THE UNIVERSITY OF MANCHESTER

MACROECONOMIC THEORY

Semester 1 2022/23

Release Date: 18 January 2023, 2:00 pm
Submission Deadline: 20 January 2023, 2:00 pm

INSTRUCTIONS SPECIFIC TO THIS EXAM:

- Answer **ONE** question from Section A and **TWO** questions from Section B. Each section is worth 50 points.
- You must submit typed responses. Hand-written responses are **not** acceptable. Any equations must be typed. However, hand-drawn diagrams are acceptable, as long as they are included within the main document of your submission.
- You must submit your answers either as a Word document or as a PDF.
- Ensure that any included diagrams are oriented correctly. Marks will be deducted if your diagrams are rotated 90 degrees, upside down, etc.
- Do not submit an image of typeset answers. Do not include equations by inserting pictures of equations.
- Students are not permitted to discuss their answers with other students before submission.
- Candidates are expected to demonstrate to the examiners a competent knowledge of all computations.
- Candidates are also advised that the examiners attach considerable importance to the clarity with which answers are expressed.

SECTION A

Answer ONE question

1. **Efficiency of the decentralized equilibrium in a search economy**

Consider the steady state of the Mortensen-Pissarides model. Suppose $r > 0$ and assume that firms are owned by households. Therefore, total welfare can be measured as the discounted sum of utility and profits per unit time:

$$W = \int_0^\infty e^{-rt} \left[yE(t) - (E(t) + V(t))c + b(1 - E(t)) \right] dt.$$

Consider a social planner who chooses the path of $V(t)$ to maximize W, subject to the constraint that $\dot{E}(t) = M(1 - E(t), V(t)) - \lambda E(t)$. The solution to this problem is the efficient allocation. Letting M_U and M_V denote the partial derivatives of $M(U, V)$ with respect to U and V, respectively, the efficient allocation is then determined by the following first-order condition:

$$e^{-rt} [y - c - b] = \mu(t) [M_U(1 - E(t), V(t)) + \lambda] - \dot{\mu}(t)$$
$$\text{where} \quad \mu(t) \equiv e^{-rt}/M_V(1 - E(t), V(t)).$$

(a) Using the first-order condition for the planner's problem, and imposing the steady state where $\dot{E} = \dot{V} = 0$, show that the equilibrium allocation will be constrained efficient when $\gamma = 1 - \phi$. Show analytically whether equilibrium employment is above or below the efficient level when (i) $1 - \phi > \gamma$ and (ii) $1 - \phi < \gamma$. Explain your steps clearly and give economic intuition. **(15 points)**

(b) Suppose the government imposes a tax T_v (or subsidy if $T_v < 0$) on firms to post vacancies and rebates the revenue back to workers as a lump-sum T. That is, the firm's profits are now $y - w - c$ if the job is filled and $-c - T_v$ if vacant. Workers receive $w + T$ if employed and $b + T$ if unemployed. Solve for the new equilibrium condition, $rV_V(E) = 0$. Find an expression for the optimal T_v (i.e., the value of T_v which shifts the equilibrium allocation to the efficient one). Explain and give economic intuition for what you find. **(10 points)**

(c) Suppose there is an increase in y. How would the efficient level of employment respond? Can you tell what would happen to the optimal T_v from part (b)? Explain and give economic intuition for what you find. **(10 points)**

(d) Assume $k = 1$, $\gamma = 1/2$, $r = 0.05$, $b = 0.2$, $c = 0.5$, $\lambda = 0.3$, $\phi = 0.25$. Plot $rV_V(E)$ against E with and without the optimal T_v for two scenarios: (i) $y = 1$ and (ii) $y = 2$. Report the value of T_v and the equilibrium E in each case. Explain what you find. **(15 points)**

2. **Barro tax smoothing model**

Consider the Barro tax-smoothing model. Suppose that output, Y, and the real interest rate, $r > 0$, are constant, and that the level of government debt outstanding at time 0 is $D_0 = 0$. Suppose there are two possible values of government purchases: either G_L or G_H, where $G_L < G_H$. Assume distortion costs are quadratic.

(a) Suppose initially that there is no uncertainty in the path of government purchases. Specifically, assume $G_t = G_H$ when t is even and $G_t = G_L$ when t is odd. What are the optimal paths of taxes, T_t, the primary deficit, $G_t - T_t$, and government debt, D_t? Give economic intuition for your answer. (**10 points**)

Now, for the rest of this question, suppose there is uncertainty over the path of government purchases, G_t. Specifically, if $G_t = G_L$, the probability that $G_{t+1} = G_H$ is $p_L \in (0, 1)$. If $G_t = G_H$, the probability that $G_{t+1} = G_L$ is $p_H \in (0, 1)$.

(b) Solve for the optimal rule for taxes T_t as a function of existing debt D_t and government purchases G_t. Give economic intuition for what you find. (**20 points**)

(c) Assume $G_L = 5$, $G_H = 10$, $r = 0.04$, $p_L = 1/5$ and $p_H = 1/10$. Plot the path of taxes T_t, the primary deficit $G_t - T_t$ and government debt D_t over 60 periods, assuming that the *realized* path of G_t alternates with G_H for 10 periods, then G_L for 5 periods, starting with G_H. In other words, $G_t = G_H$ for the first 10 periods, $G_t = G_L$ for the next 5 periods, $G_t = G_H$ for the next 10 periods, and so on. Give economic intuition for what you find. (**10 points**)

(d) Suppose the *realized* value of G_t was G_H forever. What would happen to the path of government debt? Is the no-Ponzi game condition violated in this situation? Why or why not? (**10 points**)

SECTION B

Answer TWO questions

Word limit for each question: 500 words

1. Solve the log-linearized version of the RBC model using the method of undetermined coefficients, where your solution takes the following form:

$$\tilde{C}_t = a_{CK}\tilde{K}_t + a_{CA}\tilde{A}_t + a_{CG}\tilde{G}_t$$
$$\tilde{L}_t = a_{LK}\tilde{K}_t + a_{LA}\tilde{A}_t + a_{LG}\tilde{G}_t$$
$$\tilde{K}_{t+1} = b_{KK}\tilde{K}_t + b_{KA}\tilde{A}_t + b_{KG}\tilde{G}_t$$

   Assume $\alpha = 1/3$, $g = 0.5\%$, $n = 0.25\%$, $\delta = 2.5\%$, $(G/Y)^* = 0.2$, $r^* = 1.5\%$, $\ell^* = 1/3$, $\rho_G = 0.75$ and $\rho_A = 0.75$. Explain carefully your solution technique and report the coefficients (a, b) for your solution. Then, trace out the impulse responses (over 60 periods) for capital, labor, consumption, output, the wage and the interest rate to a 1% technology shock. Give economic intuition for how the RBC economy responds. How does the persistence of productivity (ρ_A) affect the dynamics? **(25 points)**

2. Suppose that output is determined by the Lucas supply curve, $y = y^n + b(\pi - \pi^e)$. Moreover, suppose that social welfare is quadratic in both output and inflation. In other words, the social loss function is

$$L = \frac{1}{2}(y - y^*)^2 + \frac{1}{2}a(\pi - \pi^*)^2, \quad y^* > y^n, a > 0.$$

   Assume the policymaker operates under discretion and chooses inflation π to minimize L subject to the Lucas supply curve. Give economic interpretation for the parameters of this model, and show what happens to equilibrium social welfare when a falls. Give economic intuition for your answer. **(25 points)**

3. The average income of farmers is less than the average income of non-farmers, but fluctuates more from year to year. Given this, how does the permanent-income hypothesis predict that estimated consumption-income functions for farmers and non-farmers differ? Give economic intuition. **(25 points)**

END OF EXAMINATION