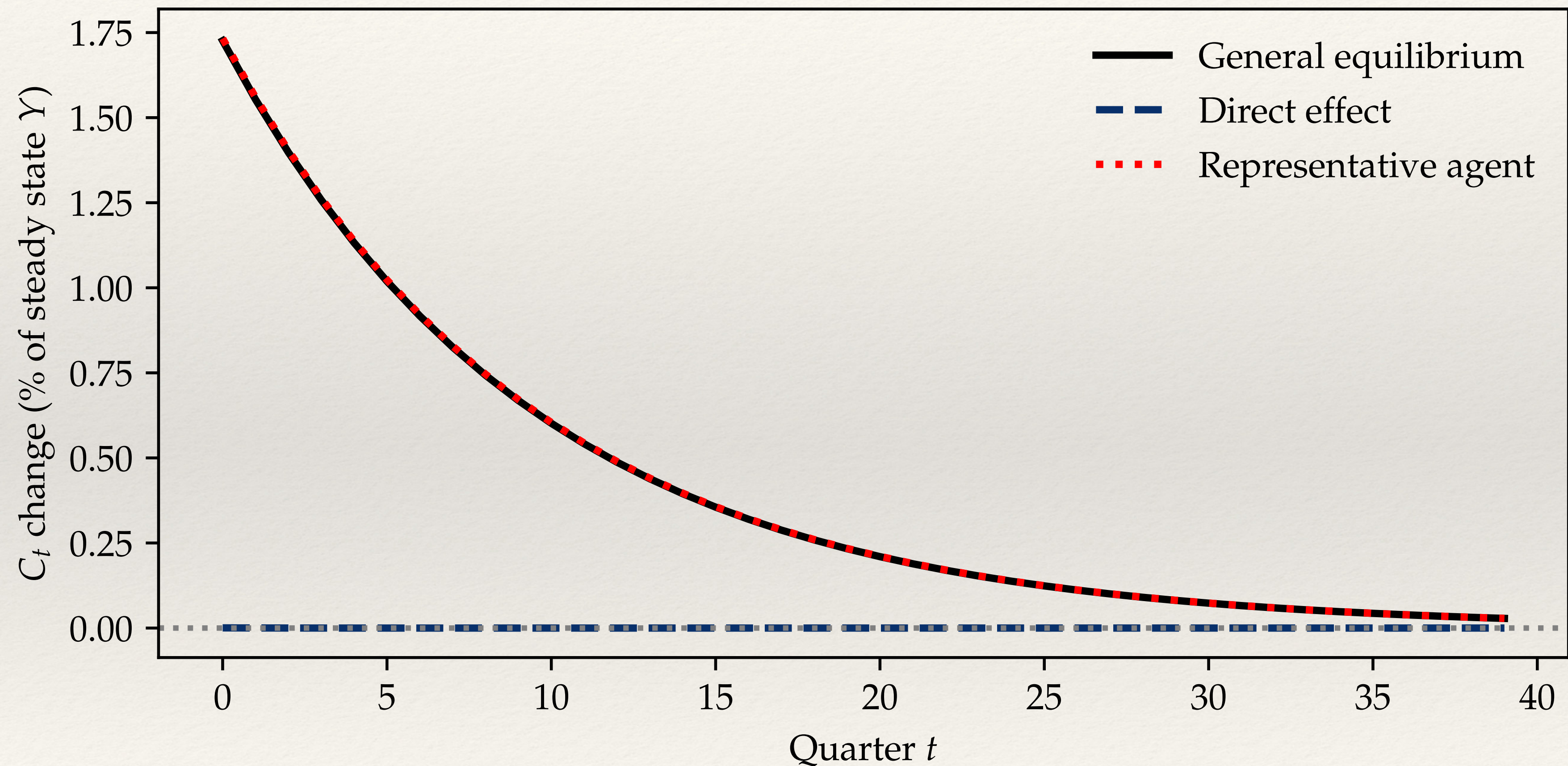
---

# Zero liquidity limit

---

- ❖ One way to get analytical traction: take  $B_{ss} \rightarrow 0$
- ❖ Since hh. borrowing limit is zero, this leads us to the “zero liquidity limit”:
  - ❖ Since no one borrows, in equilibrium also no one lends
  - ❖ So, in equilibrium, everyone has  $c_{it} = z_{it}$
  - ❖ How do we get there? keep  $r$  constant but recalibrate  $\beta$  until we hit  $B_{ss} \simeq 0$
  - ❖ What happens?

# Impulse response to AR(1) monetary shock



❖ Now we get **exactly** the representative agent solution... with  $\sim 0$  direct effect!

# Interpretation and importance of GE

- ❖ Agent with highest motive to save is on their Euler equation:

$$c_{it}^{-1/\sigma} = \beta_{it}(1 + r_t)\mathbb{E} [c_{it+1}^{-1/\sigma}]$$

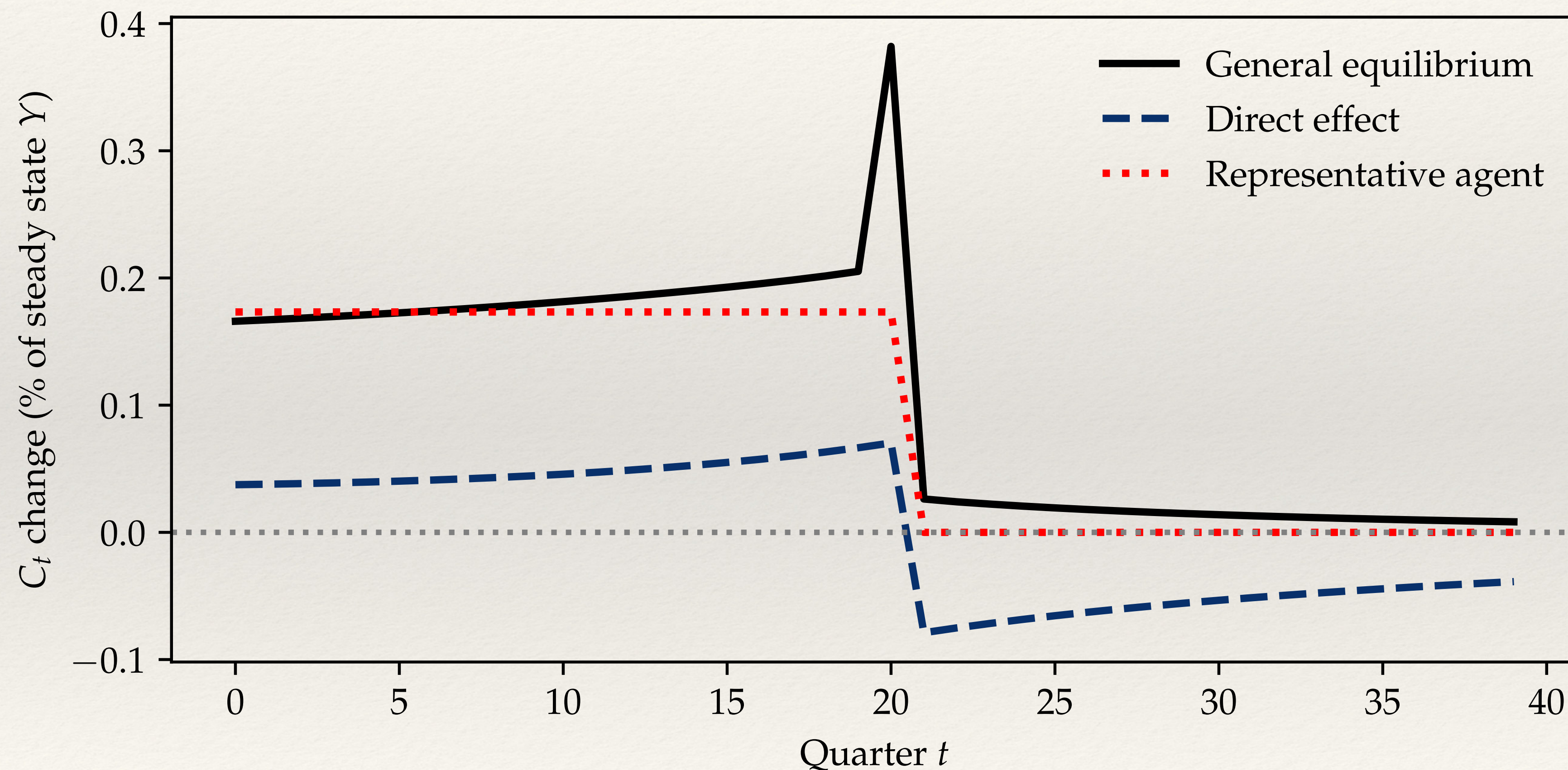
- ❖ In eqbm  $c_{it} = z_{it}$  in all states, but also  $z_{it} = e_{it}Z_t$  and  $Z_t = Y_t - T_t = C_t$ . So:

$$C_t^{-1/\sigma} = (1 + r_t)\beta_{it}\frac{\mathbb{E} [e_{it+1}^{-1/\sigma}]}{e_{it}^{-1/\sigma}}C_{t+1}^{-1/\sigma} = \tilde{\beta}(1 + r_t)C_{t+1}^{-1/\sigma} \quad \tilde{\beta} \equiv \max_i \beta_{it}\frac{\mathbb{E} [e_{it+1}^{-1/\sigma}]}{e_{it}^{-1/\sigma}}$$

- ❖ Equilibrium  $C$  follows Euler equation too, despite EE failing for most agents!
- ❖ Idea: unc'd agents respond to  $r$ , other agents respond to  $Y \rightarrow$  amplification!
- ❖ **Werning (2015) equivalence result, version 1** (zero liquidity, any  $\sigma$ )

# HANK doesn't solve the forward guidance puzzle!

- ❖ Back to our calibration with  $B/Y = 1$ , consider forward guidance shock:



- ❖ The direct effect of  $dr$  is lower on impact... but not the GE response to  $dr$  !

---

# Summary: monetary policy in HANK

---

- ❖ Does HANK change the aggregate effect of monetary policy?
  - ❖ Not necessarily: Werning neutrality benchmark (version 1: zero liquidity)
  - ❖ Effects could go either way from this benchmark, see tomorrow
- ❖ Does HANK change the transmission of monetary policy?
  - ❖ Yes: indirect effects much more important than in RANK!

---

# Next: additional topics

---

- ❖ Now that we've covered the basics, let's turn to some more advanced topics:
  1. Cyclical income risk
  2. Maturity structure
  3. Nominal assets
  4. The stock market

Cyclical income risk

---

# Cyclical income risk

---

- ❖ Recall canonical model: household takes  $n_{it} = N_t$  as given and solves

$$\max_{c_{it}} \mathbb{E}_0 \sum_{t=0}^{\infty} \beta_{it} \left( u(c_{it}) - v(n_{it}) \right)$$

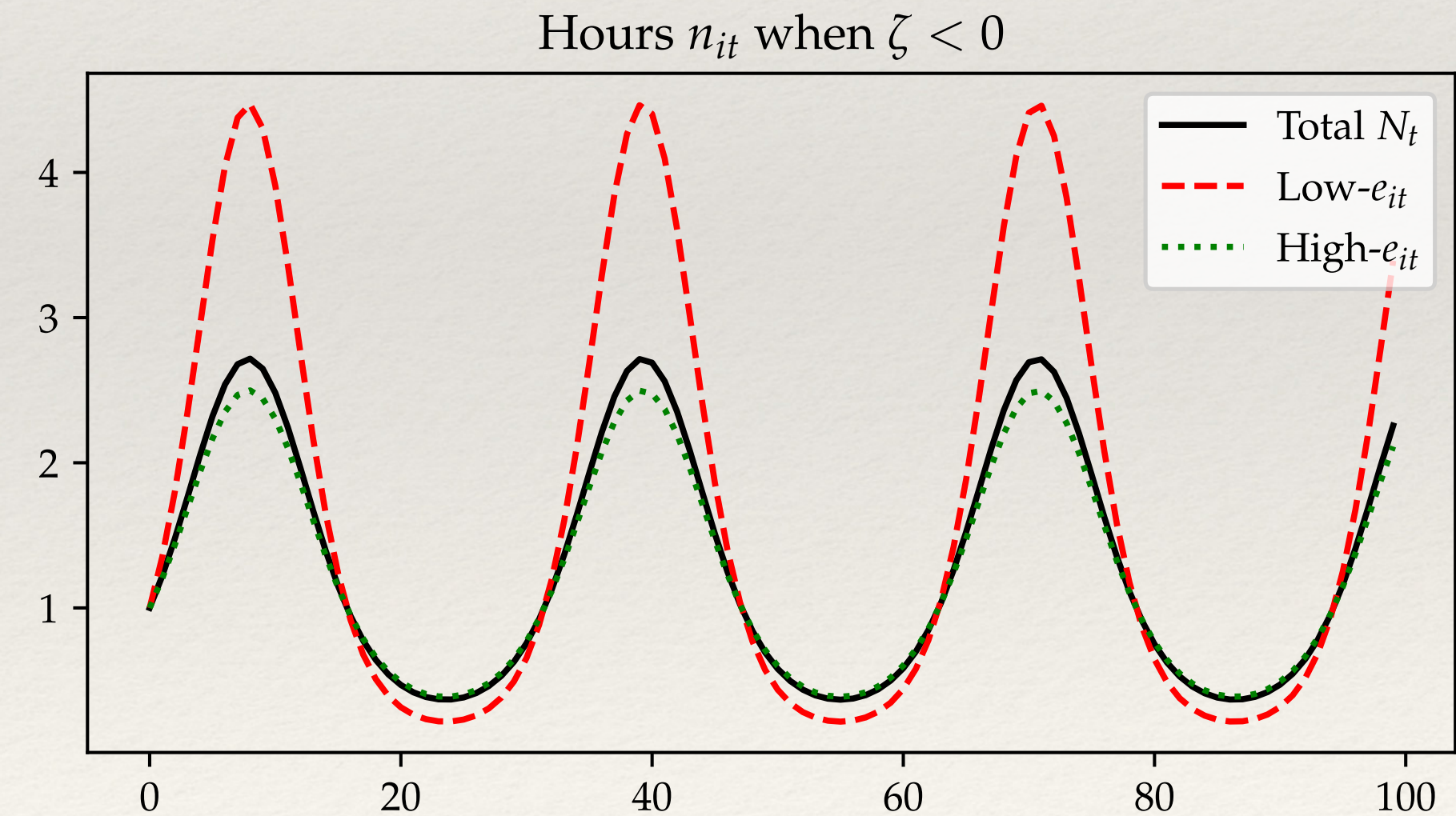
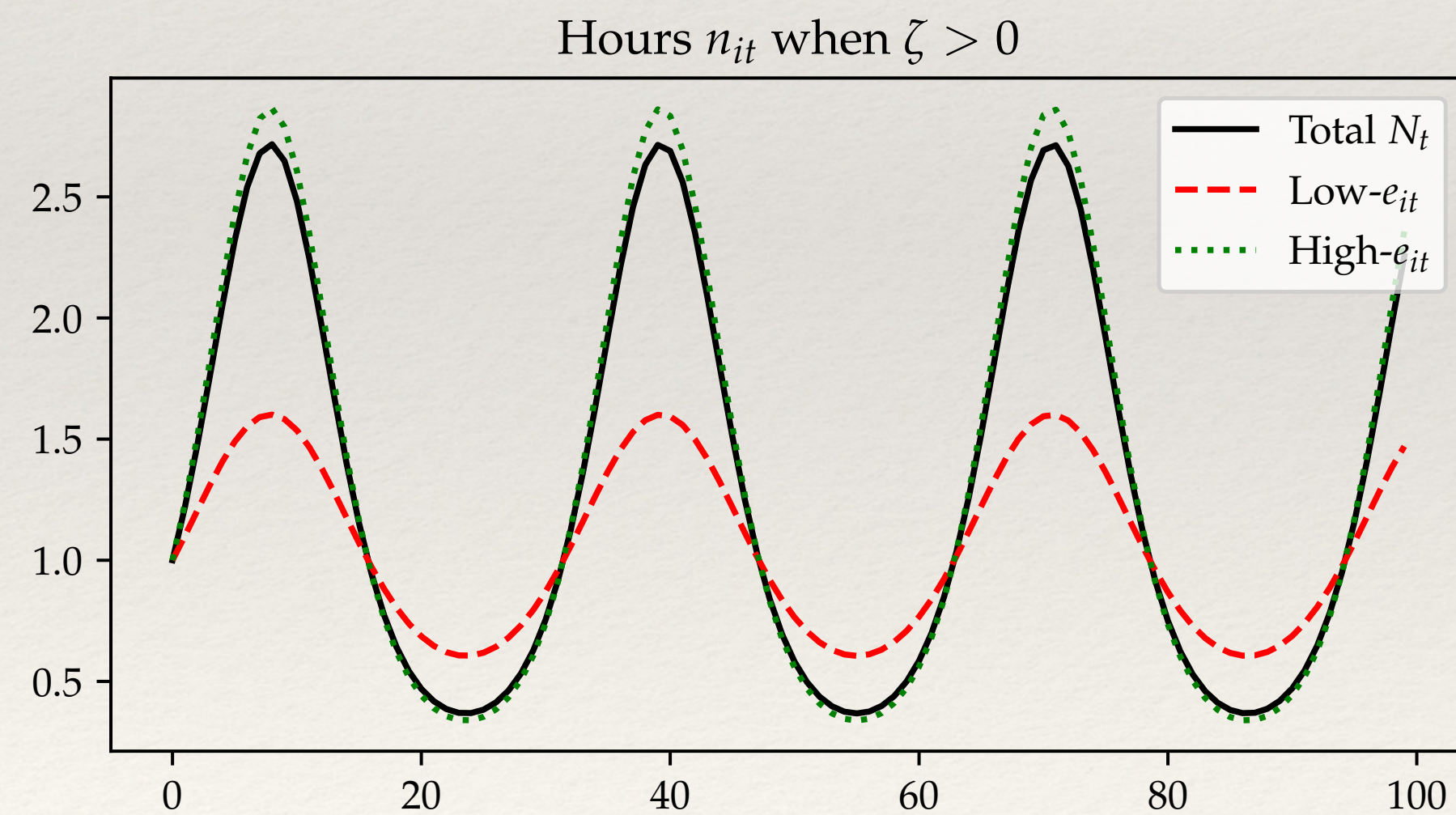
$$c_{it} + a_{it} \leq (1 + r_t^p) a_{it-1} + (1 - \tau_t) \frac{W_t}{P_t} n_{it} e_{it}$$
$$a_{it} \geq 0$$

- ❖ This is restrictive: hours  $n_{it}$  don't move uniformly across people over the cycle!
- ❖ Relaxing this assumption will make a difference, but also uncover a big “puzzle”

# Introducing unequal rationing

- ❖ Simple way to relax is to assume that labor is rationed as a function of  $e_{it}$ , per  
(assuming normalization  $N_{ss} = 1$ )

$$n_{it} = N_t \frac{(e_{it})^{\zeta \log N_t}}{\mathbb{E} \left[ e_i^{1+\zeta \log N_t} \right]} \equiv N_t \Gamma(e_{it}, N_t)$$



- ❖  $\zeta > 0$ : procyclical inequality+income risk,  $\zeta < 0$  countercyclical,  $\zeta = 0$  acyclical

# Introducing unequal rationing

- ❖ Simple way to relax is to assume that labor is rationed as a function of  $e_{it}$ , per  
(assuming normalization  $N_{ss} = 1$ )

$$n_{it} = N_t \frac{(e_{it})^{\zeta \log N_t}}{\mathbb{E} \left[ e_i^{1+\zeta \log N_t} \right]} \equiv N_t \Gamma(e_{it}, N_t)$$

- ❖  $\zeta > 0$ : procyclical inequality+income risk,  $\zeta < 0$  countercyclical,  $\zeta = 0$  acyclical

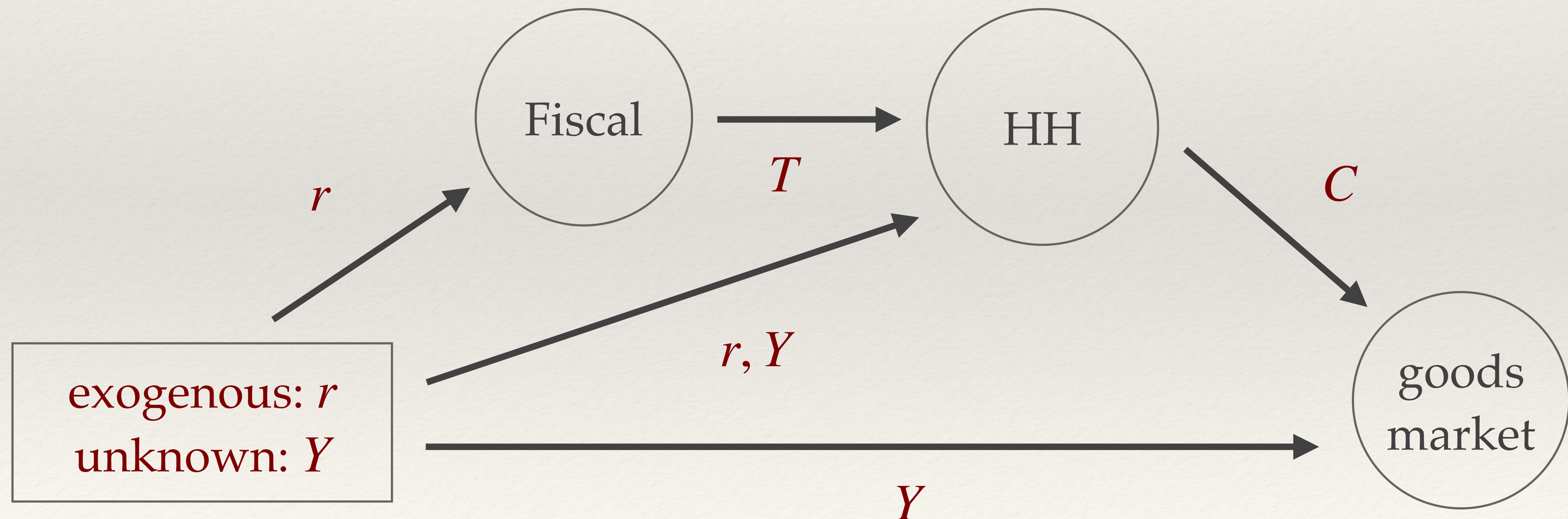
- ❖ In particular the distribution of pretax income  $y_{it} = \frac{W_t}{P_t} n_{it} e_{it}$  moves with the cycle

$$\text{sd}(\log y_{it}) = (1 + \zeta \log N_t) \text{sd}(\log e_i)$$

- ❖ Matters because: 1) current shocks redistribute between different MPCs, and  
2) future shocks change perceived income risk

# How does this change the model?

- ❖ Now post-tax income  $z_{it}$  for individual  $i$  is  $z_{it} = (Y_t - T_t)\Gamma(e_{it}, Y_t)$
- ❖ This results in a consumption function  $\mathcal{C}_t\left(\{r_s, Y_s, T_s\}\right)$ . DAG:



# Practical implementation with hetinput:

- ❖ Simple modification of the “hetinput” to the household block:

```
def income_cyclical(Y,T, e_grid, e_pdf, zeta):
    y = (Y-T) * e_grid ** (1 + zeta * np.log(Y)) / np.vdot(e_grid ** (1 + zeta * np.log(Y)), e_pdf)
    return y
```

```
household_cyc = hh.add_hetinputs([income_cyclical])
```

```
print('Household block inputs:' , household_cyc.inputs)
print('Household block outputs:' , household_cyc.outputs)
```

✓ 0.0s

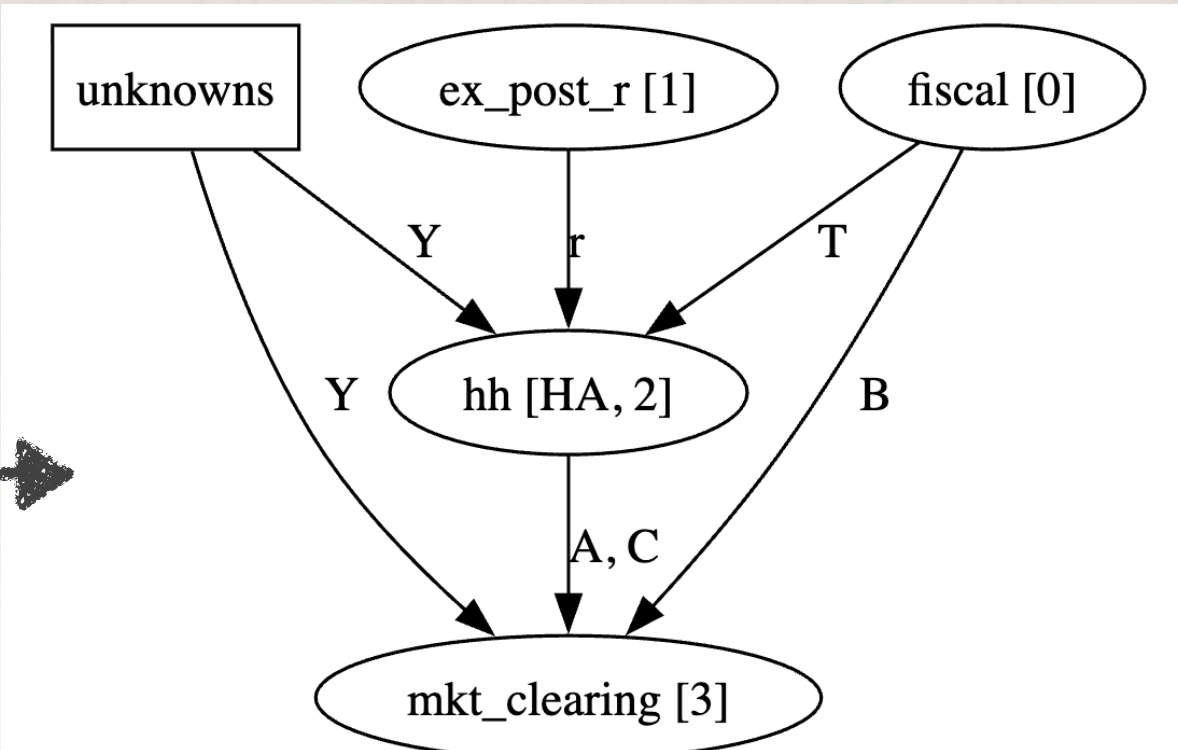
# Python

```
Household block inputs: ['a_grid', 'r', 'beta', 'eis', 'Pi', 'Y', 'T', 'e_grid', 'e_pdf', 'zeta']
Household block outputs: ['A', 'C']
```

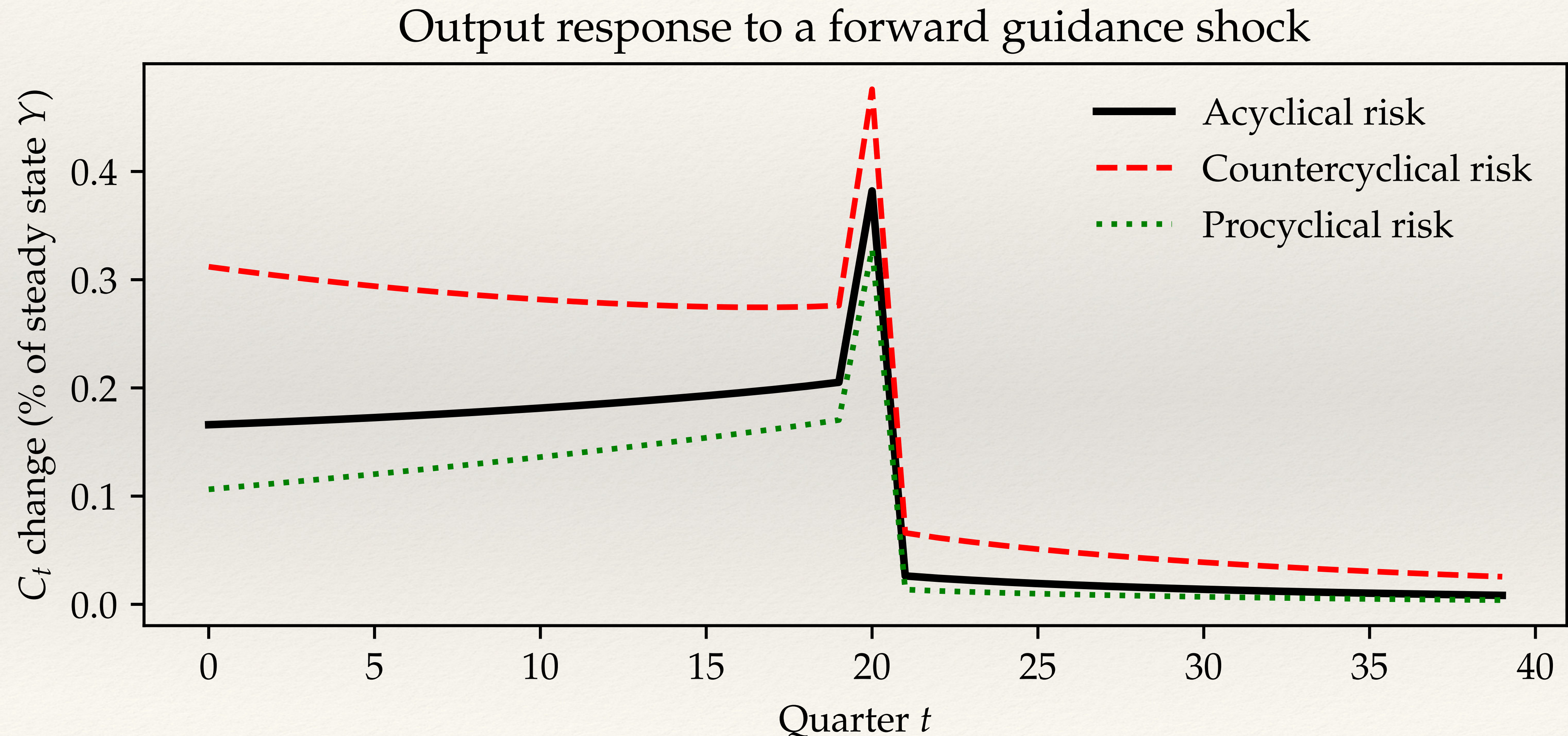
- ❖ Can then combine this and other blocks into model:

```
model_cyc = sj.create_model([household_cyc, ex_post_r, fiscal, mkt_clearing], \
                             name="HA Model with cyclical income risk")
```

```
sj.drawdag(model_cyc, unknowns=['Y'])
```



# Result: countercyclical risk amplifies FG puzzle!



---

# What is happening?

---

- ❖ Go back to zero liquidity limit  $B_{ss} \rightarrow 0$ . Now, can show:

$$C_t = \delta \cdot C_{t+1} - \frac{1}{\sigma} \cdot \text{const} \cdot (r_t - \bar{r})$$

- ❖ There is dynamic discounting  $\delta < 1$  iff procyclical income risk  $\zeta > 0$
- ❖ Dynamic amplification  $\delta > 1$  iff countercyclical income risk  $\zeta < 0$
- ❖ Countercyclical income risk usually thought to be more plausible:
  - ❖ Theoretically: eg, from unemployment risk (Ravn-Sterk, Challe, Kekre...)
  - ❖ Empirically: eg, work by Guvenen&co and Storesletten&co
- ❖ Bilbiie's "catch-22": countercyclical risk plausible at micro level, not macro!

# Indirect ways to make income risk cyclical

- ❖ In richer models, income of agents typically involves multiple components,

$$y_{it} = \frac{W_t}{P_t} n_{it} e_{it} - \underbrace{T_{it}}_{\text{Taxes}} + \underbrace{Tr_{it}}_{\text{Transfers}}$$

- ❖ These also matter for cyclicity of income risk
- ❖ For example, suppose we set taxes to keep  $(1 + r_t)B_t$  constant as in our baseline, but that transfers are (nontraded) dividends from firms with sticky prices
  - ❖ Both  $T_{it}$  and  $Tr_{it}$  fall when  $r_t \downarrow$  (why?)
- ❖ Suppose that  $T_{it}$  are paid by the high  $e_{it}$ , but everyone owns equal share of firms
- ❖ Then income risk is procyclical! This is McKay, Nakamura, Steinsson

# Maturity structure

# Maturity structure

- ❖ So far: agents trade short term assets. What if longer maturities / duration?
- ❖ For tractability, assume “Calvo bonds”
  - ❖ buy one bond today for  $q_t$ , coupon payments  $1, \delta, \delta^2, \dots$

- ❖ New household problem:
$$\max_{c_{it}} \mathbb{E}_0 \sum_{t=0}^{\infty} \beta_{it} \left( u(c_{it}) - v(N_t) \right)$$
$$c_{it} + q_t \lambda_{it} \leq (1 + \delta q_t) \lambda_{it-1} + Z_t e_{it}$$
$$\lambda_{it} \geq 0$$

↖ Total number of coupons owned coming into  $t$

- ❖ Asset pricing condition:
$$1 + r_t = \frac{1 + \delta q_{t+1}}{q_t}$$

---

# Rewriting the problem

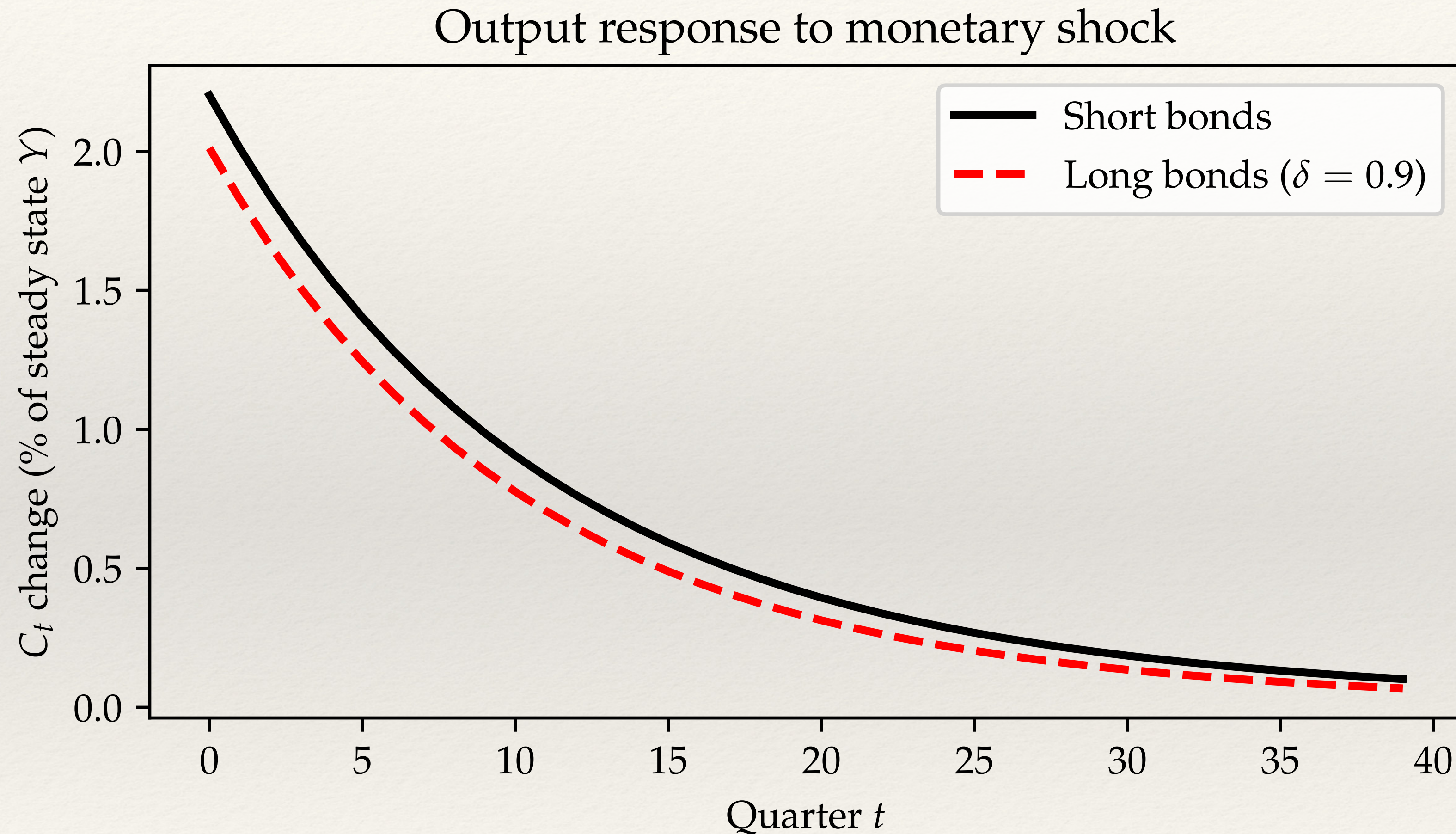
---

- ❖ Redefine  $a_{it} = q_t \lambda_{it}$ . Using asset pricing condition, we have

$$\begin{aligned} \max_{c_{it}} \quad & \mathbb{E}_0 \sum_{t=0}^{\infty} \beta_{it} \left( u(c_{it}) - v(N_t) \right) & r_{t+1}^p &= r_t, t \geq 0 \\ c_{it} + a_{it} & \leq (1 + r_t^p) a_{it-1} + Z_t e_{it} & 1 + r_0^p &= \frac{1 + \delta q_0}{q_{ss}} \\ a_{it} & \geq 0 \end{aligned}$$

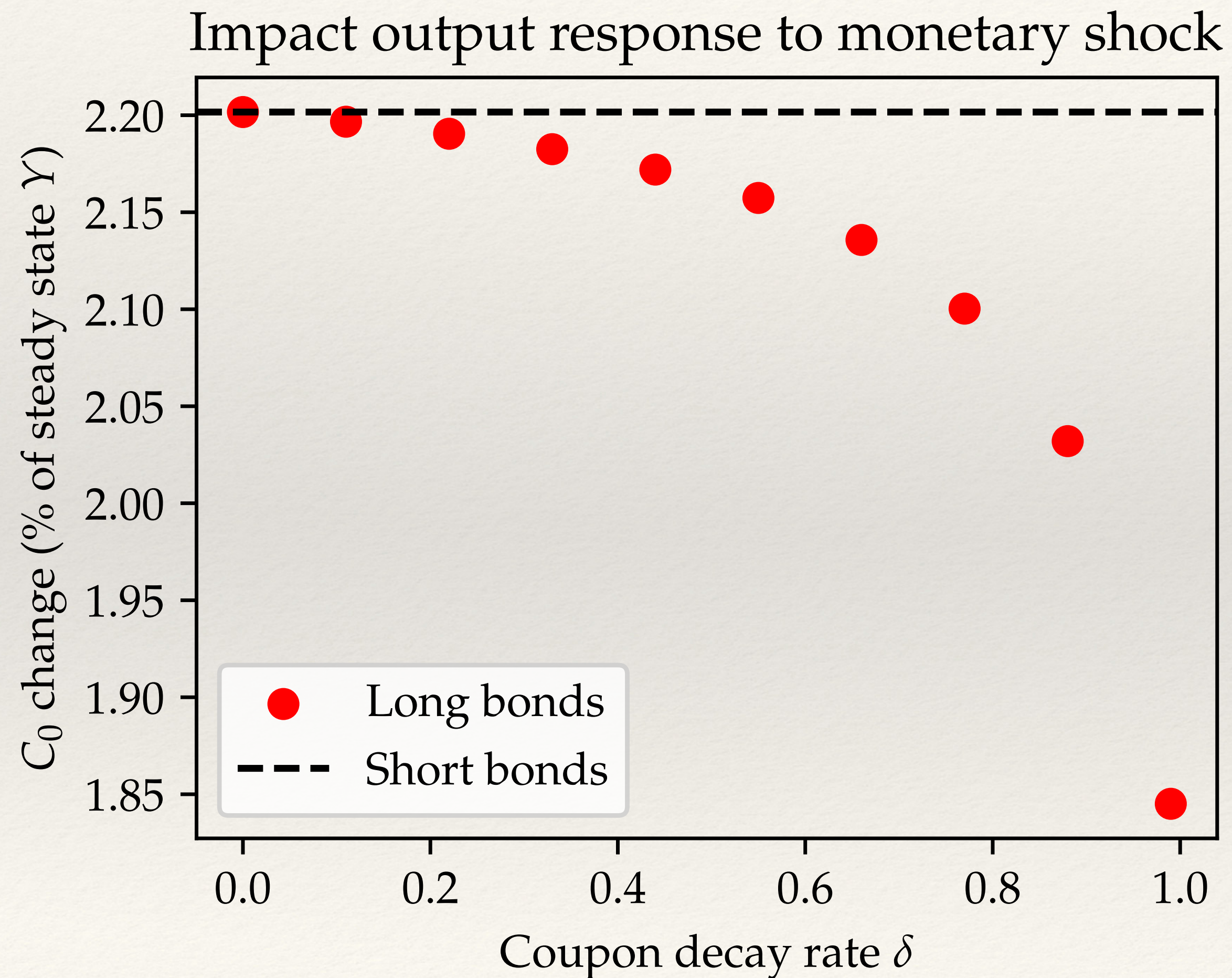
- ❖ Lower ex-ante  $r_t \rightarrow$  higher bond price  $q_0 \rightarrow$  higher  $r_0^p$  (capital gain)
- ❖ Same for government budget constraint:  $B_t = (1 + r_t^p) B_{t-1} + G_t - T_t$ 
  - ❖ here  $B_t \equiv q_t \lambda_t$  is market value of gov debt. Assume **fiscal rule**  $\lambda_t = \lambda_{ss}$ ,  $G_t = G_{ss}$

# Effect of long maturities on monetary impulse



❖ Longer maturities reduce the output effect of a monetary shock ! Why?

# Effect of maturity structure explained



- ❖  $\delta \uparrow$  : households make cap. gains from monetary expansion, gov makes loss
- ❖ Redistribution from taxpayers to bond holders. Latter have lower MPCs, so aggregate effect on spending falls!
- ❖ Expect monetary policy to be more powerful in countries with short durations (eg ARMAs)
- ❖ Actually true in data! (Calza et al)

# Nominal assets

# Nominal assets

- ❖ So far, all assets are real. But in practice, many assets are nominal
  - ❖ Mortgages, bonds, etc
  - ❖ Creates very large exposures to inflation risk via nominal positions (see e.g. Doepke and Schneider)

- ❖ Consider 1-period bonds:
$$\max_{c_{it}} \mathbb{E}_0 \sum_{t=0}^{\infty} \beta_{it} \left( u(c_{it}) - v(N_t) \right)$$
$$P_t c_{it} + A_{it} \leq (1 + i_t) A_{it-1} + P_t Z_t e_{it}$$

$$A_{it} \geq 0$$

Can relax to have  $P_t \underline{a}$

- ❖ Fisher equation:

$$1 + r_t = \frac{(1 + i_t) P_t}{P_{t+1}}$$

In practice, borrowing constraints interact with inflation in complex ways! (“Tilt effect”)

---

# Rewriting the problem

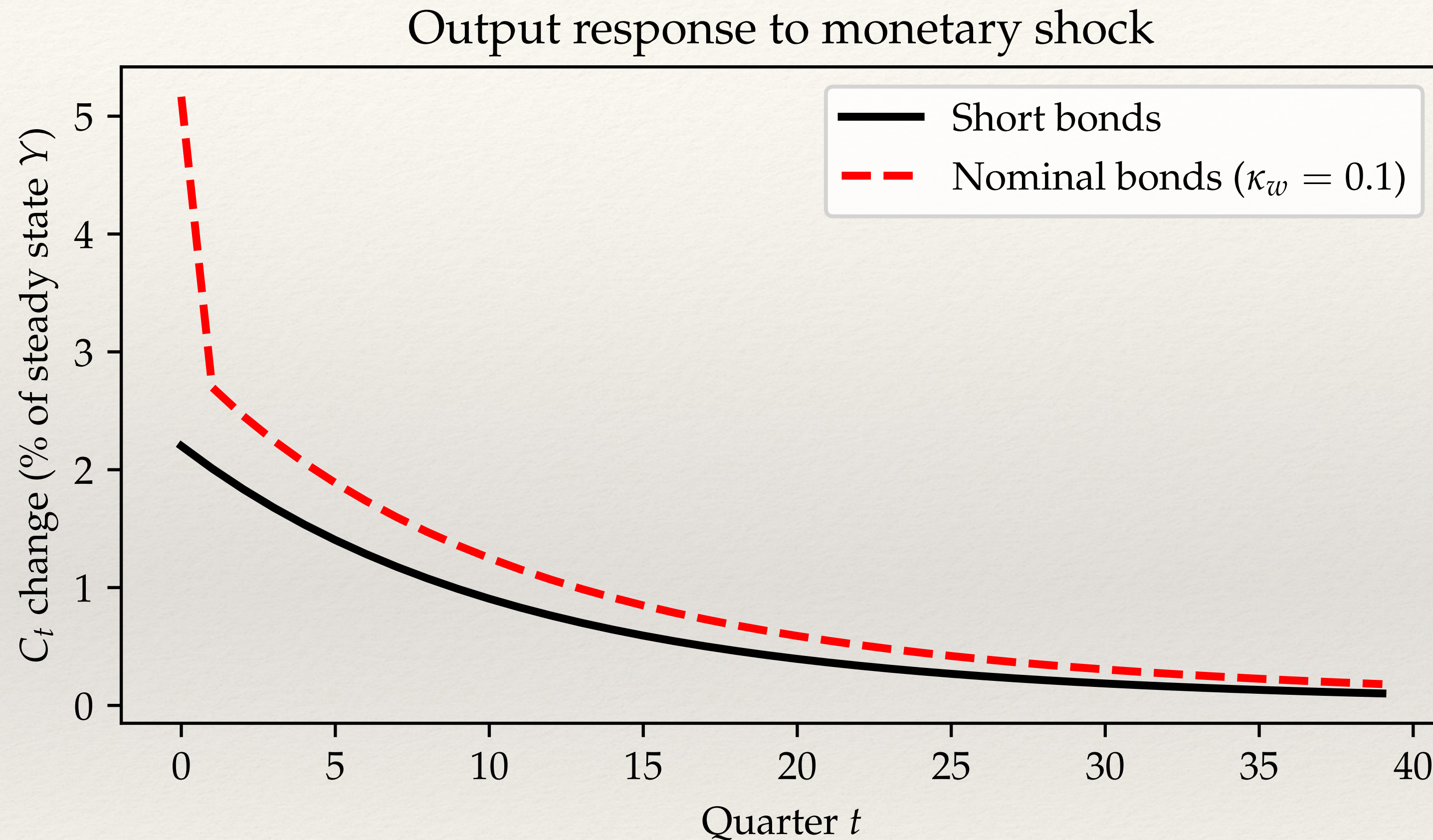
---

- ❖ Now redefine  $a_{it} \equiv A_{it}/P_t$ . Using Fisher equation, we have

$$\begin{aligned} \max_{c_{it}} \quad & \mathbb{E}_0 \sum_{t=0}^{\infty} \beta_{it} \left( u(c_{it}) - v(N_t) \right) & r_{t+1}^p &= r_t, t \geq 0 \\ c_{it} + a_{it} & \leq (1 + r_t^p) a_{it-1} + Z_t e_{it} & 1 + r_0^p &= (1 + r_{ss}) \frac{P_{ss}}{P_0} = (1 + r_{ss}) \frac{1 + \pi_{ss}}{1 + \pi_0} \\ a_{it} & \geq 0 \end{aligned}$$

- ❖ Same for gov budget constraint, fiscal rule continues to keep  $(1 + r_t)B_t$  constant
- ❖ Even with  $r_t$  rule, inflation now matters for aggregate demand due to nominal revaluation! Use Phillips curve:  $\pi_t = \kappa_w(Y_t - 1) + \beta\pi_{t+1}$

# Output effect of a monetary policy shock



- ❖ **Fisher effect:** inflation redistributes from bondholders to taxpayers
- ❖ Those agents have higher MPCs, this boosts demand (effect bigger with steeper P.C.)

# The stock market

---

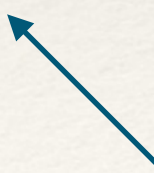
# Introducing a stock market

---

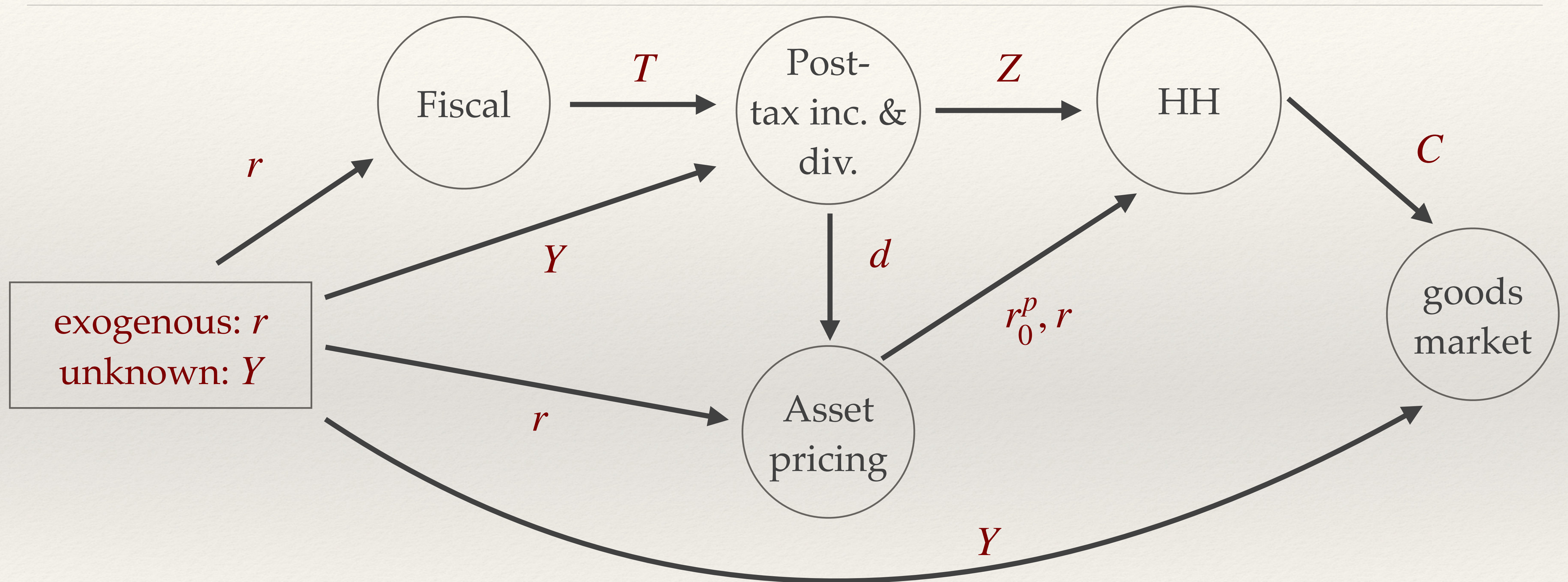
- ❖ Calibration with  $A_{ss} = B_{ss} = Y_{ss}$  not realistic
  - ❖ Households hold a lot more wealth than this,  $\sim 5$  GDP in the U.S.
  - ❖ Invested (at least) in stocks **in addition** to bonds
- ❖ To incorporate this, change calibration to have markups  $\mu > 1$ ,  $A_{ss}/Y_{ss} = 5$
- ❖ Firm problem now implies  $\frac{W_t}{P_t} = \frac{1}{\mu}$  and dividends  $d_t = (1 - \tau_t) \left(1 - \frac{1}{\mu}\right) Y_t$
- ❖ Stocks are claim to dividends with price  $p_t$
- ❖ A mutual fund owns bonds and stocks, sells shares to hh's with return  $r_t^p$

[Households owning stocks and bonds directly similar, see portfolio lecture]

# Asset pricing conditions

- ❖ No arbitrage condition for the mutual fund:  $1 + r_t = \frac{p_{t+1} + d_{t+1}}{p_t}$ , for  $t \geq 0$
- ❖ Ex-post return to mutual fund holders between  $t$  and  $t + 1$ :  $r_{t+1}^p = r_t$
- ❖ What is the ex-post return between  $t = -1$  and  $t = 0$ ?
- ❖ Stock market price at date 0 is  $p_0 = \sum_{s=1}^{\infty} \left( \prod_{u=0}^{s-1} \frac{1}{1 + r_u} \right) d_s$   in ss, just  $p_{ss} = \frac{d_{ss}}{r}$
- ❖ Total ex-post return is  $1 + r_0^p = (1 + r_{ss})\omega + \frac{p_0 + d_0}{p_{ss}}(1 - \omega)$   s.s. share of bonds in mutual funds portfolio  $B_{ss}/A_{ss}$

# DAG of model with traded markups

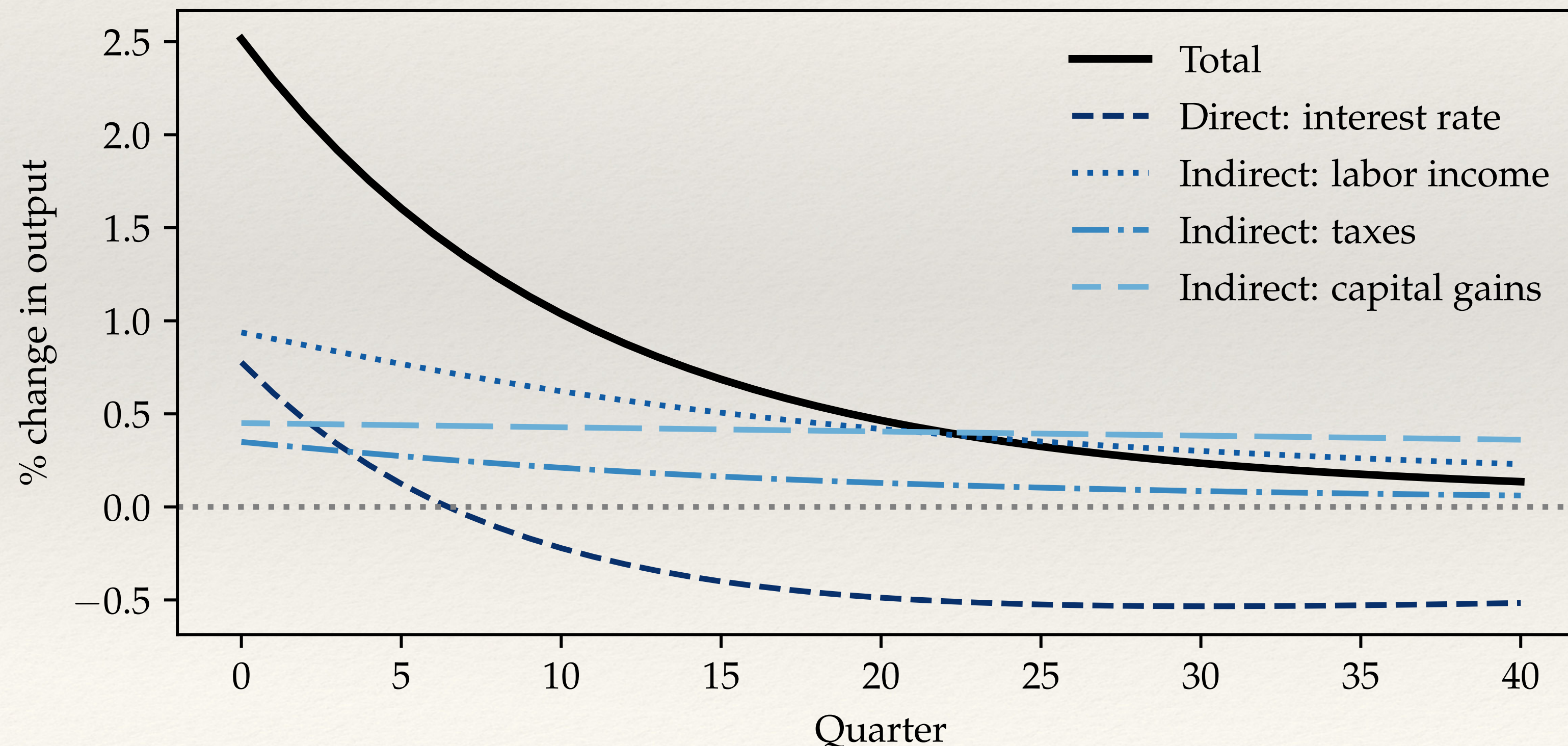


- ❖ Goods market clearing:  $Y_t = \mathcal{C}_t \left( r_0^p, \{r_s\}, \{ (Y_s - T_s) / \mu \} \right) + G_{ss}$

# Impulse response to AR(1) monetary shock

❖ Calibration:  $B_{ss}/Y_{ss} = 1$

$$d\mathbf{Y} = \underbrace{\mathbf{M}^r dr}_{\text{Direct interest rate effect}} - \underbrace{\mathbf{M}/\mu B_{ss} dr}_{\text{Tax effect}} + \underbrace{\mathbf{M}/\mu d\mathbf{Y}}_{\text{Labor income effect}} + \underbrace{\mathbf{m} A_{ss} dr_0^p}_{\text{Cap. gain effect}}$$



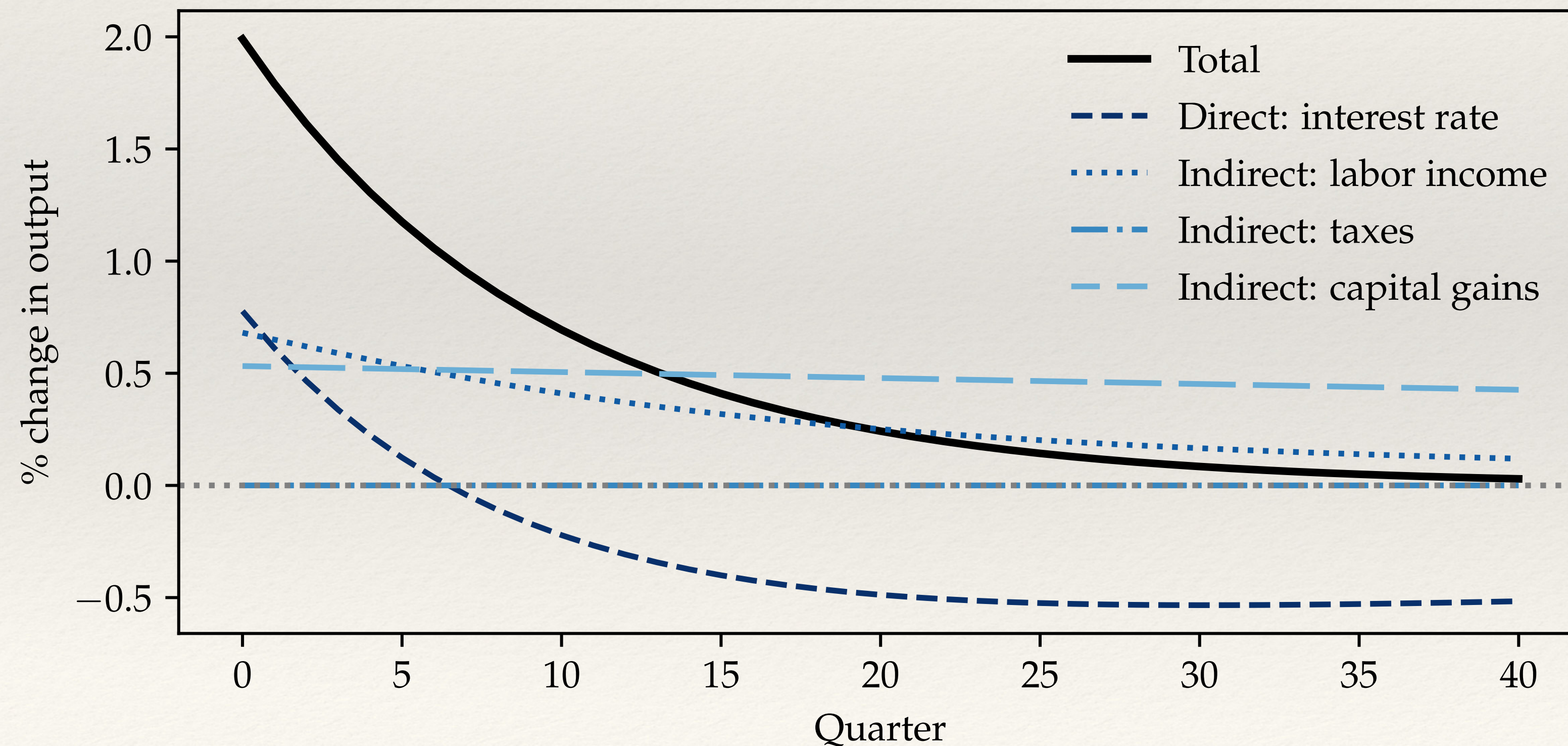
New capital gain effect!

Magnitude governed by  $\mathbf{m}$ ,  
the MPC out of capital gains  
(low in data & model, here  
about 1 cent on the dollar  
per quarter)

# Impulse response in model without bonds

❖ Calibration:  $B_{ss}/Y_{ss} = 0$

$$d\mathbf{Y} = \underbrace{\mathbf{M}^r dr}_{\text{Direct interest rate effect}} + \underbrace{\mathbf{M}/\mu d\mathbf{Y}}_{\text{Labor income effect}} + \underbrace{\mathbf{m}A_{ss} dr_0^p}_{\text{Cap. gain effect}}$$



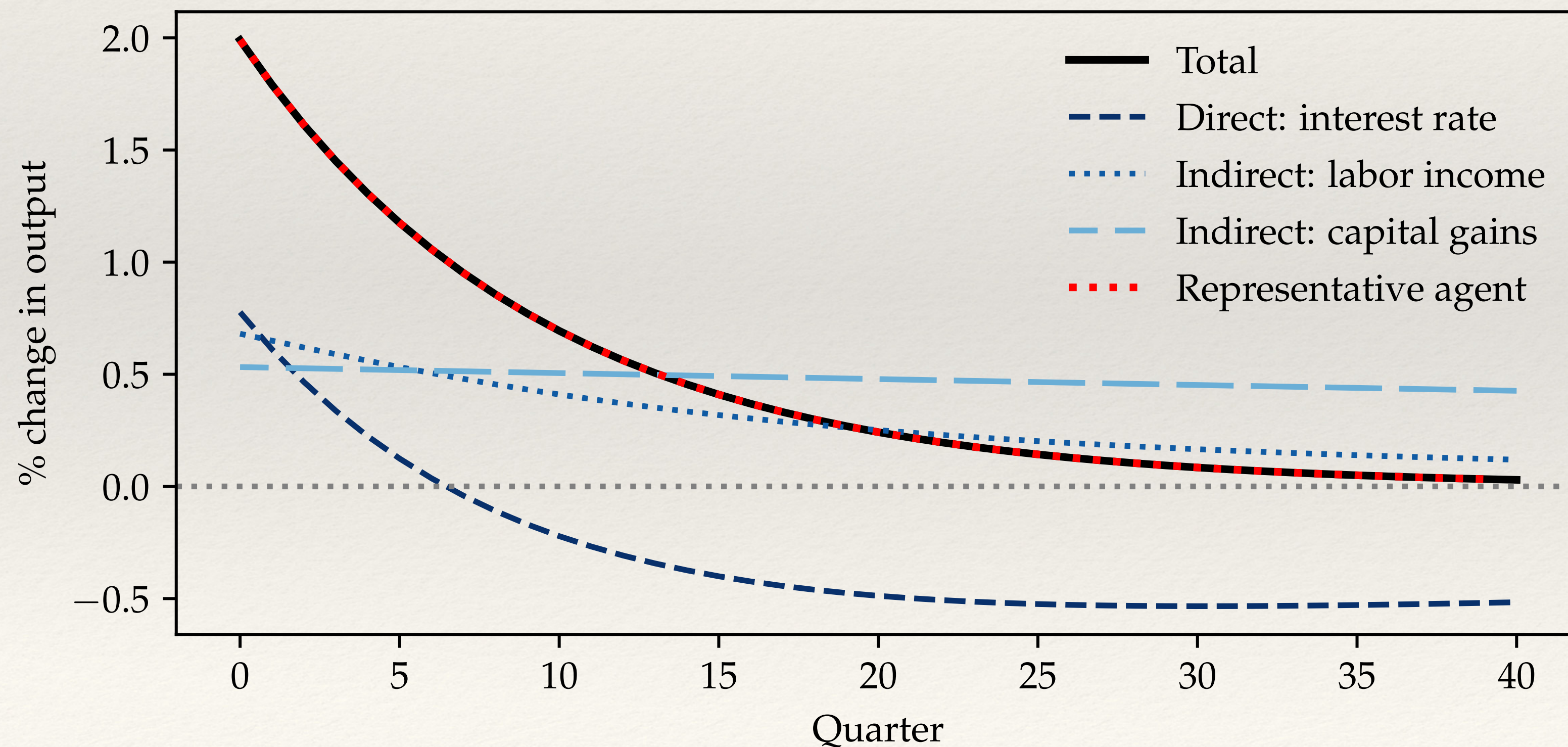
Tax effect is now zero...

# Impulse response in model without bonds

❖ Calibration:  $B_{ss}/Y_{ss} = 0$

$$d\mathbf{Y} = \underbrace{\mathbf{M}^r dr}_{\text{Direct interest rate effect}} + \underbrace{\mathbf{M}/\mu d\mathbf{Y}}_{\text{Labor income effect}} + \underbrace{\mathbf{m}A_{ss}dr_0^p}_{\text{Cap. gain effect}}$$

Direct interest rate effect   Labor income effect   Cap. gain effect



Total effect is exactly the same as in RANK!

$$dC_t = 0.25 \cdot C \cdot \frac{\rho^t}{1 - \rho}$$

Coincidence?

---

# Neutrality result

---

- ❖ No! For the calibration with  $B_{ss} = 0$  and  $u(c) = \log c$ , we prove (see ARE):

$$d\mathbf{Y} = -C\mathbf{U}d\mathbf{r} \qquad \mathbf{U} \equiv \begin{pmatrix} 1 & 1 & 1 & 1 & \dots \\ 0 & 1 & 1 & 1 & \dots \\ 0 & 0 & 1 & 1 & \dots \\ 0 & 0 & 0 & 1 & \dots \\ \vdots & \vdots & \vdots & \vdots & \ddots \end{pmatrix}$$

- ❖ Monetary policy effects in HANK and RANK are the same for **any**  $d\mathbf{r}$  !
- ❖ **Werning (2015) result version 2** (log utility + “acyclical liquidity”)

---

# Summary

---

- ❖ HANK substantially enriches the analysis of monetary policy
- ❖ Key points:
  - ❖ Countercyclical income risk has large amplification effects
  - ❖ Maturity structure important due to capital gains-induced redistribution
  - ❖ Nominal positions relevant due to inflation-induced redistribution
  - ❖ With traded stocks, can get other instance of equivalence to rep agent
- ❖ See ARE paper for more on monetary-fiscal interactions, fiscal theory of the price level, investment and Taylor rules