Monetary policy topics

NBER Heterogeneous-Agent Macro Workshop

Adrien Auclert

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What's next

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

Roadmap

1. Maturity structure
2. Nominal assets
3. Fiscal policy
4. Investment
5. 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 $1, \delta, \delta^2, \ldots$

New household problem:

$$\begin{aligned} V_t\left(\lambda_-, e\right) &= \max u\left(c\right) + \beta \mathbb{E}\left[V_{t+1}\left(\lambda, e'\right)|e\right] \\ c + q_t \lambda &= \left(1 + \delta q_t\right)\lambda_- + eY_t \\ q_t \lambda &\geq \underline{a} \end{aligned}$$

where $\lambda =$ 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

$$\begin{aligned} c + q\lambda &= (1+r)\, q\lambda_- + eY \\ q\lambda &\geq \underline{a} \end{aligned}$$

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 !**

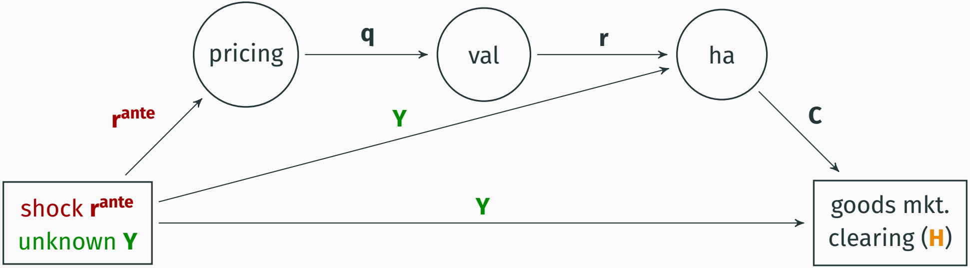
$$1 + r_0 = (1 + r_{ss})\, \frac{1 + \delta q_0}{1 + \delta q_{ss}} = \frac{1 + \delta q_0}{q_{ss}} \neq 1 + r_0^{ante} \qquad (1)$$

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

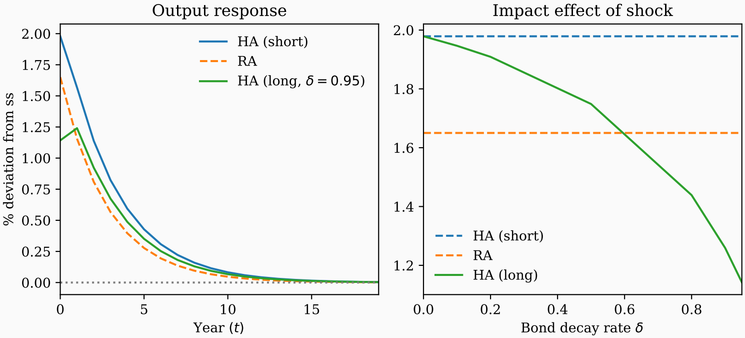
Our new DAG is:



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

$$\begin{aligned} V_t(a_-, e) &= \max u(c) + \beta \mathbb{E}\left[V_{t+1}(a, e') \,|e\right] \\ c + a &= (1 + r_t)\, a_- + eY_t \\ a &\geq \underline{a} \end{aligned}$$

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

- Perfect foresight Fisher equation gives again:

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

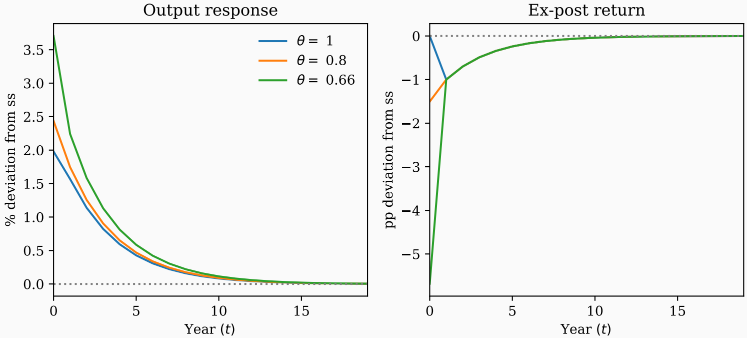
  but also "Fisher effect" (capital gain/loss) from date-0 revaluation

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

- 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!

$\rightarrow$ 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:**

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

Setting up a fiscal rule

Calibration as in fiscal policy lecture. Government budget constraint:

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

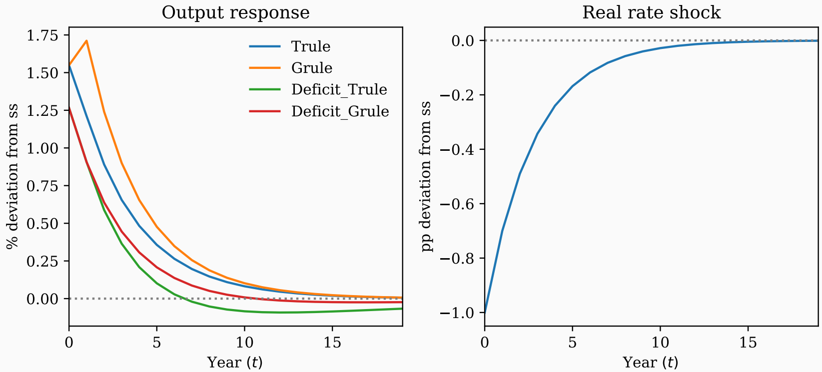
Consider following fiscal *rules*

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, $T_t = T + \phi_T \left(B_{t-1} - B\right)$
4. Deficit finance, using G spending to bring debt back $G_t = G - \phi_G \left(B_{t-1} - B\right)$

[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

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

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

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

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

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

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

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

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

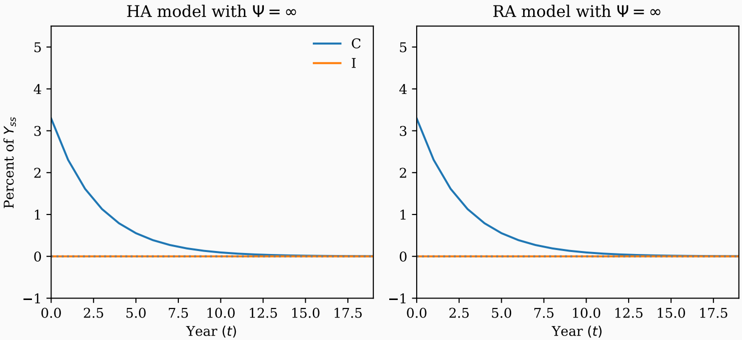
With quadratic adjustment cost, get Q theory equations, $\frac{I_t}{K_t} - \delta = \frac{1}{\Psi}(Q_t - 1)$ and

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

Neutrality result with inelastic investment

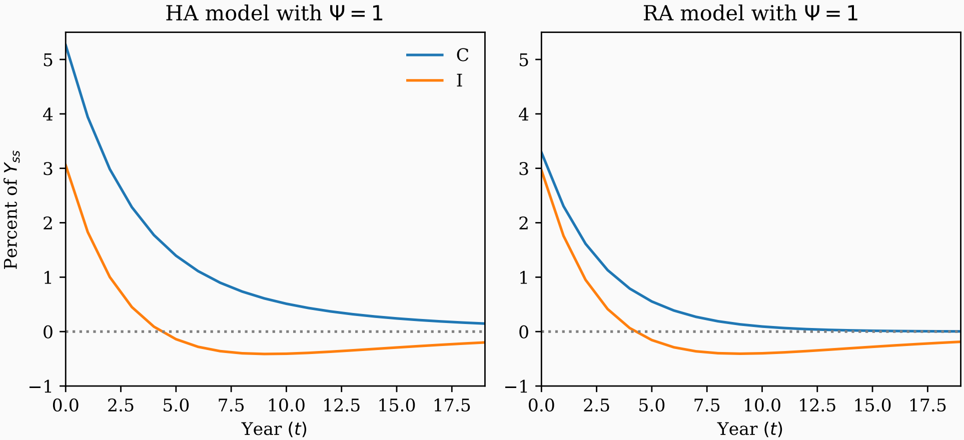
Neat result by Werning (2015): If investment does not respond $\Psi = \infty, \delta = 0$, but capital still there $\alpha > 0$, and EIS = 1 $\Rightarrow$ neutrality again, HA = RA!

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! $I \to Y \to C$ link is key.



Takeaway

Conclusion

HANK substantially enriches the analysis of monetary policy.

Key points:

1. Indirect effects much larger than RA, though no robust result that HA $\gtrless$ 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

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