Notes on HANK models

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Motivation: consumption response to monetary policy

- In standard models of conventional monetary policy, households
  1. react strongly to changes in interest rates
  2. react very little to changes in wealth: marginal propensity to consume about equal to interest rate

  Empirical estimates suggest:
  1. times series evidence finds low elasticity of aggregate consumption to interest rate changes;
  2. average marginal propensity to consume (first quarter after wealth shock) of about 0.25

RANK, TANK and HANK models

- RANK: representative agent (means here: household) New Keynesian model
- HANK: heterogeneous agent NK model; households are subject to idiosyncratic shocks
- TANK: two-agent NK model:
  1. savers (Ricardian) households, behave like the representative household in RANK models
  2. spenders: do not save, consume all their disposable income in current period

  Attempt to obtain some of the effects of HANK models in a simple framework

Direct and indirect effects of conventional monetary policy

- Direct effect: independent of changes in HH disposable labor income The direct effect includes:
  1. substitution effect from interest rate changes

$$\beta \, \mathrm{E}_t \left(\frac{C_{t+1}}{C_t} \right)^{-\sigma} \frac{R_t}{\pi_{t+1}} = 1 \tag{1}$$

  2. wealth effect (higher interest rate means positive wealth effect for lenders, negative wealth effect for borrowers
- Indirect effect:

$$\Delta R \implies \Delta \mathit{Demand} \implies \Delta \mathit{Income} \implies \Delta \mathit{consumption} \tag{2}$$

RANK vs. HANK

- In RANK models,
  - the response of consumption to monetary policy is almost exclusively driven by direct response
  - the indirect effect is minimal;
    why? HH infinitely lived, not credit constrained.
- In HANK models,
  -
  -
  -

Saving model for ”normal” HHs

Buffer stock model (Carroll 2001)

- uncertainty about labor income (and perhaps many other things)
- borrowing constraint
- discount rate higher than interest rate

Consequence:

- Impatience: HHs tend to reduce savings
- Uncertainty: HH need a buffer stock (assets above borrowing limit)
- The two factors together make HHs fluctuate around an average wealth level
- Relaxing the borrowing limit reduces savings by about the same amount

The model of Aiyagari (1994)

- Households are ex ante identical
- Their labor productivity x is subject to idiosyncratic shocks that are not insurable; their labor income is

$$y_t = w_t x_{i,t} L_{i,t} \tag{3}$$

- They can save in a riskless asset at interest rate r.
- Firm side is neoclassical: constant returns to scale, perfect competition on goods and labor markets

Results:

- Stationary cross-sectional distribution of household wealth
- The aggregate economy is stationary: w_t, r_t constant
- Households have precautionary savings motive $\Longrightarrow$
- In equilibrium,

$$r < 1/\beta - 1 \tag{4}$$

The model of Kaplan, Moll, and Violante (2018)

Households:

- Continuum of households, ex ante identical
- Each period, they get a shock to their **individual** labor productivity
- therefore: HHs differ ex post because of their different shock history (no more tricks with insurance in big family!)
- HHs can save in liquid or illiquid assets; three individual state variables:
  1. illiquid wealth a
  2. liquid wealth b
  3. labor productivity z
- HHs die with probability ζ, are replaced by new HH with zero wealth; their wealth goes to survivors (perfect annuity markets)

Decision problem of HHS

The following is a *discrete time* version of the model

- HHs maximize

$$\mathrm{E}_0 \sum_{t=0}^{\infty} \rho^t u(c_t, l_t) \tag{5}$$

- Budget constraints:

$$b_t = (1-\tau_t) w_t z_t l_t + r^b_{t-1} b_{t-1} + T_t - d_t - \chi(d_t, a_{t-1}) - c_t$$
$$a_t = r^a_t a_{t-1} + d_t$$
$$b_t \geq -\underline{b}, \qquad a_t \geq 0$$

  where

  - d_t: are portfolio changes form liquid to illiquid assets, subect to adjustments costs

$$\chi(d, a) = chi_0 |d| + chi_0 |d/a|^2 a \tag{6}$$

  - T_t: government transfers

Production

1. Final-goods producer aggregates intermediate goods, with demand elasticity $-\epsilon$.
2. Intermediate-goods sector
   - monopolistically competitive
   - C-D production function, constant returns to scale
   - nominal rigidity: price adjustment cost (result almost identical to Calvo pricing)

   Gives rise to forward-looking Phillips curve

Illiquid wealth

- There are two types of illiquid wealth:
  1. physical capital k
  2. shares of intermediate firms (which make a positive profit)
- There are no transaction costs between these types of asset, therefore they have the same expected return in equilibrium (in a linear approximation)
- We can therefore assume that every households holds the two types of liquid assets in equal shares

Government

- Monetary policy: simple Taylor rule
- Fiscal policy
  - exogenous government expenditures G
  - lump sum transfer T and linear labor tax at rate τ
  - only the government issues liquid assets (bonds)

Equilibrium

- Bond markets:

$$B_t^{HH} + B_t^{gov} = 0 \tag{7}$$

- Market for illiquid assets:

$$K_t + q_t = A_t \tag{8}$$

- Labor market clearing

$$N_t = \int z l_t(a, b, z) d\mu_t \tag{9}$$

- Goods market clearing: output is split between
  - expenditure components: G, C, I
  - adjustment costs prices, transaction costs, borrowing costs (intermediation)

Calibration

- Liquid vs. illiquid assets: illiquid assets involve transaction costs (houses, consumer durables, stocks in pension accounts)
- Estimating HH income process: log-productivity is sum of two independent processes, a temporary and a persistent one
- Match wealth distribution (skewness, tails) by interest rate and transaction costs. Average illiquid wealth transaction is 1.7 percent of illiquid wealth; cost is 23 percent of transaction. Aggregate transaction costs less than 4% of GDP.
- Production and monetary policy parameters from NK literature (very simple Taylor rule)

Household behavior

- quarterly MPC (fraction of one-time inflow of liquid wealth that is spent in the first quarter) is 16% on average.
- MPC varies between 0 and 0.3
- households with high illiquid wealth but low liquid wealth have high MPC (”rich hand-to-mouth consumers”)

Monetary transmission mechanisms in HANK model

- Total consumption response to interest rate shock similar to RANK
- Crucial difference: 80 percent of reponse are indirect effect!
- Response differs greatly across households, mainly as a function of liquid wealth. Indirect effect strongest for households at borrowing limit and around zero liquid wealth.
- Effect of monetary policy shock strongly depends on response of fiscal policy (something must change, since government issues debt and is directly affected by interest rate change).

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