UNIVERSITY OF CALIFORNIA
DEPARTMENT OF ECONOMICS

Economics 202A
Fall 2014
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MIDTERM EXAM

The exam consists of two parts. There are 80 points total. Part I has 18 points and Part II has 62 points.

The exam is designed to take 80 minutes, but you have 90.

Some parts of the exam are harder than others. If you get stuck on one part, do the best you can without spending too much time, and then work on other parts of the exam.

PART I. Multiple choice (18 points)

In your blue book, give the best answer to 6 of the following 7 questions. Note:

– If you wish, you may add a BRIEF explanation of your answer to AT MOST ONE question. In that case, your grade on that question will be based on your answer and explanation together. This means that an explanation can either raise or lower a grade.

– If you answer all 7 questions, your overall score will be based on your average, not on your 6 best scores.

1. Consider two countries, 1 and 2, that are described by the Solow model. Both countries are on their balanced growth paths, and the only difference between them is that $s_2 > s_1$. Then:

A. Output, consumption, and investment are all higher in country 2.

B. Output is higher in country 2, but consumption and investment can both be either higher, lower, or the same as in country 1.

C. Output and investment are higher in country 2, but consumption can be either higher, lower, or the same as in country 1.

D. Investment is higher in country 2, but output and consumption can both be either higher, lower, or the same as in country 1.

2. Consider an infinitely-lived household maximizing the utility function $\int_{t=0}^{\infty} e^{-\rho t} U(C(t)) dt$ subject to the usual intertemporal budget constraint. Let r(t) denote the real interest rate at t and let $R(t) \equiv \int_{\tau=0}^{t} r(\tau) d\tau$. Then the Euler equation relating consumption at two dates, A and B (B > A) is:

A. $\frac{\dot{C}(A)}{C(A)} = \frac{[r(t)-\rho]}{\theta}$.

B. $\frac{\dot{C}(A)}{C(A)} = \frac{\dot{C}(B)}{C(B)}$.

C. $U'(C(A)) = \left[\frac{e^{R(B)-R(A)}}{e^{\rho(B-A)}}\right] U'(C(B))$.

D. $U'(C(A)) = \left[\frac{[r(B)-r(A)]}{[\rho(B-A)]}\right] U'(C(B))$.

3. In a Diamond economy with logarithmic utility, $U_t = \ln C_{1t} + [\ln C_{2,t+1} / (1+\rho)]$, and Cobb-Douglas production, $Y_t = K_t^{\alpha} (A_t L_t)^{1-\alpha}$, a rise in individuals' discount rate, ρ:

A. Shifts the locus showing k_{t+1} as a function of k_t down.

B. Shifts the locus showing k_{t+1} as a function of k_t up.

C. Does not affect the locus showing k_{t+1} as a function of k_t.

D. Has an ambiguous effect on the locus showing k_{t+1} as a function of k_t.

4. Consider an economy described by: $\dot{B}(t) = bB(t)$, $\dot{D}(t) = d[cB(t)]^{\omega}D(t)^{\mu}$, $J(t) = [(1-c)B(t)]D(t)$, with $b > 0$, $d > 0$, $0 < c < 1$, $\omega > 0$, $B(0) > 0$, and $D(0) > 0$. This economy will converge to a balanced growth path if and only if:

A. $\mu < 1$.

B. $\mu \leq 1$.

C. $\omega < 1$.

D. $\omega \leq 1$.

5. In the P. Romer model of endogenous technological change, the condition for equilibrium in the allocation of workers between R&D and goods production at time *t* is:

A. The wages in the two sectors at time *t* are equal.

B. The present value of the revenues from an idea created at time *t* equals the wage in the goods-producing sector at time *t*.

C. The marginal product of an idea in creating new ideas equals its marginal product in goods production.

D. The price of using an idea equals $\eta/(\eta - 1)$ times the cost of producing the idea, where η is the elasticity of demand for the input using a given idea.

6. One of the empirical issues that Jones addresses in "Time-Series Tests of Endogenous Growth Models" is:

A. Whether population growth is stationary or nonstationary.

B. Whether the growth rate of income per capita is higher in countries with larger populations.

C. The horizon over which investment affects growth.

D. The correlation between the number of scientists and engineers and the saving rate.

7. The "accounting" approach to decomposing cross-country income differences described in Section 4.2 of Romer, *Advanced* Macroeconomics, <u>fails</u> to assign to human capital:

A. Differences in income stemming from differences in the quality of schooling.

B. Any impact of human capital on income that operates through externalities.

C. The fact that when human capital raises income, if the saving rate does not change then the quantity of saving rises, thereby raising the stock of physical capital.

D. (A) and (B).

E. (A) and (C).

F. (B) and (C).

G. (A), (B), and (C).

H. None of the above.

PART II. Problems (62 points)

DO ALL 3 PROBLEMS.

(21 points) 8. Consider the Solow model without technological progress. Suppose that, in contrast to the usual assumption in the model, population growth is higher when output per worker is higher. Specifically, assume that $n = n(y)$, with $n'(\bullet) > 0$, where y is output per worker. Assume that $n(y) + \delta > 0$ for all y.

a. Describe how, if at all, this change affects our usual diagram for the Solow model – that is, the diagram showing actual investment per worker and break-even investment per worker as functions of capital per worker.

b. Suppose the economy is on a balanced growth path. Let n^* denote the rate of population growth on this balanced growth path. Now suppose there is a permanent increase in the saving rate.

i. Does this change permanently affect the growth rate of output per worker? Why or why not? Does it permanently affect the growth rate of total output? Why or why not?

ii. Is the long-run effect of the increase in the saving rate on output per worker bigger, smaller, or the same as it would be if population growth stayed constant at n^*? Explain your answer.

c. Derive an expression for the elasticity of the balanced-growth-path value of output per worker, y^*, with respect to the saving rate, s.

(EXAM CONTINUES ON NEXT PAGE)

(21 points) 9. Consider the planner's problem in the Ramsey model, with one change: the discount rate of the representative household is not constant. Specifically, the household's lifetime utility is given by:

$$\int_{t=0}^{\infty} e^{-D(t)} u(C(t))dt, \quad u'(\bullet) > 0, \quad u''(\bullet) < 0,$$

where $D(t) \equiv \int_{\tau=0}^{t} \rho(\tau)d\tau$.

For simplicity, assume that population growth and technological progress are both zero, and normalize the number of households to 1. As usual in the Ramsey model, the economy has an initial capital stock of $K(0) > 0$, K evolves according to $\dot{K}(t) = Y(t) - C(t)$, and $Y(t) = F\big(K(t), L(t)\big)$, where $F(\bullet)$ has the usual properties.

This problem asks you to use optimal control to derive the Euler equation for consumption. Specifically:

a. Set up the Hamiltonian.

b. Find the conditions for optimality.

c. Use your results to find an expression for $\dot{C}(t)/C(t)$.

(Hint: Consider the special case of $\rho(t) = \bar{\rho}$ for all t. If your answer to (C) doesn't simplify to our usual expression for $\dot{C}(t)/C(t)$, this suggests that you've gone astray somewhere. If you have, you might want to redo (a) and (b) using the present-value Hamiltonian rather than the current-value Hamiltonian – it may be easier to see how to proceed with that approach.)

(20 points) 10. Consider a Ramsey-Cass-Koopmans economy where capital income is taxed at rate $\bar{\tau}$, $0 < \bar{\tau} < 1$. Thus the after-tax real interest rate households face at time t is $(1 - \bar{\tau})f'(k(t))$, and so the equation of motion for c is $\dot{c}(t)/c(t) = [(1 - \bar{\tau})f'\big(k(t)\big) - \rho - \theta g]/\theta$. The government makes no purchases, but instead rebates the tax revenues to households in a lump-sum manner. Thus the equation of motion for k is $\dot{k}(t) = y(t) - c(t) - (n + g)k(t)$. Let $\bar{c}^*$ and $\bar{k}^*$ denote the balanced-growth-path values of c and k in this economy.

Now suppose the government switches to a policy where the tax rate on capital income depends on c: $\tau(t) = \tau(c(t))$, with $\tau'(c) > 0$, $0 < \tau(c) < 1$ for all c, and $\tau(\bar{c}^*) = \bar{\tau}$. The τ a household faces is determined by the economy-wide value of c, not by the household's own value of c. As before, the tax revenues are rebated to households in a lump-sum manner.

a. How, if at all, does this change affect the $\dot{c} = 0$ locus? Explain.

b. How, if at all, does this change affect the $\dot{k} = 0$ locus? Explain.