HARVARD UNIVERSITY
DEPARTMENT OF ECONOMICS

General Examination in Macroeconomic Theory

Fall 2010

PLEASE USE A SEPARATE BLUE BOOK FOR EACH PART AND WRITE THE QUESTION NUMBER ON THE FRONT OF THE BLUE BOOK.

PLEASE PUT YOUR EXAM NUMBER ON EACH BOOK.

PLEASE DO NOT WRITE YOUR NAME ON YOUR BLUE BOOKS.

For those taking the **GENERAL EXAM** in macroeconomic theory:

1. You have **FOUR** hours.

2. Answer **ALL QUESTIONS** in Parts I, II, III, IV, and V.

3. Time allotted for each part:
   - I. 48 minutes
   - II. 48 minutes
   - III. 48 minutes
   - IV. 48 minutes
   - V. 48 minutes

Fall Macro General

August 2010

Part I (48 minutes) True/False/Uncertain. Explain your answer. Explanation determines grade.

1. An optimizing agent should choose a consumption level that is proportional to the expectation of the net present value of her income stream.

2. Assume that a firm pays a *discrete* cost whenever it adjusts its capital stock, but pays no *variable* cost when it adjusts its capital stock. If the firm is making a capital adjustment, it will jump to the unique capital level that maximizes flow earnings, regardless of whether the firm is adjusting the capital stock up or down.

3. As long as an agent is not liquidity constrained, the perturbation argument implies that the marginal utility of a dollar of current consumption should equal the discounted marginal utility of a dollar of savings. In other words,

$$u'(c_t) = E_t \delta R u'(c_{t+1}).$$

4. If agents have constant relative risk aversion, the Euler Equation implies that predictable changes in log income should not predict changes in log consumption. More generally, $\ln(c_t)$ should be a random walk.

5. Assume that $x(0) = 1$ and x follows geometric Brownian motion, such that

$$dx = \mu x dt + \sigma x dz,$$

where $\mu < 0$. Then $x(t)$ is unbounded below.

6. Suppose that a firm faces a price, p, that is given by Brownian motion with negative drift. Suppose that the firm has variable cost, $c > 0$. The firm needs to decide when to shut down, which is an irreversible decision. The firm follows a stopping rule, choosing to shut down when $p \le p^*$. Optimal choice of the stopping threshold implies that

$$0 < p^* \le c.$$

Barro question (48 minutes)

Consider the neoclassical growth model, discussed, for example, in Barro & Sala-i-Martin, *Economic Growth*, Ch. 2. Households maximize utility, U, over an infinite horizon, using a constant rate of time preference, ρ. Each period's utility, $u(c)$, is iso-elastic with curvature parameter θ; that is, marginal utility is $c^{-\theta}$ (c is consumption per person). The real interest rate is r.

1. What is the key first-order condition for maximizing utility in this model? Explain briefly where this condition comes from. How does the parameter θ enter into this condition?

2. What is the coefficient of relative risk aversion in this model? How does this parameter enter into the analysis? What problems might arise in this context?

Suppose now that the growth rate of population and the labor force is n. **Assume that the rate of technological progress is zero.** Suppose that the economy starts with capital per worker, k, equal to $k(0)$, which is less than the steady-state value, k^*. Capital depreciates at the rate δ. The production function is $y=A\cdot f(k)$, where y is output per worker, A is a positive constant, and $f(\cdot)$ satisfies the usual neoclassical properties.

3. What condition relates k to r?

4. Write down the two dynamic equations for c and k. Briefly sketch where these two equations come from.

5. Show the phase diagram—involving pairs of (k, c) that generate $\dot{c} = 0$ and $\dot{k} = 0$. Sketch briefly where these curves come from. Use the phase diagram to discuss the steady-state values, k^* and c^*. Use the diagram to discuss the dynamic path of (k, c). Why do k and c approach k^* and c^*, respectively, over time? That is, how do you rule out dynamic paths that lead asymptotically away from the steady-state position? What is the growth rate of k, c, and y in the steady state?

6. How would you modify the model to generate growth in y in the long run?

Answer all the following questions. Some are True/False/Uncertain and are explicitly denoted as such. The others are direct questions. Explain and detail your answers VERY carefully. The QUALITY of your explanation determines your grade.

1. Explain how the impulse responses for consumption and labor in the RBC model change when the persistence of the productivity shock increases. How is the amount of amplification of productivity fluctuations on output affected?

2. Explain what the employment-lottery model is, how to think about it, and its implications for the RBC model.

3. Explain what happens when the RBC model is extended to incorporate endogenous capital utilization.

4. The (log-linearized) New Keynesian model can be summarized by three equations. A Philips curve, a dynamic IS equation, and a policy rule (say a Taylor rule). Write down these equations and explain how they can be derived.

5. True/False/Uncertain (for each of the following three statements). In the New-Keynesian model, real interest rates are counter-cyclical when monetary policy shocks are driving fluctuations. In the RBC model, real interest rates are pro-cyclical when productivity shocks are driving fluctuations. In both cases, real wages are pro-cyclical. All these properties are consistent with the data.

6. Consider a Taylor rule of the form $i_t = \rho + \phi_\pi \pi_t$. What does local determinacy mean? What conditions on the parameters (ρ, ϕ_π) of the Taylor rule guarantee local determinacy? Consider alternatively a money supply rule $M_t = \bar{M}$ (where M_t is nominal money supply and $\bar{M}$ is a constant) yield local determinacy?

7. Consider a Taylor rule of the form $i_t = \rho + \phi_\pi \pi_t$. Assume that the Taylor rule yields local determinacy. Suppose that the economy is initially in steady state. What happens to inflation and interest rates in the short run and in the long run when the coefficient ρ is increased to $\rho' > \rho$? What happens to output in the short run and in the long run?

8. Consider the New-Keynesian model and imagine that the natural interest rate is negative today. There is a zero lower bound on nominal interest rates because agents can substitute away from bonds and into cash. Consider a Taylor rule that delivers the flexible price outcome with zero inflation $i_t = \phi_\pi \pi_t + \phi_y y_t$. How can this rule be improved upon when the zero bound is binding?

Question for fall 2010 macro theory generals

Despite the continuing large gap between actual and full-employment output in the United States, together with near-zero price inflation over most of the past two years, concerns over the possibility of a return to rapid inflation continue to play a major role in the ongoing debate over the stance of U.S. monetary policy.

Assume that an economy's central bank has policy objectives with respect to both price inflation and real economic activity (as, for example, the U.S. Federal Reserve System is charged by law to do.) Assume also that both households and firms are forward-looking in their economic behavior. How does the slope of the economy's short-run Phillips curve – that is, the relationship between this period's inflation and this period's output – influence the optimal response of monetary policy to (a) aggregate demand shocks and (b) aggregate supply shocks? In each case explain why, for an observed shock of given type and given magnitude, the optimal monetary policy response is stronger or weaker, or is invariant, depending on whether the short-run Phillips curve is flatter or steeper.

Be as explicit as you can about the economic reasoning that is the basis for your answer. Also be specific about how you are measuring the strength of the monetary policy response to these shocks, and how you are defining the flatness/steepness of the Phillips curve.

Economics 2010d: International Macro
Fall 2010: Kenneth Rogoff
(All Parts Worth Equal Credit)

Part I. Consider a stochastic two-country world, two-period endowment economy, in which agents in the home country have utility function

$$U = \left(\frac{C_1^{1-\rho}}{1-\rho}\right) + E\left(\frac{\beta C_2^{1-\rho}}{1-\rho}\right).$$

Agents in the foreign country have an identical utility function. Home income in the first period is given by Y, and in the second period by $Y(s)$, where s is the state of nature. Agents abroad receive income stream Y^* and $Y^*(s)$.

(a) Assuming that there are complete state contingent markets in this global economy, show analytically in what sense consumption risk is shared. It is sufficient to show your result in terms of relating consumption growth rates across countries.

(b) Now suppose that home utility is given by

$$U = \left(\frac{C_1^{1-\rho}}{1-\rho}\right) + E\left(\frac{\beta C_2^{1-\rho}}{1-\rho}\right)$$

and foreign utility by

$$U = \left(\frac{(C_1^*)^{1-\rho^*}}{1-\rho^*}\right) + E\left(\frac{\beta (C_2^*)^{1-\rho^*}}{1-\rho^*}\right)$$

where $\rho \neq \rho^*$. What relationship does this model predict between the $\log(C_2/C_1)$ and $\log(C_2^*/C_1^*)$?

(c) Now assume $\rho = \rho^*$; suppose that agents can trade only risk-free bonds paying fixed interest rate r (where the interest rate is determined endogenously in global equilibrium). Taking r as given, characterize how home first-period consumption C_1 is related to expected home second-period consumption EC_2.

Part II. *Speculative attacks on the exchange rate.* Suppose that the demand for money in a small open economy is characterized by

$$\mathsf{m}_t - \mathsf{e}_t = -\eta \mathsf{r}_t, \tag{1}$$

where m is the log of the money supply, e is the log of the exchange rate, and r is the nominal interest rate. We will assume that home and foreign bonds must pay the same interest rate (when returns are converted to a common currency) so that

$$r_t = r^* + \dot{\mathsf{e}}_t,$$

where $\dot{\mathsf{e}}_t \equiv \mathrm{d}\mathsf{e}_t/\mathrm{d}t$ is the expected rate of change of the exchange rate. Also r^* is the foreign interest rate, which we set equal to zero ($r_t = \dot{\mathsf{e}}_t$).

A simplified version of the central bank's balance sheet (in levels not logs) is

$$M_t = B_{H,t} + \overline{\mathcal{E}} B_{F,t}, \tag{2}$$

where B_H denotes the central bank's holdings of domestic-currency bonds, and B_F denotes its holdings of foreign-currency bonds.

Assume that the central bank is required by the central government to purchase domestic bonds at a rate given by

$$\frac{\dot{B}_H}{B_H} = \dot{\mathsf{b}}_H = \mu, \tag{3}$$

where $\mathsf{b}_\mathrm{H} \equiv \log B_H$, for as long as $B_{F,t} > 0$.

(a) Suppose that the central bank aims to keep the exchange rate fixed as long as it has adequate reserves. What does that imply about the path of the money supply? If the central bank is fixing the exchange rate, does it have any discretion over the interest rate?

(b) Denote the "shadow exchange rate" $\tilde{\mathsf{e}}_t$ by

$$\tilde{\mathsf{e}}_t = \mathsf{b}_{H,t} + \eta\mu. \tag{4}$$

Draw a graph with time on the horizontal axis, giving the shadow exchange rate and the fixed exchange rate. Briefly explain why a collapse must occur on date T when $\tilde{\mathsf{e}}_T = \bar{\mathsf{e}}$. Why can't a speculative attack occur before this time?

(c) Plot the log of the money supply m_t and the central bank's holdings of foreign reserves $B_{F,t}$ against time. Explain what happens to the money supply at date T when the speculative attack occurs.

(d) In practice, interest differentials—both short and medium term—seldom help predict speculative exchange rate attacks more than a month or two prior to the event. Why is this a problem for the kind of model you analyzed in part (**a**) above? Why is it a problem that, for most countries that have experienced speculative attacks, foreign reserves (e.g. dollars, US Treasury bills, gold) typically exceed the value of the country's currency supply, even at the pre-crisis exchange rate?

(e) Suppose now that $\mu < 0$. That is, the government is running surpluses instead of deficits. Suppose the central bank has no way of issuing its own debt, so it must rely on its initial holdings of $B_{H,0}$ to fund its foreign exchange purchases. Is this policy sustainable, will there be any kind of speculative attack?

Part III.

(a) The United States has almost continually run large trade and current account balance deficits during the past 18 years. What explanations suggest that

this might be a relatively benign equilibrium phenomenon that will work its way gradually out of the system? More generally, why might capital flow from poor to rich countries?

(b) Briefly explain why a small country might be willing to repay its debt to maintain a reputation for repayment. If creditors have no legal rights and a country in default on its own debt can still hold assets abroad, why might this weaken reputation as an incentive for repayment?

(c) Friedman and Schwartz blame the tight monetary policy in the United States in the late 1920s for the depth and duration of the Great Depression. Why is this explanation inadequate especially for understanding why the Great Depression lasted so long? Why might the gold standard have helped propagate the Great Depression internationally?