

14.05 – INTERMEDIATE MACROECONOMICS

Midterm 2, Fall 2024

This is a closed-book exam. Read the questions carefully before starting to answer. You will be graded on the quality of your explanations as well as the accuracy of your answers. You have 85 minutes. Good luck!

Exercise 1 (30 points)

For parts a)–e), decide whether the statement is true, false, or uncertain. *Briefly* explain your answer, with your explanations not exceeding two sentences for each (sub-)item.

- a) [6 points] Consider the labor-only RBC model covered in class, with a constant returns-to-scale production function

$$y_t = A_t \ell_t.$$

A positive supply shock—i.e., an increase in productivity A_t —necessarily increases the equilibrium real wage w_t .

- b) [6 points] According to the permanent-income model of consumption, even a small one-off income gain—like a stimulus check—should have a large effect on household consumption, because consumption tracks current income.

- c) [6 points] Even a temporary fall in house prices can have a large effect on the consumption of borrowing-constrained, hand-to-mouth households.

- d) [6 points] The Fisher equation says that real interest rates r , nominal interest rates r^n , and inflation π are related as

$$1 + r = \frac{1 + r^n}{1 + \pi}.$$

It follows from this relation that an increase in nominal interest rates by the central bank *increases* inflation.

- e) [6 points] Optimal investment by a competitive firm satisfies the optimality condition

$$1 + r = f'(k) + (1 - \delta)$$

If the production function $f(\bullet)$ is neoclassical, then this relation implies that an increase in interest rates r lowers capital k and thus investment.

Exercise 2 (35 points)

Consider a household that makes consumption-savings decisions. The household lives three periods, $t \in \{0, 1, 2\}$, which you can respectively think of as young age, middle age, and retirement. The household starts with zero assets, $a_0 = 0$, and her income stream satisfies,

$$y_2 = 0 < y_0 = 10 < y_1 = 110.$$

That is, in period 0, the household makes a relatively small amount of income. As she transitions to period 1, her income considerably increases. In period 2, however, the household's income drops to zero. The household's per-period utility function is given by $u(c) = \log c$. For simplicity, we normalize the discount rate as well as the interest rate to zero, $\rho = r = 0$.

First suppose the household can save or borrow (at rate $r = 0$) without any constraints (except for the natural constraint that she cannot leave behind negative assets). In this case, the household's optimization problem can be written as,

$$\max_{c_0, a_1, c_1, a_2, c_2} u(c_0) + u(c_1) + u(c_2)$$

subject to the three budget constraints

$$\begin{aligned} c_0 + a_1 &= y_0, \\ c_1 + a_2 &= y_1 + a_1, \\ c_2 &= a_2. \end{aligned}$$

- a) [10 points] Characterize the household's optimal consumption levels, c_0, c_1, c_2 , as well as her path of savings, a_1, a_2 . Is the household saving or borrowing in period 0? Is she saving or borrowing in period 1? Provide a brief intuition.

For the remaining parts, we will assume that at date 0 the household faces an additional borrowing constraint, which we capture in reduced form as,

$$a_1 \geq -\bar{b}_1$$

- b) [15 points] Suppose first that the borrowing limit is very tight, i.e., $\bar{b}_1 = 0$. Characterize the household's optimal consumption level, c_0 . Suppose the initial income increases from $y_0 = 10$ to $y_0 = 20$. How does this affect c_0 ? Is the effect the same as/smaller than/greater than the effect you would obtain if the permanent-income hypothesis applied (i.e., no borrowing limit, as in a))? Provide a brief intuition.
- c) [10 points] Return again to assuming $y_0 = 10$. Now however suppose that the borrowing

limit is looser, increasing to $\bar{b}_1 = 10$. How does this affect c_0 ? Provide a brief intuition.

Exercise 3 (35 points)

We consider a variant of the (static) New Keynesian model with supply shocks. Aggregate demand is described by the following relation between output, interest rates, and inflation:¹

$$-\gamma y_t = r_t^n - \pi_t \quad (1)$$

Aggregate supply is

$$\pi_t = \kappa(y_t - \hat{a}_t) \quad (2)$$

where $\hat{a}_t$ is the supply shock. Finally the central bank follows a simple Taylor-type rule:

$$r_t^n = \phi_\pi \pi_t, \quad (3)$$

with $\phi_\pi > 1$.

- a) *[10 points]* What are the effects of a positive supply shock $\hat{a}_t > 0$ on output y_t , inflation π_t , and nominal interest rates r_t^n ? Provide a graphical illustration using as AS-AD diagram with output y on the x -axis and inflation π on the y -axis. *[Hint: (2) is the AS-curve. Obtain the AD curve by combining (1) and (3).]*
- b) *[10 points]* Suppose that prices are very flexible, i.e., that κ is very large. Using your general expressions from item a), discuss what happens to output following a positive supply shock. How does this prediction compare with the RBC model? Again provide a graphical representation, and comment on the slope of the supply curve.
- c) *[5 points]* Now suppose that, because of a prior contractionary demand shock, nominal interest rates are at the zero lower bound, so $r_t^n = 0$ (rather than equation (3)). Furthermore suppose that prices are very rigid, so κ is very small, close to 0. What are the effects of a positive supply shock now? What is going on? Discuss, providing yet again a graphical AS-AD representation.
- d) *[10 points]* Finally consider the same scenario as in item c), but suppose that prices are somewhat flexible, with $0 < \kappa < \gamma$. What are the effects of a positive supply shock now? With interest rates stuck at the zero lower bound and the economy already in recession, would the central bank welcome a positive supply shock? What is going on? Show again how the AS-AD representation of the economy changes.

¹Note that contemporaneous inflation enters (1), as in Problem Set 4.

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