Intermediate Macroeconomics: Final Exam

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Instructions

- This exam is out of 100 points.

- You have **120** minutes to complete the exam.

- **Write down your answers on the provided answer sheets, in either English, Chinese, or a combination of both**. Don't forget to write down your name.

- No calculators, phones, notes or books of any kind are permitted.

Good Luck!

1. True/False/Uncertain (15 points, or 5 points each)

Assess whether the following statements are true, false or uncertain and justify your answers. Points are given for explanations only.

   a. (5 pts) The Friedman rule states that the socially optimal real interest rate should be 0, in which case the nominal interest rate will be exactly equal to the inflation rate.

   b. (5 pts) From asset pricing models we studied in class, risky assets always have higher prices than safe assets with the same expected return.

   c. (5 pts) In the Real Business Cycle (RBC) model studied in class, output fluctuation is generated by a stochastic shock in household's aggregate labor supply. As a result, RBC model does a good job explaining labor market fluctuations during economic expansions and recessions.

2. McCall Model with Discrete Offer Distribution (10 Points)

Consider a McCall labor search model with a simplified wage distribution. A worker is either employed or unemployed in each period.

   • If employed at wage w, the worker earns the same wage forever.

   • If unemployed, she could randomly draw a wage offer w each period. The offer is good with probability π, in which case $w = \bar{w}$; and is bad with probability $1 - \pi$, and $w = 0$

After looking at the offer, the worker can choose to accept it or reject it. If she accepts, she become employed forever with the current wage offer. If she rejects, she can claim unemployment benefit b in the current period and search again in the next period. Finally, her utility function is

$$\sum_{t=0}^{\infty} \beta^t y_t$$

where $\beta \in (0, 1)$ is the depreciation rate.

   a. (6 pts) Write down the value functions $V_E(w)$ for an employed worker, and V_U for an unemployed worker who has not drawn the wage offer yet.

   b. (4 pts) **(Hard)** Solve the reservation wage w_R for the worker by setting $V_E(w_R) = V_U$ and assuming $w_R \in (0, \bar{w})$.

3. Solow Model with Natural Resources (30 points)

Consider a Solow model with natural resources as an input in the production function, which is given by

$$Y_t = K_t^\alpha (A_t N_t)^\beta B_t^\kappa$$

where K_t, N_t and B_t denote the stock of capital, labor and natural resources respectively. Assume that $\alpha, \beta, \kappa \in (0,1)$ and $\alpha + \beta + \kappa = 1$. The saving rate of the economy is exogenously fixed at $s \in (0,1)$ and capital depreciates at rate $\delta \in (0,1)$. Population and productivity grow exogenously with fixed growth rates:

$$N_t = (1 + g_N)^t N_0$$

$$A_t = (1 + g_A)^t A_0$$

The stock of natural resources depletes exogenously at the constant rate $\theta > 0$ i.e.

$$B_t = (1 - \theta)^t B_0$$

The law of motion for capital is given by

$$K_{t+1} = (1 - \delta)K_t + sY_t$$

(In your answer to this question, use lowercase letters to denote variables normalized by effective labor.)

a. (5 pts) Normalize the law of motion for capital by effective labor. Make sure to subsitute normalized output y_t by an expression in terms of k_t and b_t.

b. (6 pts) Compute the growth rate of aggregate output Y_t along a balanced growth path as a function of the growth rate of capital g_K and other model parameters. (**Hint: use the production function and the fact that** $\ln(X_{t+1}) - \ln(X_t) \approx \frac{X_{t+1} - X_t}{X_t}$. **)**

c. (6 pts) Use the fact that K_t/Y_t is constant along a balanced growth path to compute g_K. Discuss whether it is positive or negative.

d. (5 pts) Compute the growth rate of output per capita, Y_t/N_t along a balanced growth path. How does the presence of natural resources affect this growth rate?

e. (4 pts) Suppose countries differ in their dependence on natural resources. What model parameter(s) do you think would vary between countries, and how would their growth rates be different? Explain.

f. (4 pts) Do you think your answer to the previous question is sensitive to assumptions about the elasticity of substitution (α, β, κ) between inputs? Explain.

4. Overlapping Generations Model with Social Security (25 Points)

Consider the following overlapping generations model with elastic labor supply. In each period, the economy is occupied by two cohorts of households, the young and the old, each living two periods from the time they are born. The population growth rate is 0. Both young and old agents are endowed with 1 unit of time, which they could use toward work (H_t) and leisure (L_t). The production function is linear in labor:

$$Y_t = H_t$$

Let $\beta = 1$. Agents born at $t \geq 0$ solve the following problem:

$$\max_{\{C_t^y, C_{t+1}^o, H_t^y, H_{t+1}^o\}} u(C_t^y) + v(H_t^y) + \left[u(C_{t+1}^o) + v(H_{t+1}^y) \right]$$

$$\text{s.t. } C_t^y + S_t^y = Y_t^y$$
$$C_{t+1}^o = Y_{t+1}^o + (1 + r_{t+1})S_t^y$$

Where S_t^y is the savings of cohort t agents when they are young, and r_{t+1} is the interest rate at time $t + 1$. **Note that this economy has no storage technology or money**. Finally, the utility functions are given by:

$$u(C) = \log(C)$$
$$v(H) = \log(1 - H)$$

a. (4 pts) What is the saving by each cohort in the competitive equilibrium? Why

b. (6 pts) Solve for the optimal consumption and labor supply choices of each agent born at $t \geq 0$ when he is young and old.

c. (4 pts) What is the level of lifetime utility of each agent born at $t \geq 0$?

d. (6 pts) A benevolent government tries to implement a social security program to this economy in order to improve agents' welfare. In each period, the government transfers a **fixed amount of output** τ from the young to the old. What are the consumption and labor supply choices of each agent born at $t \geq 0$ under this new policy?

e. (5 pts) What is the level of lifetime utility of each agent born at $t \geq 0$? Is this social security scheme improving agents' welfare as the government promised? Why or why not?

5. Short Answer (20 points)

Many economists believe that **money is neutral**, which means a change in the stock of money only affects nominal variables such as prices and wages, and has no effect on real variables such as consumption, output and capital. However, there are other economists (including Keynes) who believe that changes in monetary policy (such as money growth rate) do have **real effects** in both short and long terms.

Using the models and techniques we learned in class, discuss your thoughts about money neutrality. In particular, do you think a change in monetary policy could generate changes in real variables? Why or why not?