Harvard University
Department of Economics

General Examination in Macroeconomic Theory

Spring 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

Macro General Exam (Laibson)
May 2010

Problem 1 (**24 minutes**) An agent draws an offer, x, from a uniform distribution with support in the unit interval. The agent can either accept the offer and realize net present value x (ending the game), or the agent can reject the offer and draw again a period later. All draws are independent. Rejections are costly because the agent discounts the future with discount factor $\delta < 1$. This game continues until the agent receives an offer that she is willing to accept.

1. Explain why the Bellman equation for this problem is given by:

$$v(x) = \max\{x, \delta E v(x_{+1})\} \qquad \#$$

2. Using economic reasoning (with or without formal mathematical derivations), characterize the optimal policy and the value function. You will be graded on the quality of your explanation.

3. Using economic reasoning, characterize the optimal policy and the value function as δ goes to unity.

4. Solve for x^*, the optimal threshold rule, as a function of δ.

Problem 2 (**24 minutes**; **True**, **False**, **or Partially True**): Please explain whether the following statements are True, False, or Partially True. You will be graded on the quality of your explanation. If a statement is false, provide a counterexample.

a. If risk aversion, γ, is high, then consumption growth, $\Delta \ln c$, should be highly sensitive to the risk free real return, r.

b. If expected corporate dividends are temporarily high, then the expected rate of capital price appreciation should be temporarily high.

c. If $x(t)$ is Brownian motion with drift $\mu = 0$ and unit variance, then

$$\lim_{t \to \infty} x(t) - x(0) = 0$$

e. Consider the functional operator, B, which maps functions into functions. Suppose that B is a contraction mapping with metric d, modulus δ, and fixed point v. Then $B^n v_0$ has an exponential convergence rate of $-\ln(\delta)$. In other words,

$$d(v, B^n(f_0)) = \delta^n d(v, f_0).$$

Robert Barro

I. Real Rates of Return and Growth Rates (24 minutes)

1. What does the deterministic neoclassical growth model imply about the long-term (steady-state) relation between the real interest rate and the growth rate of real GDP?

2. How does the theoretical result in part 1. accord with long-term data on real rates of return and growth rates of real GDP? In answering, be clear about which real rates of return you have in mind.

3. How does the answer in part 2. relate to the well-known equity-premium puzzle?

4. How might you modify the neoclassical growth model to explain the empirical patterns found in part 2.? Does your modification account for the equity-premium puzzle?

II. Tax Smoothing and Strategic Debt (24 minutes)

Suppose that government spending in each period t is G_t. Spending can be financed by a proportional tax on labor income or by issuing (non-state-contingent) public debt—which, for simplicity, pays a constant real interest rate each period.

1. If G_t varies randomly from period to period, how should the labor-income tax rate be set each period? Under this policy, how does the level of public debt evolve over time?

2. Suppose that governing power each period is controlled by party D or party R. With probability p ($0<p<1$), the incumbent party for period t is voted out and is replaced the next period by the other party. Party D puts a lot more weight in its preference function on government spending than does party R. How do choices of labor-income tax rates now differ from those chosen in part 1.? What do these differences imply about the behavior of public debt?

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 exogenous labor, a lower intertemporal elasticity of substitution implies a higher saving rate.

2. True/False/Uncertain. When the standard RBC model is extended to incorporate durable goods as well as non-durable goods, then durable goods expenditure and durable goods consumption are more volatile than non-durable good consumption, just as in the data.

3. True/False/Uncertain (for each of the following three statements). In 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.

4. True/False/Uncertain. In the New-Keynesian model, it is possible to design a Taylor rule for monetary policy that achieves the flexible price allocation with zero inflation.

5. 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?

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

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

8. (Harder). 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. Can monetary authorities do better than simply set a zero nominal interest rate today and follow a Taylor rule in the future?

Question for spring 2010 macro theory generals

One significant consequence of the 2007-9 financial crisis has been the sharp deterioration in the fiscal position of many of the industrial world's governments. At the end of its 2008 fiscal year, the U.S. Government's interest-bearing debt equaled .40 times that year's U.S. gross domestic product. At fiscal year-end 2009, the debt-to-GDP ratio was up to .53. According to the Congressional Budget Office's latest "baseline" projection, the ratio will rise to .60 by the end of the current fiscal year, and it will continue to rise, in later years, into the .65-.70 range; but under more pessimistic views of the government's tax and spending policies, or of the economy's growth prospects, the debt ratio would instead continue to rise, in time reaching .80 or even higher. Moreover, this situation in United States is in no way unique. In many European countries both deficits and debt are even larger compared to GDP.

Some economists have expressed concern that an increase in government debt on this scale will lead to a resurgence in price inflation. Other economists have argued that while rising government debt relative to GDP might have other undesirable consequences, it will not affect price levels as long as the Federal Reserve System (or in the Euro-area the European Central Bank, or in the U.K. the Bank of England) maintains a firmly anti-inflationary monetary policy. Still others have argued that the rising government debt level is not inflationary now, while resources remain underutilized in the wake of the recent recession, but that it will become so once the economy returns closer to full employment.

Question (a) Under what conditions would rising government debt, relative to GDP, lead to inflation even if the central bank pursued what would ordinarily be construed as a non-inflationary policy? What would the central bank's low-inflation commitment mean in this sequence of events?

Question (b) If rising government debt were to lead to inflation, despite the central bank's commitment to the contrary, what would determine whether the inflation rate would begin to rise only after the economy returned to full employment or would begin to rise before output reached full-employment levels? What specific elements of economic behavior might matter for this distinction?

Question (c) If the conditions you specify in part (a) and (b) above held, but the central bank were completely unresponsive – suppose, for the sake of simplicity, that it simply held the quantity of its liabilities fixed – what further kinds of outcomes might ensue?

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

Part I. Consumers in the home country live for two periods and maximize intertemporal preferences:

$$u(c_t^y) + \beta \sum_s \pi(s) u(c_{t+1}^o(s))$$

where $\pi(s)$ is the probability that state s occurs. The consumer chooses consumption in the two periods, holdings of the securities $b_{t+1}(s)$, and capital holdings to maximize utility subject to the budget constraints:

$$c_t^y + \sum_j q^j K_{t+1}^j + \sum_s \frac{p(s)}{1+r} b_{t+1}(s) = w_t$$

and

$$c_{t+1}^o = \sum_j R_{t+1}^j q^j K_{t+1}^j + b_{t+1}(s)$$

where q^j is the price of capital in country $j = H, F$ and w_t is the wage from the inelastic supply of one unit of labor.

(a) Argue that with complete markets the growth rate of consumption is equalized across countries.

In the problem set we defined the share of investment for the home country η_t, by $I_t^H = \eta_t I_t^W$, where the superscript W denotes world variables.

(b) Discuss briefly (no algebra required) how a persistent shock in the foreign country's labor force affects domestic investment if: (a) there are two sectors in the economy; (b) there is a single sector in the economy. Discuss the role of adjustment costs (i.e. a non-constant price q^j). *Hint:* Remember that η_t satisfies

$$\eta_t = E\left(\frac{Y_{1,t+1}^H}{Y_{1,t+1}^W}\right)$$

where Y is output and the subscript 1 denotes the capital-intensive sector. In the model with the single sector the corresponding condition is

$$\eta_t = E\left(\frac{Y_{t+1}^H}{Y_{t+1}^W}\right).$$

Part II. *Speculative Attacks on the Exchange Rate and Global Games.* Imagine that the Central Bank holds fundamentals of $\theta \in [0, 1]$. The level of fundamentals, however, are not common knowledge. We assume instead that there are a continuum of individual traders of

mass 1, each of whom is endowed with one unit of domestic currency, and receives a private signal x_i about the quality of the fundamentals;

$$x_i = \theta + \varepsilon_i \tag{1}$$

with $\varepsilon_i \sim N(0, 1/\lambda_\varepsilon)$. Every agent's prior about the level of fundamentals is uniform over the entire real line, i.e. it is completely uninformative.
If a trader i decides to attack ($I_i = 1$) she gets

$$\begin{aligned} -\theta, \text{ if } R &= 0 \\ 1-\theta, \text{ if } R &= 1 \end{aligned} \tag{2}$$

where $R = 1$ stands for "regime change" (abandon the peg). So the cost of attacking depends on the level of fundamentals. The Central Bank abandons the peg whenever the size of the attack, or mass of agents that decide to sell their unit of domestic currency for 1 unit of reserves, is larger than the fundamentals;

$$\begin{aligned} R &= 1 \Leftrightarrow A = \int_0^1 I_i di > \theta \\ R &= 0 \text{ otherwise .} \end{aligned} \tag{3}$$

(a) Imagine that individual traders follow "threshold strategies" given by

$$\begin{aligned} I_i &= 1 \Leftrightarrow x_i \leq x^\star \\ I_i &= 0 \text{ otherwise .} \end{aligned} \tag{4}$$

Compute the size of the aggregate attack A as a function of $x^\star$. Characterize the threshold level of $\theta = \theta^\star$ such that the regime fails whenever $\theta < \theta^\star$, also as a function of $x^\star$.

(b) Such threshold strategies need to be determined endogenously in equilibrium. Intuitively what condition will give you an additional expression linking $\theta^\star$ to $x^\star$? Provide such expression explicitly. Hint: the distribution of θ, from the perspective of an agent that observes x_i is given by:

$$\theta | x_i \sim N\left(x_i, \lambda_\varepsilon^{-1}\right).$$

(c) Solve for $x^\star$ as a function of $\theta^\star$ and show that the implicit equation characterizing $\theta^\star$ is:

$$1 = \frac{\Phi^{-1}(\theta^\star)}{\sqrt{\lambda_\varepsilon}} + 2\theta^\star,$$

where $\Phi(\cdot)$ is the standard normal CDF.

(d) Is the equilibrium unique? Explain your reasoning.

Part III.

(a) What is the evidence that currency unions increase trade? Can you list two or three important critiques of the evidence? Does having a fixed exchange rate appear to produce similar effects on trade quantitatively?

(b) *Borrowing constraints with direct sanctions.* A small country faces a fixed world interest rate, with utility

$$U_1 = u(C_1) + \beta u(C_2).$$

First-period output is given by Y_1. Second-period output is $Y_2 = F(K_2)$. The country can finance investment either by borrowing D or by reducing consumption (assume no inherited capital stock). Thus, the first-period finance constraint is given by $K = Y_1 + D - C_1$ (there are only two periods).

The second-period finance constraint is given by

$$C_2 = F(K) - \Re$$

where it is assumed that capital can be consumed after production, and repayments $\Re$ are subject to the constraint $\Re \leq \eta[F(K)]$, where $0 < \eta < 1$ is the share of the country's output that can be seized by foreign creditors in the event the country fails to repay its debt $(1+r)D$ in the second period.

(i) Let $\bar{D}$ denote the maximum level of borrowing the country can undertake such that, in equilibrium, it will not choose to default on repayments. Let K^* denote the corresponding optimal choice of investment. Explain, graphically or otherwise, why the following condition might or might not hold in equilibrium:

$$(1+r)\ \bar{D} = \eta[F(K^*)].$$

(ii) Explain why a small rise in indebtedness in this model might lead to a large decrease in repayments received by creditors.

(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

$$u(C_N) + \left(\frac{C_T^{1-\rho}}{1-\rho}\right)$$

where C_N denotes consumption of nontraded goods 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.