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**Part A: Answer any two of the three following questions.**


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**A1. Fiscal Austerity**

Faced with rising debt-GDP ratios, governments in the U.S. and Europe are currently in the process of implementing austerity measures that include a combination of spending cuts and tax increases. Your task is to analyze the effects of these austerity measures (*ceteris paribus*) on the macro economy in the short run (i.e., when wages and prices are sticky). Consider the following scenarios.

1. *Closed Economy*: Assume the economy is described by an IS-LM model with static inflationary expectations ( $\pi^e = d\pi^e = 0$ ). Note that real money demand depends on real disposable income ( $Y-T$ ). The capital stock and technology are fixed.

$$\text{IS: } Y = E(Y-T, r, G) \quad \text{where } r=R, 0 < E_{Y-T} < 1, E_r < 0, E_G = 1$$

$$\text{LM: } M/P = L(Y-T, R) \quad \text{where } L_{Y-T} > 0, L_R < 0$$

The variables are:  $Y$  = real output/income,  $E$  = aggregate expenditures,  $T$  = taxes,  $r$  = real interest rate,  $R$  = nominal interest rate,  $G$  = government purchases,  $M$  = nominal money supply,  $P$  = (fixed) price level, and  $L$  = real money demand.

- Explain verbally and show graphically how and why the closed economy responds to the combination of spending cuts and tax increases in the short run.
- Calculate and sign the relevant derivatives.
- Explain how your answer changes if money demand depends on real income ( $Y$ ) rather than real disposable income ( $Y-T$ ).

2. *Small Open Economy*: Assume the economy is described by a standard Mundell-Fleming model with static inflationary expectations ( $\pi^e = d\pi^e = 0$ ) and static exchange rate expectations ( $de^e = 0$ ).

Explain verbally and show graphically how and why the small open economy responds in the short run to the combination of spending cuts and tax increases for the case of:

- fixed exchange rates.
- flexible exchange rates.

Be sure to discuss the role of capital mobility in each case.

## A2. Growth

1. Consider the following Solow model with Hicks-neutral technology.

$$(1) Y = AK^aL^{1-a} \quad \text{where } A > 0, 0 < a < 1 \quad \text{(production function)}$$

$$(2) dL/dt = nL \quad \text{where } n > 0 \quad \text{(labor accumulation)}$$

$$(3) dK/dt = sY - \delta K \quad \text{where } 0 < s < 1, 0 < \delta < 1 \quad \text{(capital accumulation)}$$

The variables are:  $Y$  = total output,  $A$  = technology,  $K$  = capital stock,  $L$  = labor,  $n$  = population growth rate,  $s$  = saving rate, and  $\delta$  = depreciation rate of physical capital.

- a. Assume that technology is constant at some level  $A_0$ . Calculate the steady-state value of capital per worker ( $y = Y/L$ ). What are the growth rates of total output and output per worker on the balanced growth path? Explain.
- b. Now suppose that technology increases to  $A_1 > A_0$  due to a one-time technology transfer from abroad. Explain verbally and illustrate graphically how the economy is affected by this change during the transition period and in the long run.

2. Consider the following R&D growth model where labor is constant and equal to one ( $L = 1$ ) and knowledge accumulation occurs as a side effect of goods production.

$$(1) Y = K^a(AL)^{1-a} \quad \text{where } L = 1, 0 < a < 1 \quad \text{(production function)}$$

$$(2) dK/dt = sY \quad \text{where } 0 < s < 1 \quad \text{(capital accumulation)}$$

$$(3) dA/dt = BY \quad \text{where } B > 0 \quad \text{(knowledge accumulation)}$$

- a. Find expressions for the growth rate of capital,  $g_K = (dK/dt)/K$ , and the growth rate of knowledge,  $g_A = (dA/dt)/A$ , in terms of  $A$ ,  $K$ , and the model parameters. Graph the two equilibrium loci ( $dg_K/dt = 0$  and  $dg_A/dt = 0$ ) in  $(g_A, g_K)$  space.
- b. Explain how a permanent drop in the saving rate affects long-run output growth in this economy.

### **A3. Statements**

Select any four (4) of the following statements and explain carefully why each is either true, false, or uncertain. You must use graphical and/or mathematical analysis to support your arguments. Your score depends on the quality and completeness of your explanations.

1. In the basic Solow growth model, labor-augmenting technological progress increases both the capital-labor ratio and the growth rate of output per worker in steady state.
2. In the classical model, money is always neutral and superneutral.
3. Given rational expectations, systematic policy will not have any output effects in the short run while discretionary policy may actually destabilize the economy.
4. In a stochastic IS-LM world, it doesn't matter whether the central bank targets the money supply or the interest rate to stabilize the economy in the face of shocks that hit the goods or money markets.
5. According to the basic Barro-Gordon model, the time-consistent equilibrium inflation rate will fall if monetary policy is delegated to an independent and conservative central banker.

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**Part B: Answer both of the following two questions.**

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**B1. Ramsey-Cass-Koopmans Growth Model**

Consider the Ramsey model of an economy in competitive equilibrium. There is a representative household and a representative firm. Assume there is no population growth ( $n = 0$ ), and capital depreciates at the rate  $\delta > 0$ . The household's utility function is

$$\lim_{\theta \rightarrow 1} \int_0^{\infty} \frac{c_t^{1-\theta} - 1}{1-\theta} e^{-\rho t} dt,$$

and the firm has a constant-returns-to-scale production function  $Y_t = \phi K_t^\alpha L_t^{1-\alpha}$ , where  $\phi$  is a constant.

- a) Write down representative household's maximization problem and derive the 4 equations that characterize the solution.
- b) Write down firm's maximization problem and the first-order conditions for this problem. Translate these conditions into intensive form.
- c) What are the equilibrium conditions for this economy?
- d) Combine your answers to parts (a) - (c) and derive a pair of differential equations for the variables  $c$  and  $k$ .
- e) Carefully draw the phase diagram, labelling the steady states on the graph and finding them algebraically (careful).
- f) Do the following comparative dynamics exercise:  $\phi' < \phi$ . As usual, the baseline economy starts in its steady state at time  $t = 0$ . The modified economy starts at time  $t = 0$  with the same amount of capital as the baseline economy. Draw (i) the phase diagram for both cases, indicating what is different, and (ii) the time paths of  $c$  and  $k$  for both cases. Assume that the substitution effect dominates the income effect.
- g) What would happen if instead of  $\phi$  being constant, we had  $\phi_t$ , with  $\dot{\phi}_t/\phi_t = g$  and  $g > 0$  constant?

## B2. Financial Intermediation

Consider the Diamond-Dybvig model with two assets. There are three periods:  $t = 0, 1, 2$ . Agents are ex-ante identical. They are endowed with one unit of a single good at  $t = 0$ , and nothing at  $t = 1, 2$ . At the beginning of  $t = 1$ , a fraction  $\pi$  of agents learn that they prefer to consume only at  $t = 1$ , while the remaining fraction  $(1 - \pi)$  of agents prefers to consume only at  $t = 2$ . There is a linear production technology whereby one unit of the good invested in period 0 yields  $R > 1$  units of the good at time 2. This technology is illiquid, in the sense that an investment that is interrupted in period 1 generates  $r < 1$  units of consumption. In addition, there is a liquid storage technology, whose return is equal to 1 in both periods. Agents preferences are given by

$$u(c) = \ln c$$

- a) Write down the problem of an agent in autarky.
- b) Now suppose that in period 1, after agents learn their idiosyncratic consumption preference shock, a financial market opens where agents can trade claims for the returns on the illiquid production technology. Write down the problem of an agent in this setting. What will the equilibrium price of a bond be in this case? What is the consumption vector? Discuss.
- c) Now, instead of a financial market, suppose agents form coalitions, which they call banks, and pool their resources. Write down the problem of the bank, the FOC, and the optimal consumption vector. Can multiple equilibria arise in this setting?
- d) Compare and contrast the autarky, market and banking environments. Discuss.