Clue to Resolving Forward Guidance Puzzle

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Research Question

How can Heterogeneous Agent New Keynesian (HANK) model resolve forward guidance puzzle?

- Estimate HANK model along with standard Representative New Keynesian (RANK) model and calculate the impulse response function.
- What is **Forward Guidance Puzzle**?
  - Central bank's announcement about the future path of monetary policy
  - Puzzle = Gap of its effect between model prediction and empirical outcomes
- What is **HANK**?
  - RANK: Assume representative households with rational expectation
  - HANK: Allow households to be heterogeneous
- Motivation & Contribution
  - Difficulties in implementing monetary policy
  - Estimate parameters and calculate impulse response using empirical data
  - Evaluate HANK which may give a clue to dealing with such difficulties

Model

- Set up RANK and HANK as (simple) DSGE models
- Households' decision problem as part of DSGE model:

$$\max U = \Sigma_{t=0}^{\infty}\beta\left[\frac{c_{h,t}^{1-\gamma}}{1-\gamma} - \frac{\ell_{h,t}^{1+\psi}}{1+\psi}\right]$$

- Households optimize consumption and labor supply subject to...
  - RANK model:

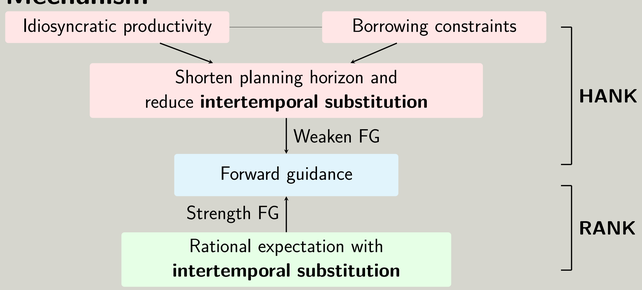
$$c_t + b_{t+1} = (1+i_t)b_t + w_t\ell_t$$

  - HANK model:

$$c_{h,t} + b_{h,t+1} = (1+i_t)b_{h,t} + w_t\, z_{h,t}\, \ell_{h,t},$$
$$b_{h,t+1} \geq 0$$

- Introduce stochastic idiosyncratic productivity ($z_{h,t}$) and borrowing constraints($b_{h,t+1} \geq 0$) to households' budget constraint.

Mechanism



- For estimation, set up more detailed models as follows:
  - RANK model following An and Schorfheide (2007)
  - a one-asset HANK model in continuous time following Ahn et al. (2017) and Kaplan et al. (2018)

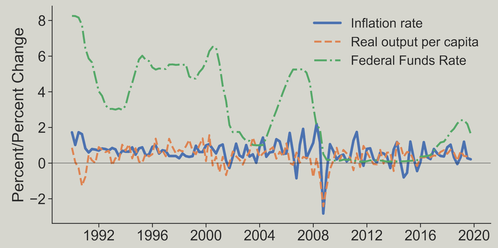
Method & Data

Method

- Bayesian methods + Markov Chain Monte Carlo (MCMC)
  - With prior distributions, log likelihood and MCMC for sampling algorithm, estimate posterior distributions of structure parameters.
- MCMC algorithm:
  - Metropolis–Hastings (MH) algorithm for RANK
  - Sequential Monte Carlo (SMC) algorithm for HANK
- Calculate impulse response functions to evaluate the effect of forward guidance

Data

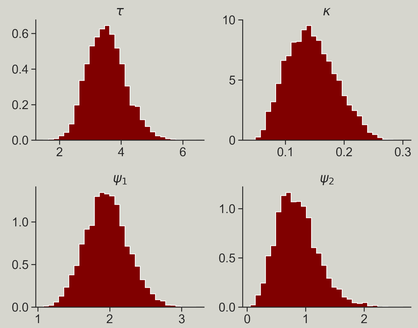
- Real output per capita, CPI for Inflation rate, Federal Funds Rate for the nominal interest rate in the U.S.
- Data period: from 1990:Q1 to 2019:Q4.



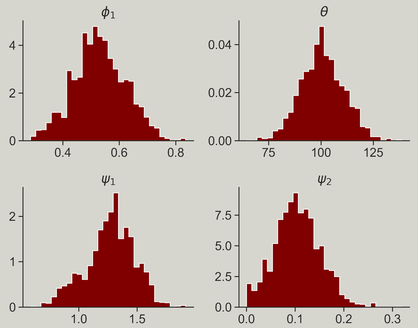
Result

Posterior Distributions

- RANK (4 out of 13 parameters)

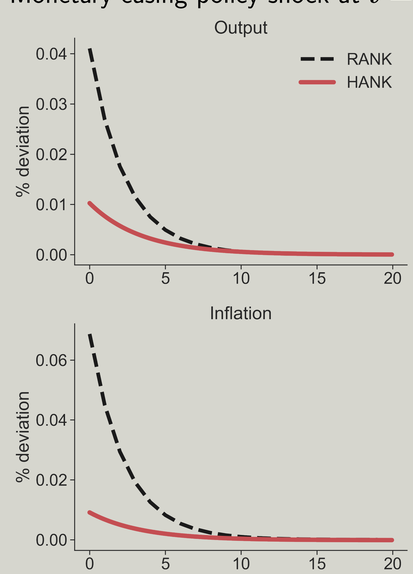


- HANK (4 out of 6 parameters)

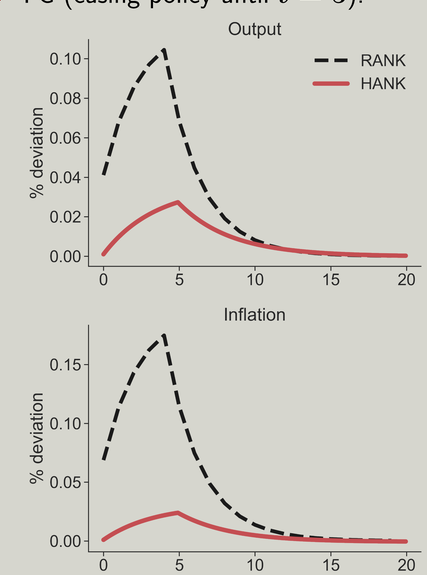


Impulse Response Functions

- Monetary easing policy shock at $t = 0$



- FG (easing policy until $t = 5$).



HANK mutes the effect of forward guidance!

Result (Estimated posterior distributions)

Table: Estimated Posterior Distribution for RANK model

Parameter	Mean	Std.Dev	90% Confidence Interval
τ	3.5294	0.6210	(2.588, 4.6116)
κ	0.1449	0.0415	(0.0814, 0.2192)
ψ_1	1.9615	0.2979	(1.4817, 2.4729)
ψ_2	0.8651	0.3583	(0.3531, 1.5183)
r_A	0.2419	0.1785	(0.0201, 0.5795)
π^*	1.4112	0.2683	(1.0086, 1.8799)
γ_Q	0.7548	0.1237	(0.5594, 0.9611)
ρ_R	0.8400	0.0235	(0.7994, 0.8768)
ρ_g	0.9760	0.0087	(0.9623, 0.9905)
ρ_z	0.9494	0.0122	(0.9288, 0.969)
σ_R	0.1793	0.0148	(0.1587, 0.2076)
σ_g	0.6877	0.0506	(0.6146, 0.7779)
σ_z	0.1965	0.0199	(0.1652, 0.2312)

Table: Estimated Posterior Distribution for HANK model

Parameter	Mean	Std.Dev	90% Confidence Interval
ϕ_1	0.5305	0.0922	(0.374, 0.6851)
θ	100.6775	10.2741	(83.7623, 117.4115)
ψ_1	1.2692	0.2100	(0.8844, 1.5926)
ψ_2	0.1051	0.0465	(0.031, 0.1843)
σ_R	0.4535	0.1847	(0.2567, 0.7995)
θ_R	0.2935	0.0978	(0.1427, 0.4613)

Conclusion

- Found that HANK model with estimated structure parameters from empirical data can reduce the power of the forward guidance
- This result is consistent with McKay et al.(2016)

Limitation & Future Work

- Expand Two assets HANK model
- Use household balance sheet data to calibrate more realistic parameters
- International comparison

Reference

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