

# AdvMacroHet-2023: Grading

## Assignment I: HANC with multiple types of labor

Ad a) Show understanding of the concept i) stationary equilibrium and ii) transition path, both in text and in math. Show understanding of the block structure illustrated in the DAG and concepts such as the shocks, the unknowns and the targets.

Ad b) Correct implementation of i) the additional heterogeneity and the two types of labor and ii) root finding for the stationary equilibrium. Explain that wealth inequality is both a consequence of i) ex ante (permanent) heterogeneity in labor productivity and discount factors and ii) ex post (temporary) stochastic differences in labor productivity.

Ad c) Show understanding of the concept of the Jacobian of the household block. Correct economic interpretation of the mechanic effect on labor supply and income, and the behavioral effect on consumption.

Ad d) Correct implementation of shocks, unknowns, targets and blocks, and of solution for the transition path. Calculation of the change in discounted expected utility for the different types. Discussion of both the direct effect on productivity and the indirect effect through complementarity in the production function.

Ad e) Correct implementation of convergence from the old to the new steady state (permanent shock). Same discussion as under d).

## Assignment II: HANC with a Welfare State

Ad a) Correct implementation of the government behavior and for finding the stationary equilibrium with clearing of both the asset and the labor market.

Ad b) Correct implementation of the maximization of expected discounted utility in an other loop, where the stationary equilibrium is found in the inner loop.

Ad c) Same as b) plus discussion of the benefits of a non-distortionary lump-sum tax,  $\chi$ , and its costs in terms of increased inequality.

Ad d) Correct implementation of change in parameter.

- Mechanical effect: Output increases, labor decreases (due to an income effect) and for fixed lump-tax and government spending, the tax rate must go up.  $G/Y$  and  $G/C^{hh}$  falls.
- Including optimized government behavior:  $G$  increases and is financed by a combination of  $\tau$  and  $\chi$ .  $G/Y$  and  $G/C^{hh}$  still lower than before the increase in  $\Gamma_Y$  because the government consumption good have become relatively more expensive.

Ad e) Correct implementation of convergence from the old to new steady state. Discussion of which policy path to choose in terms of the expected discounted utility of agents.

# Exam

## Question 1: Solution method

- a) Show understanding of what an input to the household block is. Suggesting e.g.:
- (a) We always have  $\delta_t = \delta_{ss}$  and  $w_t = w_{ss}$  so these could be converted to parameters.
  - (b) We can create  $\text{div\_transfer}_t = \text{div}_t + \text{transfer}_t$ , so  $\text{div}_t$  and  $\text{transfer}_t$  do not need to be separate inputs.
  - (c) We can define  $\tilde{w}_t = (1 - \tau_t)w_t$ , so  $\tau_t$  and  $w_t$  do not need to be separate inputs (less relevant given  $w_t$  is constant).
- b) Show understanding of what an unknown is and that the number of unknowns and targets must be equal. E.g. suggest:

```
1 for t in range(par.T):
2
3     u_lag = prev(u,t,ini.u)
4     u[t] = (u_lag - S[t]*lambda_u_s[t] + delta[t]*(1 - u_lag))
5     errors_u[t] = 0.0
```

Listing 1: Inspiration for blocks.py

Note: It can alternatively be used that  $S_t = u_{t-1}$ .

- c) Discussion that it is close to linear, but not exactly linear for large enough shocks. Based on e.g. either
- (a) Compare non-linear solutions with shocks of different sizes, or
  - (b) Compare linear solution and non-linear solution with »large shock«.

## Question 2: Fiscal multiplier

- a) Correct implementation of shock and calculation of fiscal multiplier. Discussion along the following lines supported by decompositions:

**Propagation in general:** Starting point is increased demand from  $G$ .

- (a) Lower unemployment  $\rightarrow$  higher job-finding rate  $\rightarrow$  lower unemployment risk
- (b) Higher inflation  $\rightarrow$  higher real interest rate
- (c) Fixed real wage  $\rightarrow$  higher dividends

- (d) Higher taxation (some initial fall due to lower unemployment)

**Consumption drivers:** Crowding-out in total

- (a) Negative: Interest rate and taxes.
- (b) Positive: Dividends and higher job-finding rate.

**Consumer types:**

- (a) HtM: Initial increase in consumption due to strong income effect from higher dividends and fewer unemployed. Negative effect from higher taxes.
  - (b) Buffer-stock: Stronger effect from higher job-finding rate due to lower precautionary saving, but smaller income effect due to lower MPC.
  - (c) PIH: Almost only about the interest-rate due high degree of self-insurance and low MPC.
- b) Correction implementation of the experiment. Explain lower multiplier with more immediate increase in taxes and thus lower income and consumption of HtM households.
  - c) Correction implementation of the experiment. Explain higher multiplier with more HtM households and therefore a larger average MPC (but a weaker response from the precautionary saving channel.)
  - d) Correction implementation of the experiment. Explain that unemployment risk does not matter in the aggregate. Unemployment does still matter because it implies less aggregate income.

**Fiscal multiplier**

- a) Correct introduction of  $\bar{u}$  as a variable. Find new stationary equilibrium with permanent extension of unemployment benefits. Compute fiscal spending multiplier as above. It is slightly larger. Discussion of why can include that there is less self-insurance and therefore a slightly larger MPC.
- b) Correct implementation of a temporary immediate UI extension and calculation of implied fiscal multiplier of UI extension. Explanation of results should include strong consumption response of buffer-stock households due to weaker precautionary saving motive.

- c) Correct implementation of temporary immediate UI extension and calculation of implied fiscal multiplier of UI extension. Explanation of results should again include strong consumption response of buffer-stock households due to weaker precautionary saving motive.
- d) Correct implementation of cancellation. Use the results from the beginning-of-period period 6 as the initial state of the economy and then find the transition path back to the steady state. The cancellation is a negative shocks from the perspective of the HtM and buffer-stock households and consumption falls in the aggregate. But the government also saves paying for the extension. The calculated fiscal multiplier is negative, discounted taxes falls, while output increases. (It can be discussed whether the government can credible announce future policy changes, or might loose that ability after the cancellation.)