HARVARD UNIVERSITY
DEPARTMENT OF ECONOMICS

General Examination in Macroeconomic Theory

FALL 2012

You have **FOUR** hours. Answer all questions

PLEASE USE A SEPARATE BLUE BOOK FOR EACH QUESTION 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.

Barro questions (7.5 minutes each, total of 60 minutes)

True-False-Uncertain

Are the following statements true, false, or uncertain? Explain briefly, but your explanation determines your grade.

1. In the neoclassical growth model, the transversality condition implies that the government cannot expand the stock of public debt forever.

2. In panel data for the growth rate of real per capita GDP for around 100 countries since the 1960s, the regression coefficient on the lagged log of real per capita GDP is close to zero. This result conflicts with the neoclassical growth model's prediction of convergence.

3. For 25 countries with data since 1870, the cross-sectional standard deviation of the log of real per capita GDP shows little change through 2009. This result conflicts with the neoclassical growth model's prediction of convergence.

4. In the Blanchard-Weil "finite-horizons" model, Ricardian Equivalence for public debt does not hold.

5. The large increase in the ratio of U.S. public debt to GDP during the 1980s conflicts with the predictions of the tax-smoothing model.

6. If production satisfies constant returns with respect to physical and human capital, real per capita GDP can grow forever at a positive rate without technological progress.

7. In the varieties model of endogenous technological progress, heightened competition in the supply of intermediate inputs raises the growth rate.

8. If the disaster probability rises, the risk-free real rate of return falls and may become negative.

1 Short Questions

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. TRUE/FALSE/UNCERTAIN. In the neoclassical growth model with endogenous labor, a temporary increase in government expenditures leads to a temporary increase in output, labor and investment.

2. Explain what the the employment-lottery model is. Can this model generate an aggregate elasticity of labor supply which is larger than the individual elasticity of labor supply?

3. Consider the RBC model with money in the utility function. Imagine 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? How would your answer change for the New Keynesian model?

4. Consider the RBC model with money in the utility function (and assume as in class that money enters the utility function separably from consumption and leisure). Consider a Taylor rule of the form $i_t = \rho + \phi_\pi \pi_t$. Assume that $\phi_\pi > 1$ so that the Taylor rule yields local determinacy. Suppose that the economy is initially in steady state. What happens to real money balances, the path of the money supply, inflation and interest rates when the coefficient ρ is increased to $\rho' > \rho$?

5. According to the Ricardian-Equivalence hypothesis, the purchase by the government of long-term government bonds financed by selling short term government bonds reduces long term real interest rates and raises short term real interest rates.

2 Problem #1

Consider the New-Keynesian model and let $\bar{r}_t$ be the natural interest rate.

1. Write down the two key equations for the linearized model and define the variables and parameters.

2. Imagine first that $\bar{r}_t \geq 0$ for all $t \geq 0$. Explain why optimal monetary policy can be described as a Taylor rule of the form $i_t = \bar{r}_t + \phi_\pi \pi_t$ with $\phi_\pi > 1$?

3. Imagine now that the natural interest rate $\bar{r}_0 < 0$ is negative, but $\bar{r}_t > 0$ for $t = 1, 2, \ldots$ There is a zero lower bound on nominal interest rates $i_t \geq 0$ because agents can substitute away from bonds and into cash. Show that if the central bank follows the optimal Taylor rule for $t \geq 1$ and sets $i_t = 0$ then $x_0 < 0$ and $\pi_0 < 0$.

4. Suppose the central bank deviates from the previous policy at $t = 1$ (but does exactly as before in all other periods) in an effort to ensure that $x_0 = 0$. Derive the four equations determining π_0, π_1, x_1 and i_1.

5. Assume the solution to the previous four equations has $i_1 > 0$. Show that $\pi_1, \pi_0, x_1 > 0$ and that $i_1 < r_1$.

3 Problem #2

Consider an economy consisting of n firms indexed by j, producing goods that are imperfect substitutes. The representative household is characterized by the following utility function :

$$U = C^{\gamma}[\frac{M}{P}]^{1-\gamma} - \xi H,$$

where H denotes labor and P the price index. C denotes aggregate consumption which is equal to:

$$C = n^{\frac{1}{1-\theta}}\{\sum_{j=1}^{n} C_j^{\frac{\theta-1}{\theta}}\}^{\frac{\theta}{\theta-1}}.$$

Denote $R = PwH + \Pi + \overline{M}$ the household nominal income, where Π denotes profits, fully hold by households, w the real wage and $\overline{M}$ the initial money endowment (assumed equal to M at the equilibrium). At the equilibrium, $C_j = Y_j$ and $H = \sum_{j=1}^{n} H_j$.

1. Solve the following consumer's program in order to derive the demand for good j (denoted C_j) and the price index P:

$$\begin{aligned} Max_{C_j} \qquad & n^{\frac{1}{1-\theta}}\{\sum_{j=1}^{n} C_j^{\frac{\theta-1}{\theta}}\}^{\frac{\theta}{\theta-1}} \\ \text{subject to } PC \quad = \quad & \sum_{j=1}^{n} P_j C_j, \end{aligned}$$

   where P_j denotes the price of good j.

2. Derive the demand equations for C and M.

3. Find the real wage w as a function of ξ and γ.

4. Suppose firms use technology $Y_j = AH_j^{\alpha}$ with $0 < \alpha \leq 1$. Derive the optimal price policy of firm j. Assume $\alpha < 1$.

5. Is there money neutrality in this model? Explain how the presence of menu costs for changing prices affects that conclusion.

6. Consider the following experiment in the case where there are menu costs: starting from the flexible price equilibrium, the money supply M is increased. Can there be multiple equilibria? Explain.

Part V 60 Minutes

Please answer all three EQUALLY WEIGHTED questions in this section.

1. (Liquidity traps) Consider a closed cash-in-advance economy in which there is no investment and the representative agent has exogenous income stream Y_t and has utility given by

$$U = \sum_{s=t}^{\infty} \beta^{s-t} u(C_s), \tag{1}$$

where $u(C_s) = log(C_s)$. The transaction technology in this economy is governed by the cash-in-advance constraint,

$$P_t C_t \leq M_t, \tag{2}$$

where P_t is the aggregate price level and M_t is the money supply. We will assume, for the moment, that prices are flexible.

Since the only two sources of final demand are consumer demand, C_t, and government spending, G_t, goods market clearing requires that

$$Y_t = C_t + G_t. \tag{3}$$

Government spending does not enter private utility and, importantly, does not require cash in advance. The Euler equation derived from the representative agent's utility maximization problem is

$$u'(C_t) = \beta(1 + r_{t+1}) u'(C_{t+1}), \tag{4}$$

where r_{t+1} is the interest rate on real bonds between period t and period $t+1$.

(a) Write the equation that relatates the nominal interest rate i_{t+1} (on a one period bond that pays off a non-indexed cash amount in period $t+1$) in terms of Y_t, G_t, P_t, Y_{t+1}, G_{t+1}, P_{t+1},

(b) Assume for this part that prices are flexible, and that G and M, are permanently fixed, and that income $Y_s = \overline{Y}$ is constant $\forall s > t$. but intitial

income $Y_t <. \overline{Y}$ Under what conditions can the economy be in a liquidty trap where $i_{t+1} = 0$?

(c) Assuming the economy is in a liquidity trap (from the assumptions of part (b)). Holding the future profile of government spending constant, what fiscal policy is required to create inflation between period t and period $t+1$? Is it also possible to create inflation holding G_t fixed but through changes in the future trajectory of G_s (for $s > t$).

(d) Until now, we have taken future monetary policy as given. What if the central bank announces an inflation target (say 3%), and that it will adjust FUTURE money growth to achieve its inflation target. Assume that it does this only by printing money and buying government debt. Can this work?

(e) Explain why credibility on future policy is at the heart of escaping from a liquidity trap. Briefly, why might this be difficult in practice?

2 Speculative attacks on exchange rates

Suppose that the demand for money in a small open economy is characterized by

$$\mathsf{m}_t - \mathsf{e}_t = -\eta \dot{\mathsf{e}}_t + y_t \tag{5}$$

where m is the log of the money supply, e is the log of the exchange rate defined as H/F (i.e. an increase of e implies depreciation of the currency), y_t is the log of output (assumed to follow some known exogenous process), and $\dot{\mathsf{e}}_t \equiv \mathrm{d}\mathsf{e}_t/\mathrm{d}t$.is the expected rate of change of the exchange rate. As long as the (log) exchange rate is fixed at $\bar{\mathsf{e}}$, the (log) money supply must be set at

$$\mathsf{m}_t = \bar{\mathsf{e}} + y_t \tag{6}$$

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

$$M_t = B_{H,t} + \overline{\mathcal{E}} B_{F,t}. \tag{7}$$

where $B_{H,}$ is the LEVEL of central bank holdings of domestic bonds, and $\overline{\mathcal{E}} B_F$ is the level of its holding of foreign bonds, converted into domestic currency by $\overline{\mathcal{E}}$, the fixed level of the exhcange rate. Suppose that the central bank is required to expand its *nominal* holdings of domestic government debt at a rate μ, and that this requirement is an absolute priority, even above fixing the exchange rate.

$$\frac{\dot{B}_H}{B_H} = \dot{\mathsf{b}}_H = \mu \tag{8}$$

where $\mathsf{b}_\mathrm{H} \equiv \log B_H$. Assume output is growing at $\dot{y}_t = \theta$, where $0 < \theta < \mu$.

(a) Assuming the central bank keeps the exchange rate fixed for as long as possible. At what rate is the central bank losing reserves.

(b) Now suppose the country is extremely fast growing, relative to its budget deficits so that $\theta > \mu$.

What implications does this condition have for the path of central bank reserves?

(c) Write the equation for the the "shadow exchange rate" (the rate that would prevail at time t should a run clean out central bank reserves at time t.

(d) 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 $\tilde{\mathsf{e}}_T = \bar{\mathsf{e}}$.

(e) Suppose $\mu = 0$, $\theta > 0$, and that the central bank has an upper limit $\overline{B}_{F,}$ on the total amount of reserve accumulation it is willing to tolerate. Once the foreign reserves hit $\overline{B}_F$, the peg will be abandoned. Can the currency be subject to a speculative attack? (You do not need to solve algebraically.) What does this suggest about the efforts by some Asian countries today to fix exchange rates today at undervalued levels?

3. Please give SHORT answers to ANY THREE of the following four short-answer essay questions

a) Suppose a small country can freely borrow on world markets, but that foreign creditors have no direct means of punishing a debtor country if it does not pay. Might the country still be able to borrow? How does your answer depend on whether the country is able to hold foreign assets in the event of default, and how in turn does it depend on the types of assets a country might hold?

(b). Can a country run a trade balance deficit in perpetuity? (The trade balance includes goods and services but not interest or asset income). Assume that the country's steady state growth rate is less than the world real interest rate.

(c). Suppose we have a world of complete asset markets but some goods are not tradeable. Further suppose that the representative agent's utility function (in every country) is identical and separable in traded and nontraded goods. Thus the utility function takes the form

$$u(C_N) + v(C_T)$$

where C_N denotes consumption and C_T is consumption of traded goods. Explain why there might be a home bias in equity holdings in this model even if there are no exogenous restrictions on asset markets.

(d) In what sense is the aftermath of the 2007–2008 financial crash similar to other past deep post–World War II financial crises, particularly as it has affected the United States? Is there any sense in which it is different?