Lecture 2
The canonical HANK model

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Fiscal and Monetary Policy with Heterogeneous Agents Minicourse
Bank of Portugal
June 2026

This lecture

Last lecture: how to solve steady states and PE transitional dynamics of neoclassical heterogeneous agent models.

Now: Let's introduce "HANK".

1. The canonical HANK model
2. Three instructive special cases
3. Summary

The canonical HANK model

Introducing the canonical HANK model

- We now embed the standard incomplete markets consumption-saving behavior into a New-Keynesian model
- Allow for a **government**: bonds, taxes, gov. spending
- References: Auclert et al. (2024) (IKC) and Auclert et al. (2025) (ARE)
- We set up the model assuming **perfect foresight w.r.t. aggregate variables**
- Later we'll discuss how this "MIT shock" relates to the solution with recurring shocks (preview: it's the same impulse response to first order!)

Household side

- Household i solves

$$\max_{c_{it}} \ \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left(u(c_{it}) - v\left(n_{it}\right)\right)$$
$$c_{it} + a_{it} \leq (1 + r_t^p) a_{it-1} + z_{it}$$
$$a_{it} \geq \underline{a}$$

- This is the "sequence" analogue of the Bellman equation from last class
- Now connect this to GE: real after tax income is

$$z_{it} = (1 - \tau_t) y_{it} \qquad\qquad y_{it} = \frac{W_t}{P_t} e_{it} n_{it}$$

- As before, e_{it} is idiosyncratic productivity
- Can capture progressive taxation as in Heathcote et al. (2017) (see IKC paper)

Unions and sticky wages (1)

- For our canonical HANK model, we'll work with **sticky wages** (not prices)
- Why? First: in the data, wages are stickier than prices!
- Usual NK assumption (flex wages/sticky prices) has other big issues for HA:

1. High-MPC households on their labor supply curves also have high "MPEs".
   - But in the data, MPEs are very small, and no evidence of correlation with MPCs
   - Removing income effects on labor also won't work: see Auclert et al. 2023
2. Also profits are (almost always) countercyclical wrt demand shocks
   - This leads to cyclical redistribution from profit earners to wage earners
   - Depending on distribution of profits, can lead to e.g. aggregate instability, < 0 fiscal multipliers, etc. (eg: Bilbiie 2008, McKay et al. 2016, Broer et al. 2020)

Unions and sticky wages (2)

- Microfound sticky wages extending Erceg et al. (2000) (see IKC)
  - every worker belongs to a union setting wages on its behalf
  - "labor allocation rule": which agent works what fraction of total labor N_t?
  - today: assume all agents work same hours, $n_{it} = N_t$
- **Today:** will use simple ad-hoc wage Phillips curve (details won't matter)

$$\pi_t^w = \kappa \underbrace{\left(v'(N_t) - \frac{\epsilon - 1}{\epsilon}(1 - \tau_t)\frac{W_t}{P_t}u'(C_t) \right)}_{\text{wedge in labor FOC of "average" agent}} + \beta \pi_{t+1}^w$$

Production

- Representative firm with aggregate production function, linear in labor

$$Y_t = N_t$$

  could also allow for time-varying TFP

- Assume **flexible prices** with monopolistic competition and CES demand $\Rightarrow$

$$P_t = \mu W_t \qquad \Leftrightarrow \qquad \frac{W_t}{P_t} = \frac{1}{\mu}$$

  Real wage constant. Profits are $\left(1 - \frac{1}{\mu}\right) Y_t \Rightarrow$ procyclical.

- Goods price inflation = wage inflation

$$1 + \pi_t = 1 + \pi_t^w$$

- For this lecture: no markups $\mu = 1$, so zero profits. Revisit later.

Government: Fiscal policy

Government sets fiscal policy, consisting of:

- G_t of gov spending
- T_t of total tax revenue, controlled via τ_t

$$T_t = \tau_t Y_t$$

- B_t of government bonds (bounded to avoid Ponzi schemes)

subject to government budget constraint

$$B_t = (1 + r_t) B_{t-1} + G_t - T_t$$

Can set any two of those and the third follows.

If we set G_t, T_t, need to make sure that $B_{-1} = \sum_{t \geq 0} \prod_{s \leq t} \left(\frac{1}{1+r_s} \right) (T_t - G_t)$

Government: How is after tax income distributed?

- Total after-tax income is

$$Z_t \equiv Y_t - T_t = (1 - \tau_t) Y_t$$

- Due to linear taxes, for individual after-tax income we have

$$y_{it} = e_{it} Y_t \qquad \Rightarrow \qquad z_{it} = e_{it} Z_t$$

- z_{it} simply a share of total after-tax income Z_t. Will be convenient.

Government: Monetary policy

Monetary authority follows an interest rate rule. Allow for two kinds of rules:

- **standard Taylor rule.** (linearized)

$$i_t = r + \phi_\pi \pi_t + \epsilon_t$$

  here: $r =$ steady state real rate, $\epsilon_t =$ monetary shock

- **real rate rule.**

$$r_t = r + \epsilon_t \qquad \Leftrightarrow \qquad i_t = r + \pi_{t+1} + \epsilon_t$$

  Equivalent to Taylor rule with coefficient 1 on expected inflation.
  Note: π_{t+1} vs π_t not key (same in cts time!), key is $\phi_\pi = 1$

Why allow for "real rate rule"? Huge gain in tractability! All monetary policy acts via changing real rate. Cost is small if Phillips curve is flat (π_t moves little).

Summary of the household model

- Agents solve

$$\max_{c_{it}} \ \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left(u(c_{it}) - v\left(n_{it}\right)\right)$$
$$c_{it} + a_{it} \leq (1 + r_t^p) a_{it-1} + Z_t e_{it}$$
$$a_{it} \geq \underline{a}$$

- This defines a household "block":

$$\{r_t^p, Z_t\}_{t=0}^{\infty} \longrightarrow \{C_t, A_t\}_{t=0}^{\infty}$$

- In general equilibrium, we have $Z_t = (1 - \tau_t) Y_t = Y_t - T_t$ and $r_t^p = r$

Definition of equilibrium

- Given $\{G_t, T_t, B_t\}$, all agents optimize and markets clear

$$G_t + C_t = Y_t$$
$$A_t = B_t$$

where household aggregates are

$$C_t = \int c_t\left(a_-, e\right) dD_t\left(a_-, e\right)$$

$$A_t = \int a_t(a_-, e) dD_t\left(a_-, e\right)$$

Computing the steady state

How can we find the steady state of this model?

1. Normalize $Y = 1$, calibrate r and B, G. Set $T = G + rB$.
2. Use **same code** as for standard incomplete markets model:
   - instead of $e_{it}Z$ now use $e_{it} \cdot (Y - T)$
   - choose β to match $A = B$.
3. $G + C = Y$ holds by Walras law. Done!

Three instructive special cases

Special cases

Will introduce three special cases that are helpful to analyze and compare the HA model to.

1. Representative-agent model (RA) — [Woodford 2003, Galí 2008]
2. Two-agent model (TA) — [Campbell and Mankiw 1989, Galí et al. 2007, Bilbiie 2008]
3. Zero-liquidity model (ZL) — [Werning 2015, Ravn and Sterk 2021, Bilbiie 2025]

Only difference across models: how C_t is determined given real rates r_t and after-tax incomes Z_t.

Representative-agent model

- This is the standard NK model (with wage rigidities)
- Consumption solves

$$\max \sum_{t=0}^{\infty} \beta^t \frac{C_t^{1-\sigma}}{1-\sigma}$$

$$C_t + a_t \leq (1+r)a_{t-1} + Z_t$$

which has the solution

$$C_t = \frac{\beta^{t/\sigma}(1+r)^{-t/\sigma}}{\sum_{s\geq 0}\beta^{s/\sigma}(1+r)^{-s/\sigma}}\left[\sum_{s\geq 0}(1+r)^{-s}Z_s + (1+r)a_{-1}\right]$$

With $r = \beta^{-1} - 1$, this is just

$$C_t = \frac{r}{1+r}\sum_{s\geq 0}(1+r)^{-s}Z_s + ra_{-1}$$

Two-agent model

- This is like an RA economy except that a fraction μ is hand-to-mouth (HTM). Only $1-\mu$ behave according to PIH.
- PIH agents' consumption is determined by

$$c_t^{PIH} = \frac{\beta^{t/\sigma}(1+r)^{-t/\sigma}}{\sum_{s\geq 0}\beta^{s/\sigma}(1+r)^{-s/\sigma}}\left[\sum_{s\geq 0}(1+r)^{-s}Z_s + (1+r)a_{-1}\right]$$

- HTM agents' consumption is determined by

$$c_t^{HTM} = Z_t$$

- Jointly pin down aggregate consumption

$$C_t = (1-\mu)c_t^{PIH} + \mu c_t^{HTM}$$

Zero-liquidity model

- Assume $\underline{a} = 0$
- What if we shrink liquidity B_t down to $\underline{a} = 0$? (e.g. via smaller β)
- Eventually, **all** agents must have zero assets, so $c_{it} = z_{it}$
- Does that mean all Euler equations fail? Consider:

$$z_{it}^{-\sigma} \geq \beta(1+r)\mathbb{E}_t\left[z_{it+1}^{-\sigma}\right] \qquad \Leftrightarrow \qquad Z_t^{-\sigma} \geq \beta(1+r)\underbrace{\mathbb{E}\left[\frac{(e')^{-\sigma}}{e^{-\sigma}}\middle| e\right]}_{\rho(e)} Z_{t+1}^{-\sigma}$$

- The last Euler equation to fail as we reduce β is that of $\overline{e} = \arg\max \rho(e)$
- Tractable! For instance, steady state r solves $\beta(1+r)\rho(\overline{e}) = 1$

Summary

Summary

We introduced a canonical HANK model:

- Standard incomplete markets households
- Standard New-Keynesian supply side, but sticky wages + flex prices
- Real rate rule for now (relax later)

Considered three useful special cases.x

Next lecture: Analyze fiscal policy in this model. Tomorrow, monetary policy.

References

Auclert, A., Bardóczy, B., and Rognlie, M. (2023). MPCs, MPEs, and Multipliers: A Trilemma for New Keynesian Models. *The Review of Economics and Statistics*, 105(3):700–712.

Auclert, A., Rognlie, M., and Straub, L. (2024). The Intertemporal Keynesian Cross. *Journal of Political Economy*, 132(12):4068–4121.

Auclert, A., Rognlie, M., and Straub, L. (2025). Fiscal and Monetary Policy with Heterogeneous Agents. *Annual Review of Economics*, 17(Volume 17, 2025):539–562.

References ii

Bilbiie, F. O. (2008). Limited Asset Markets Participation, Monetary Policy and (inverted) Aggregate Demand Logic. *Journal of Economic Theory*, 140(1):162–196.

Bilbiie, F. O. (2025). Monetary Policy and Heterogeneity: An Analytical Framework. *The Review of Economic Studies*, 92(4):2398–2436.

Broer, T., Hansen, N.-J. H., Krusell, P., and Öberg, E. (2020). The New Keynesian Transmission Mechanism: A Heterogeneous-Agent Perspective. *Review of Economic Studies*, 87(1):77–101.

Campbell, J. Y. and Mankiw, N. G. (1989). Consumption, Income, and Interest Rates: Reinterpreting the Time Series Evidence. *NBER Macroeconomics Annual*, 4:185–216.

Erceg, C. J., Henderson, D. W., and Levin, A. T. (2000). Optimal Monetary Policy with Staggered Wage and Price Contracts. *Journal of Monetary Economics*, 46(2):281–313.

Galí, J. (2008). *Monetary Policy, Inflation, and the Business Cycle: An Introduction to the New Keynesian Framework*. Princeton University Press.

Galí, J., López-Salido, J. D., and Vallés, J. (2007). Understanding the Effects of Government Spending on Consumption. *Journal of the European Economic Association*, 5(1):227–270.

Heathcote, J., Storesletten, K., and Violante, G. L. (2017). Optimal Tax Progressivity: An Analytical Framework. *Quarterly Journal of Economics*, 132(4):1693–1754.

McKay, A., Nakamura, E., and Steinsson, J. (2016). The Power of Forward Guidance Revisited. *American Economic Review*, 106(10):3133–3158.

Ravn, M. O. and Sterk, V. (2021). Macroeconomic Fluctuations with HANK & SAM: an Analytical Approach. *Journal of the European Economic Association*, 19(2):1162–1202.

Werning, I. (2015). Incomplete Markets and Aggregate Demand. Working Paper 21448, National Bureau of Economic Research,.

Woodford, M. (2003). *Interest and Prices: Foundations of a Theory of Monetary Policy*. Princeton University Press.