1. Consider a IS-LM graph for a closed-economy where the real interest rate is on the vertical axis. Consider also a IS*-LM* graph for an open-economy (the Mundell-Fleming model) where the exchange rate (e=(foreign dollar)/(domestic collar)) is on the vertical axis. Now assume there is an increase in tax (T).

   (a) (10pt) Draw an IS-LM graph showing the effect of an increase in T on a closed economy. Draw two IS*-LM* graphs showing the effect on an open economy with fixed exchange rates and floating exchange rates, respectively. Explain your graphs.

   (b) (10pt) In which of the three scenarios (closed, open with fixed exchange rates, open with floating exchange rates) does the increase in T has the largest effect on output? Which scenario has the least effect on output? What is the economics reason? Your explanation determines the grade.

2. Consider a two-period consumption choice model. Assume an agent is endowed with non-labor income y_1 and y_2 in period 1 and 2, respectively. The agent's life-time utility is

$$U = u(C_1) + \beta E_t[u(C_2)],$$

   where $u(\cdot)$ is the instantaneous utility function, C_i is the consumption in period i, and $0 < \beta < 1$ is the preference discount factor. In period 1, the income can be used either to consume or to buy S units of bonds which costs P_1 per unit. The bond will mature in period 2 and each unit will have the payoff X_2 which is stochastic. Payoff of the bond can be used for consumption in period 2. The bond has no value left after period 2 and the agent dies after period 2. The agent's task is to maximize the life-time utility by choosing the optimal amount of S.

   (a) (5pt) Write down the agent's budget constraint of period 1.

   (b) (5pt) Write down the agent's budget constraint of period 2.

   (c) (5pt) Write down the agent's utility maximization problem.

   (d) (7pt) Derive the problem's first-order condition and show the agent's willingness to pay for one unit of the bond (i.e., solve for P_1).

   (e) (8pt) Suppose for some reason that the positive correlation between $u'(C_2)$ and X_2 suddenly increases. Does the agent's willingness to pay for the bond (P_t) goes up or down after the increase in the correlation? WHY?

3. Consider a Solow model with technological progress and population growth. A final good in the economy is produced according to: $Y_t = (A_t N_t)^{(1-\alpha)} K_t^{\alpha}$, $0 < \alpha < 1$, where A_t is the technology level, K_t is the predetermined capital stock and N_t is the population number. The capital stock evolves according to $K_{t+1} = I_t + (1-\delta)K_t$, where $0 < \delta < 1$, K_0 is given, and I_t is investment. A_t and N_t evolve according to $A_t = A_{t-1}\gamma_a$, and $N_t = N_{t-1}\gamma_n$ where the value of A_0 and N_0 are given and $\gamma_a \geq 1$ and $\gamma_n \geq 1$ are the growth rate of technology and population respectively. The resource constraint is $Y_t = C_t + I_t$ where C_t is consumption in period t. Suppose the economic agent saves s fraction of their production each period. Therefore $I_t = sY_t$

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(a) (6pt) Define the capital stock per effective unit of labor, $k_t = \frac{K_t}{A_t N_t}$ and derive a non-linear difference equation in a single state variable,

$$\gamma_a \gamma_n k_{t+1} = s k_t^{\alpha} + (1-\delta) k_t$$

(b) (6pt) Solve for the steady state level of capital per effective worker, $\frac{K_t}{A_t N_t}$, output per effective worker, $\frac{Y_t}{A_t N_t}$, and saving per effective worker, $\frac{S_t}{A_t N_t}$.

(c) (6pt) What are the growth rates of output, Y, consumption, C, and investment, I respectively?

(d) (6pt) Use a diagram to determine the steady state quantity of capital per effective worker.

(e) (6pt) Suppose that the economy is initially in a steady state and that some of the national's capital stock is destroyed because of a natural disaster. Will the economy converge back to the same steady state? Use a diagram to show the dynamic adjustment of capital per worker over time.

4. Consider a static economy where a household lives only for one period. The representative household chooses between consumption, c, and leisure, l to maximize his or her utility. Suppose that the household has h hours of time that he can choose between working, n, and leisure, l, i.e., $h = l + n$. The household receive wage income wn, which is denoted as units of consumption goods, for his labor service. In addition, the preference of the household can be expressed as $U(c,l) = \log c + \theta \frac{l^2}{2}$, where θ is parameter determine the relative weight from utility of leisure. So, we can restate the household's optimization problem as

$$\max_{c,l} \log c + \theta \frac{l^2}{2}$$
$$\text{subject to}$$
$$c = w(h-l)$$
$$c \geq 0$$
$$h \geq l \geq 0.$$

(a) (6pt) Draw the household's budget constraint and show his or her optimal choice of consumption and leisure. Please provide the economic interpretation for the figure.

(b) (6pt) Please solve for the optimal choice of leisure, l. In particular, express l as a function of real wage, w, the parameter θ and the time endowment, h.

(c) (8pt) Suppose that a household can earn a higher wage rate for working overtime. That is, for the first q hours the household works, he or she can receive a real wage rate of w_1, and hours worked more than q, he or she can receive w_2, where$w_2 > w_1$. Draw the new budget constraints and show the optimal choice for a household. Explain the intuition why a household would never work q hours or anything very close to q hours.