A Behavioral Heterogeneous Agent New Keynesian Model

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Motivation and Contribution

New empirical facts about effectiveness and transmission mechanisms of monetary and fiscal policy:

- MP works to large extent through indirect (GE) effects.
- Forward guidance has weak effects on economic activity.
- Advanced economies have been stable during long ELB periods.
- Government spending increases consumption.

⇒ These facts are at odds with standard textbook macro models!

⇒ How can we overcome these challenges?

Our contribution: new framework that allows for household heterogeneity and bounded rationality in the form of cognitive discounting:

Behavioral Heterogeneous Agent New Keynesian Model

The behavioral HANK model:

...can account for all these empirical facts simultaneously

...remains analytically tractable

...generates intertemporal marginal propensities to consume consistent with the data

...can be reconciled with recent findings on expectation patterns in survey data

Model

Household heterogeneity:

- two types: "unconstrained" and "hand-to-mouth" households
- households face idiosyncratic risk of switching type ⇒ self-insurance motive

Bounded rationality:

$$\mathbb{E}_t^{BR}[X_{t+1}] \equiv \underbrace{X_t^d}_{\text{default value}} + \bar{m}\mathbb{E}_t \underbrace{\left[\tilde{X}_{t+1}\right]}_{\text{deviation from } X_t^d}$$

- $\bar{m} \in [0,1]$: cognitive discounting parameter, $\bar{m} = 1$: rational expectations
- $\bar{m} < 1$: underreaction of aggregate expectations ⇒ data: $\bar{m} \in [0.6, 0.85]$
- X_t^d: steady state as baseline, relaxed in extensions

Key equilibrium equations (linearized):

- Hand-to-mouth households' consumption:

$$\widehat{c}_t^H = \chi \widehat{y}_t$$

$\chi > 1$: hand-to-mouth households are more exposed to aggregate income fluctuations as in the data (χ depends on redistribution policies)

- Unconstrained households' Euler equation:

$$\widehat{c}_t^U = \underbrace{s\mathbb{E}_t^{BR}\left[\widehat{c}_{t+1}^U\right] + (1-s)\mathbb{E}_t^{BR}\left[\widehat{c}_{t+1}^H\right]}_{\text{Precautionary savings and bounded rationality}} - \frac{1}{\gamma}\left(\widehat{i}_t - \mathbb{E}_t\pi_{t+1}\right).$$

+ Monetary policy

$$\widehat{i}_t = \phi_\pi \pi_t + \phi_y \widehat{y}_t + \varepsilon_t^{MP}$$

+ Standard New Keynesian supply side:

$$\pi_t = \kappa \widehat{y}_t + \beta \bar{M}^f \mathbb{E}_t \pi_{t+1}$$

Results

Behavioral HANK IS Equation:

$$\widehat{y}_t = \psi_f \mathbb{E}_t \widehat{y}_{t+1} - \psi_c \frac{1}{\gamma}\left(\widehat{i}_t - \mathbb{E}_t\pi_{t+1}\right),$$

where

$$\psi_f \equiv \bar{m}\delta, \quad \delta \equiv 1 + (\chi - 1)\frac{1-s}{1-\chi\lambda}$$

and

$$\psi_c \equiv \frac{1-\lambda}{1-\chi\lambda}$$

Monetary Policy:

- Amplification of contemporaneous monetary policy (through indirect GE effects) if and only if

$$\chi > 1.$$

- No forward guidance puzzle if

$$\psi_f + \frac{\kappa}{\gamma}\psi_c < 1.$$

- Behavioral HANK: generates both!
- Rational HANK or behavioral RANK: cannot have both simultaneously!

Modified Taylor Principle:

The behavioral HANK model has a determinate, locally unique equilibrium if and only if:

$$\phi > \phi^* = 1 + \frac{\psi_f - 1}{\frac{\kappa}{\gamma}\psi_c}.$$

- Behavioral HANK: $\phi^* < 0$: determinacy under peg

⇒ Economy remains stable at effective lower bound

- Rational HANK: $\phi^* \gg 1$

Fiscal multipliers:

$$\frac{\partial \widehat{c}_t}{\partial g_t} = \frac{1}{1-\nu\rho_g}\frac{\zeta}{1+\frac{1}{\gamma}\psi_c\phi\kappa}\left[\frac{\chi-1}{1-\lambda\chi}\left[\lambda(1-\bar{m}\rho_g) + \bar{m}\rho_g(1-s)\right] - \kappa\frac{1}{\gamma}\psi_c\left(\phi - \rho_g\right)\right],$$

where

$$\nu \equiv \frac{\psi_f + \kappa\frac{1}{\gamma}\psi_c}{1+\frac{1}{\gamma}\psi_c\phi\kappa}.$$

- Behavioral HANK: positive multipliers but bounded

Intertemporal Marginal Propensities to Consume:

- Behavioral HANK matches empirical estimates of iMPCs (key statistic for policy analysis)
- Bounded rationality leads to higher future MPCs, especially when idiosyncratic risk is high

Policy Implications:

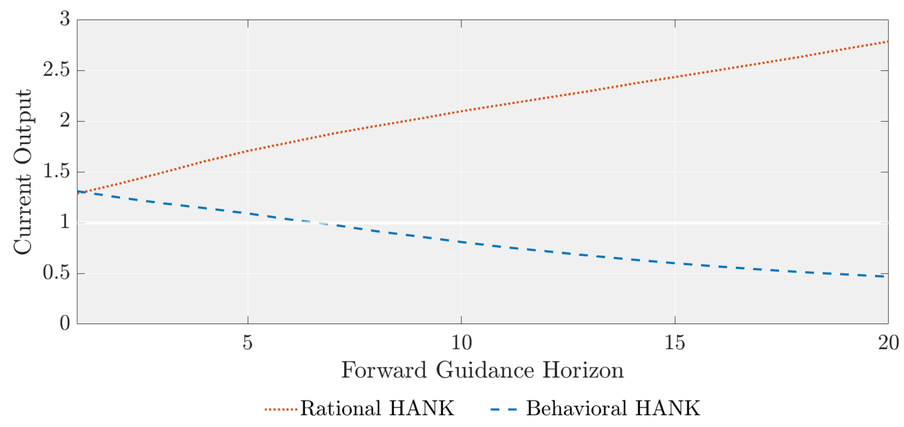
Behavioral HANK has qualitatively different policy implications:

- Frontloading of policies is more effective
- While rational models predict backloading is more effective!

Quantitative Behavioral HANK Model

Incomplete markets model + bounded rationality

- Ex ante identical households:
  - face idiosyncratic productivity risk (instead of type-switching) + borrowing constraints (endogenously-binding)
  - self-insure by accumulating bonds (now in positive net supply)
- Bounded rationality: cognitive discounting of expected future deviations from stationary equilibrium, but rational with respect to idiosyncratic shocks
  - collapses to standard one-asset HANK for $\bar{m} = 1$
- Countercyclical inequality (corresponds to $\chi > 1$ in tractable model)



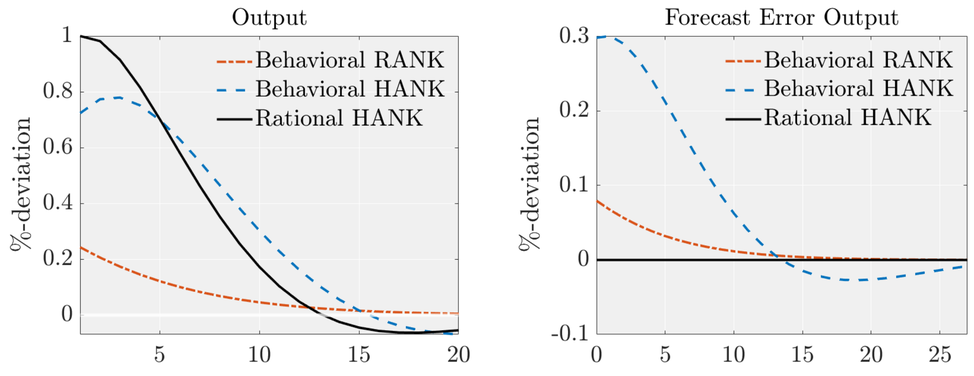
Behavioral HANK: MP amplification ✓ Solve forward guidance puzzle ✓

⇒ insights from tractable model go through!

Extensions

1. **Sticky wages**

⇒ How does the economy respond to a monetary policy shock?



Interaction of sticky wages, household heterogeneity and bounded rationality produces:

⇒ Hump-shaped responses of macroeconomic aggregates (left-hand panel)

⇒ Subjective expectations that initially underreact but overshoot after some time (right-hand panel)

- Both findings are consistent with the data!

2. **Backward-looking default value:** $X_t^d = X_{t-1}$

- Equivalence result with models featuring incomplete information and learning