

Lecture 5

Monetary policy topics

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We just started scratching the surface of monetary policy in HANK

Now: We go a little deeper by exploring a few key topics in the literature

- 1 Maturity structure
- 2 Nominal assets
- 3 Fiscal policy
- 4 Investment
- 5 Taylor rules
- 6 Takeaway

Maturity structure

Longer maturities

So far: agents trade short term assets. What if longer maturities / duration?

For tractability, assume “Calvo bonds”:

- buy one bond today for q_t , get stream of real payments $1, \delta, \delta^2, \dots$

New household problem:

$$V_t(\lambda_-, e) = \max u(c) + \beta \mathbb{E} [V_{t+1}(\lambda, e') | e]$$

$$c + q_t \lambda = (1 + \delta q_t) \lambda_- + e Y_t$$

$$q_t \lambda \geq \underline{a}$$

where λ = total number of bonds (total current coupon). No arbitrage:

$$q_t = \frac{1 + \delta q_{t+1}}{1 + r_t^{ante}}$$

Steady state and dynamics

In steady state, we can rewrite constraints as

$$c + q\lambda = (1 + r)q\lambda + eY$$

$$q\lambda \geq \underline{a}$$

Redefining $a \equiv q\lambda$ means steady state is identical given \underline{a}, r, β .

Same argument applies during transitions too, for $t \geq 1$: constraints are independent of maturity!

What about date $t = 0$? **Revaluation effect !**

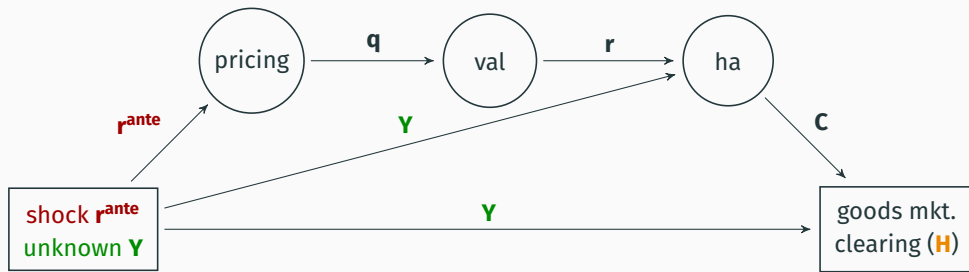
$$1 + r_0 = (1 + r_{ss}) \frac{1 + \delta q_0}{1 + \delta q_{ss}} = \frac{1 + \delta q_0}{q_{ss}} \neq 1 + r_0^{ante} \quad (1)$$

Handle this using the hh block in its ex-post formulation, plus (1) and

$$r_t = r_{t-1}^{ante} \quad t \geq 1$$

DAG for the long-bonds model

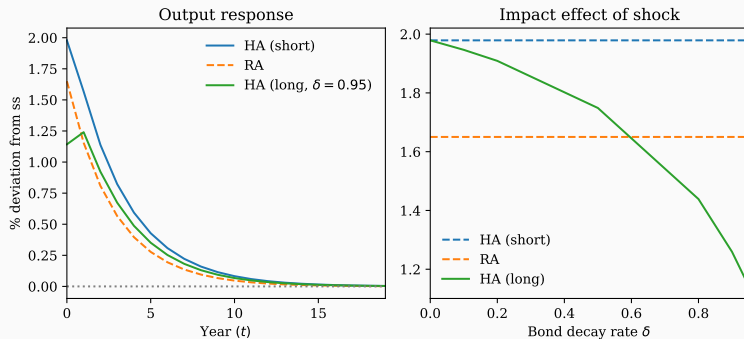
Our new DAG is:



Two new blocks:

- pricing: $q_t = \frac{1+\delta q_{t+1}}{1+r_t^{ante}} \rightarrow$ can use a SolvedBlock here
- valuation: $r_t = \frac{1+\delta q_t}{q_{t-1}} - 1$

Impulse responses with longer maturities



- $\delta \uparrow \Rightarrow$ low MPC rich benefit from capital gains, while poor make losses [see also Auclert 2019]
- This reduces demand! $HA < RA$

Nominal assets

Nominal assets

- So far, assets were all real. But many assets are nominal.
 - Again, think mortgage debt, nominal bonds, etc.
 - Creates very large exposures to inflation risk via nominal positions
 - See estimates in [Doepke and Schneider \(2006\)](#)
- Here: analyze consequence of one-period nominal assets.
- Assume that now:

$$P_t c_{it} + A_{it} = (1 + i_t) A_{it-1} + e_{it} W_t N_t$$

$$A_{it} \geq P_t \underline{a}$$

Note: nominal borrowing constraint relaxes with inflation.

In practice it's probably not so simple (eg “tilt effect” in mortgages)

Incorporating unexpected revaluation

- Define real asset position $a_{it} = A_{it}/P_t$. Household problem now

$$V_t(a_-, e) = \max u(c) + \beta \mathbb{E} [V_{t+1}(a, e') | e]$$

$$c + a = (1 + r_t) a_- + e Y_t$$

$$a \geq \underline{a}$$

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

- Perfect foresight Fisher equation gives again:

$$r_t = r_{t-1}^{ante} \quad t \geq 1$$

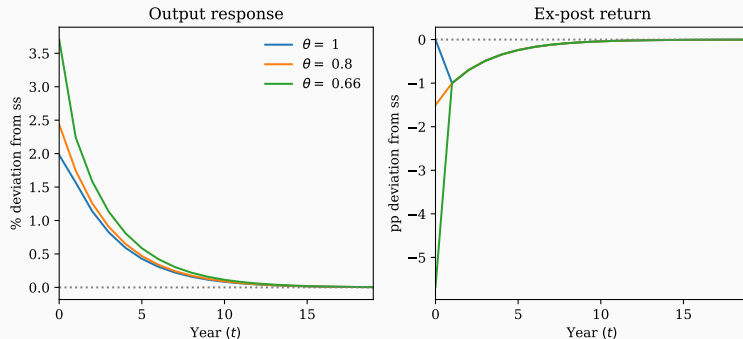
but also “Fisher effect” (capital gain/loss) from date-0 revaluation

$$1 + r_0 = (1 + i_0) \frac{P_{-1}}{P_0} = (1 + r_{ss}) \frac{1 + \pi_{ss}}{1 + \pi_0}$$

- Even with r^{ante} rule, inflation now directly matters for demand via ex-post r_0

Aggregate implication of Fisher channel: AR(1) shock to r

- Again simple to simulate with SSJ (what is your DAG?)



- **Fisher effect:** inflation redistributes towards agents with lower nominal positions, who have high MPCs. Bigger with steeper Phillips curve (lower θ_w)
- Would be even more pronounced with long maturities

Fiscal policy

So far, no fiscal side. But monetary-fiscal interactions potentially important!

→ changes in r directly affect government budget!

Here: analyze consequences of fiscal response to monetary policy

For this, return to canonical model **with government bonds + linear taxation:**

$$\begin{aligned}V_t(a_-, e) &= \max u(c) + \beta \mathbb{E} [V_{t+1}(a, e') | e] \\c + a &= (1 + r_{t-1}^{ante}) a_- + (Y_t - T_t) e \\a &\geq \underline{a}\end{aligned}$$

Setting up a fiscal rule

Calibration as in fiscal policy lecture. Government budget constraint:

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

Consider following fiscal *rules*

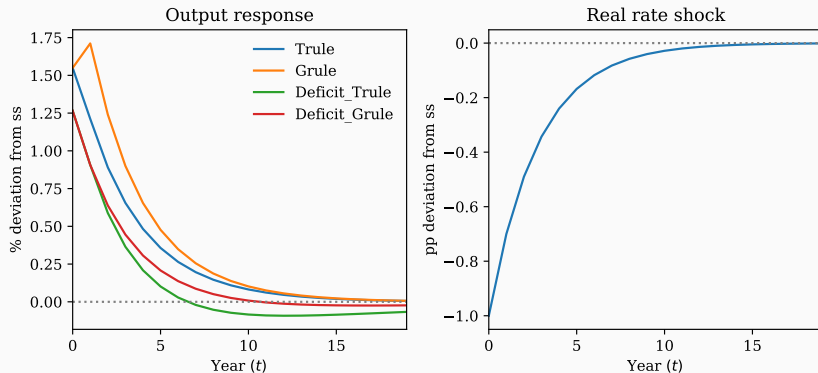
1. Constant B , all regular taxes: $T_t = G + r_{t-1}B$
2. Constant B , all spending: $G_t = T - r_{t-1}B$
3. Deficit-finance, using taxes to bring debt back, $T_t = T + \phi_T (B_{t-1} - B)$
4. Deficit finance, using G spending to bring debt back $G_t = G - \phi_G (B_{t-1} - B)$

[Need $\phi_G, \phi_T > r$. Why?]

Note: these all correspond to different “fiscal blocks”.

With deficit financing, need SolvedBlock.

Importance of fiscal rule for AR(1) shocks to policy



- G rule has stronger effect on demand than T rule, both weaker with deficits
- With longer maturities, fiscal rule matters less [Auclert et al. \(2020\)](#)

Investment

No investment so far. Let's change this!

[Reference: [Auclert et al. \(2020\)](#) appendix A]

$$C_t + I_t = Y_t = XK_t^\alpha N_t^{1-\alpha}$$

Obvious: output is affected differently now since investment responds

Not so obvious: does **consumption** respond differently?

Not true in RA model: C_t purely governed by Euler equation

$$C_t^{-\sigma} = \beta (1 + r_t^{ante}) C_{t+1}^{-\sigma}$$

Same for given path of r_t^{ante} ! **What happens in HA?**

Model setup

Now final goods firm rents capital and labor, flexible prices,

$$w_t = X(1 - \alpha) K_t^\alpha N_t^{1-\alpha} \quad r_t^K = X\alpha K_t^{\alpha-1} N_t^{1-\alpha}$$

Capital firm owns K_t and rents it out, invests s.t. quadratic costs, so

$$D_t = r_t^K K_t - I_t - \frac{\Psi}{2} \left(\frac{K_{t+1} - K_t}{K_t} \right)^2 K_t$$

- detour: Why adjustment costs? Without, **crazy elasticity of investment to r_t**

$$\frac{dK_{t+1}}{K} = -\frac{1}{1-\alpha} \frac{1}{r+\delta} dr_t \quad \Rightarrow \quad \frac{dI_0}{I} = -\frac{1}{1-\alpha} \frac{1}{r+\delta} \frac{1}{\delta} dr_0$$

with $\delta = 4\%$, $r = 1\%$, $\alpha = 0.3$, semi-elasticity is -715!

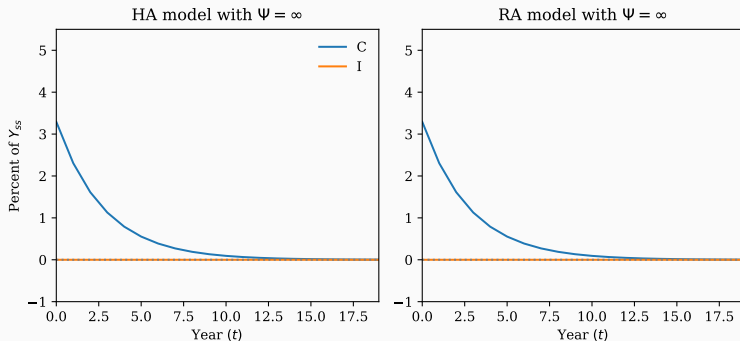
With quadratic adjustment cost, get Q theory equations, $\frac{I_t}{K_t} - \delta = \frac{1}{\Psi} (Q_t - 1)$ and

$$p_t = Q_t K_{t+1} = \frac{p_{t+1} + D_{t+1}}{p_t}$$

Neutrality result with inelastic investment

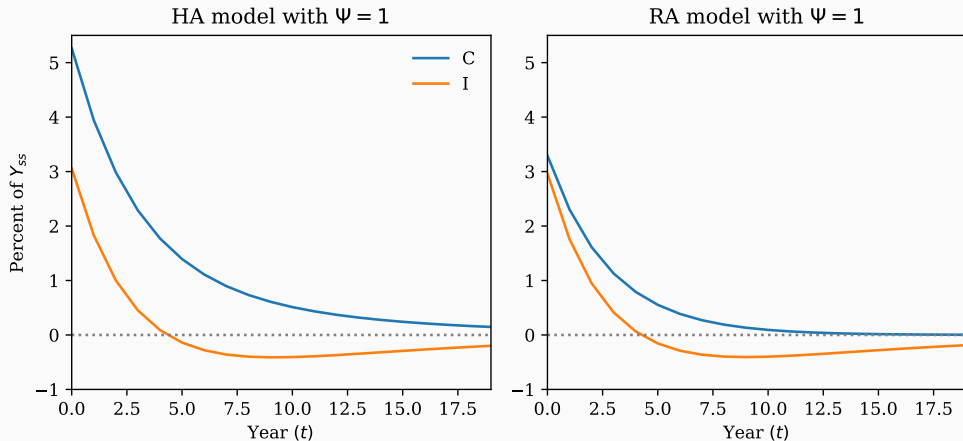
Neat result by **Werning (2015)**: If investment does not respond $\Psi = \infty$, $\delta = 0$, but capital still there $\alpha > 0$, and $EIS = 1 \Rightarrow$ neutrality again, $HA = RA$!

Capital alone does not make a difference. Key: agents trade claims on capital whose price p_t gets revalued!



Elastic investment: $HA > RA!$

Auclert et al. (2020): elastic investment $\Psi < \infty \Rightarrow$ amplification! $I \rightarrow Y \rightarrow C$ link is key.



Taylor rules

Taylor rule

- So far, we analyzed monetary policy with an r rule.
- More common in the literature to study a Taylor rule

$$\dot{i}_t = \bar{r} + \phi_\pi \pi_t + \epsilon_t$$

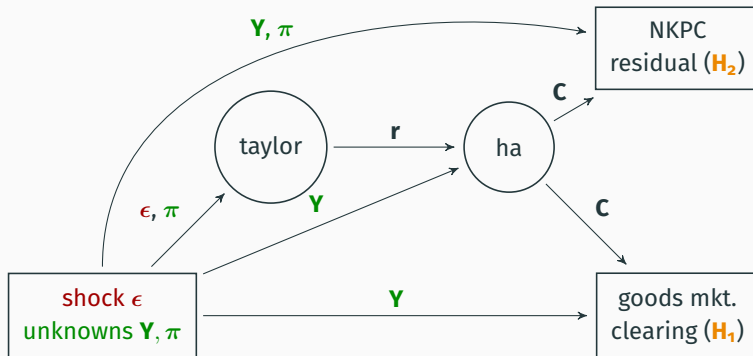
- Since ex-post real rate is $r_0 = \bar{r}$ and, for $t \geq 0$,

$$r_{t+1} = \dot{i}_t - \pi_{t+1} + \epsilon_t = \bar{r} + \phi_\pi \pi_t - \pi_{t+1} + \epsilon_t$$

We now need to set up the DAG with π as an unknown

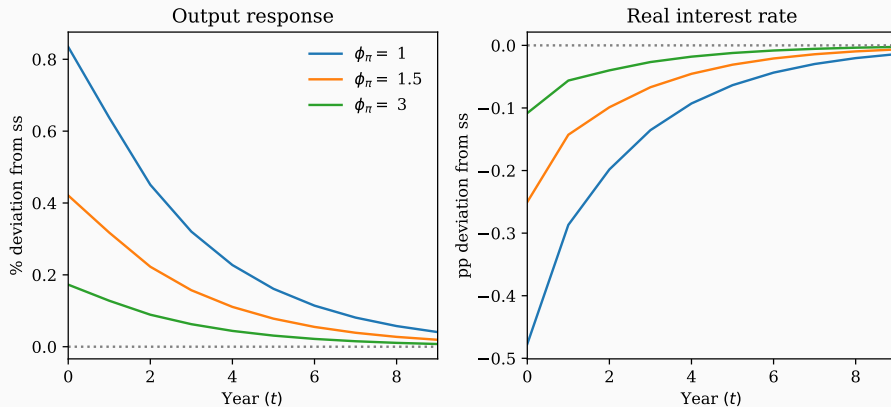
Taylor rule DAG

Here is one possible DAG for this model



- Now model is mapping: $(Y, \pi, \epsilon) \rightarrow H \equiv (H_1, H_2)$.
- Two unknowns, two targets: can solve as usual!

Response to AR(1) monetary shock



- Endogenous tightening to inflation mitigates r_t drop for given ϵ_t

Takeaway

HANK substantially enriches the analysis of monetary policy.

Key points:

1. Indirect effects much larger than RA, though no robust result that $HA \geq RA$
2. Countercyclical income risk has large amplification effects
3. Maturity structure & redistribution become important
4. Relevance of fiscal-monetary interactions (esp. with short maturities)
5. Complementarity between investment and high MPCs

The literature is growing and there is still a lot to do!

References

- Auclert, A. (2019). Monetary Policy and the Redistribution Channel. *American Economic Review*, 109(6):2333–2367.
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