Harvard University  
Department of Economics  

General Examination in Macroeconomic Theory  

Fall 2006  

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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.

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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. 60 minutes  
   II. 60 minutes  
   III. 40 minutes  
   IV. 40 minutes  
   V. 40 minutes
Part I (15 minutes): True/false/uncertain. Explain briefly. Quality of explanation determines grade.

1. The variance of $x(t) - x(0)$ increases linearly with $t$ if $x$ is an Ito Process.
2. An Ito Process can’t be mean-reverting.
3. A continuous-time Bellman equation always contains a second order term when the state variable of the value function is an Ito Process.
4. An Ito Process is not differentiable because it is discontinuous.

Part II (15 minutes): True/false/uncertain. Explain your answer. Quality of your explanation determines your grade.

1. If consumers are rational, consumption will be a random walk.
2. A temporary tax cut would do more to increase the consumption of 25-year-olds than 55-year-olds.
3. If a worker expects a 15% wage increase in 2007, then consumption should rise in anticipation during 2006.
Part III (30 minutes): A procrastination problem.

- Assume that an agent is a quasi-hyperbolic discounter with $\delta = 1$ and $0 < \beta < 1$.

- Assume that the agent faces a discrete-time infinite horizon problem.

- The agent needs to complete some task. The agent pays a punishment cost of 1 each period that begins with the task still uncompleted.

- If a period begins with the task still uncompleted, the agent pays the punishment cost of 1, and then decides whether to complete the task at a cost of $c$ units of (current) effort.

- Once the task is completed, it remains completed forever and the agent pays no more punishment costs.

- Assume that $c > \beta(1 + c)$. Assume too that commitment is not available (except for question 3.)

**Question 1:** Is the following strategy an equilibrium strategy for a sophisticated agent? “Complete the task in the current period if it hasn’t already been completed.” Assume that all selves follow this strategy. Is this an equilibrium?

**Question 2:** Is the following strategy an equilibrium strategy for a sophisticated agent? “Do not complete the task in the current period if it hasn’t already been completed.” Assume that all selves follow this strategy. Is this an equilibrium?

**Question 3:** If the agent could commit herself, when would she complete the task? (For all other questions, assume that commitment is not available.)

**Question 4:** When would a naive agent complete the task? What would her payoff be in this game?

**Question 5:** Assume that sophisticates follow a mixed strategy equilibrium. In each period, with probability $p$ the sophisticate completes the task. Explain why $0 \leq p \leq 1$ solves the following two equations, where $V$ is the continuation payoff for a period that begins with the task still uncompleted.

\[
V = 1 + pc + (1 - p)V \\
c = \beta V
\]
Question 6: Show that

\[ V = \frac{1 + pc}{p} \]

and

\[ p = \min \left\{ \frac{\beta}{c(1 - \beta)}, 1 \right\}. \]

Question 7: Explain intuitively – using the economics of the problem – why \( V \to 1 + c \) as \( p \to 1 \).

Question 8: Explain intuitively – using the economics of the problem – why \( p \to 1 \) as \( \beta \to 1 \).
I. Neoclassical Growth with Human Capital (30 minutes)

Suppose that the production function is

\[ Y = AK^{\alpha}H^{\beta}L^{1-\alpha-\beta} \]

where \( 0<\alpha<1, \ 0<\beta<1, \ \alpha+\beta<1; \) \( K \) is physical capital, \( H \) is human capital, and \( L \) is raw labor. Assume that \( L \) is constant. Output can be used for consumption, \( C \), and investment in physical and human capital. Both forms of capital depreciate at the rate \( \delta \). There is no technological progress. The gross saving rate equals the constant \( s \).

1. What determines the ratio of \( K \) and \( H \). (Assume that \( K \) and \( H \) are reversible, so that one unit of \( K \) can be transformed into a unit of \( H \), and vice versa.)
2. Write out a dynamic equation for the growth rate of \( Y/L \).
3. What conditions determine the steady-state values of \( Y/L \), \( K/L \), and \( H/L \)?
4. What determines the rate of convergence to the steady state in this model?

How does the result relate to the standard Solow model in which \( \beta=0 \)?

II. Public Debt (30 minutes)

1. What is Ricardian Equivalence? Does this property hold in the usual neoclassical growth model? Does it hold in the Blanchard-style model, in which individuals die off probabilistically at the rate \( p \) per year?

2. Explain how Ricardian Equivalence depends on whether taxes are lump-sum or distorting. If taxes are not lump-sum—but are levied say on consumption—what is the reasoning behind the tax-smoothing idea? With tax-smoothing, how would budget deficits respond to a recession or a temporary surge in government expenditure?

3. What is the idea behind strategic budget deficits? Can this concept explain the run-up in the U.S. public debt starting in the mid 1980s?
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Macro General Fall 2006

Question 1

Consider the following three models which provide a link between inflation and output: 1) the traditional Phillips curve, 2) the Calvo model 3) the Mankiw Reiss model. Describe the key assumptions underlying the three models. Characterize their different implications; consider in particular their different implications for an expected and an unexpected disinflation. Provide a brief criticism of each one of the three models.

Question 2

Define strategic complementarities. Are they necessary and sufficient to have multiple equilibria that can be Pareto ranked? Explain your answer. Choose a model that displays strategic complementarities, describe it and characterize the implications of it and how strategic complementarities operate in the model.
Question for fall 2006 macro theory generals

Suppose that some event has adversely affected an economy's ability to produce goods and services with any given cost (for example, the economy imports from abroad most of the oil it uses and the international price of oil has recently tripled). Suppose also that the 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). On the assumption 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 such an event? More specifically, is the optimal policy response stronger or weaker as the short-run Phillips curve is steeper? Explain fully the economic reasoning that provides the basis for your answer. Also be specific about how you are measuring the strength or weakness of the central bank's policy response.
Questions for the Macro General

1. Risk Sharing (Cole and Obstfeld)

There is only one period, two countries (1 and 2) and two goods (A and B). The representative agent in each country has a utility function given by:

\[ u(c^A, c^B) = \frac{(c^A c^B)^{\frac{1 - \rho}{2}}}{1 - \rho} \]

where \( \rho > 0 \) and where \( c^A \) represents the consumption of good A and similarly for \( c^B \).

There is a state of world indexed by \( s \in S \). In state \( s \in S \), which occurs with probability \( \pi(s) > 0 \), country 1 is endowed with \( e^A(s) \) units of good A while country 2 is endowed with \( e^B(s) \) units of good B (Note country 1 has no endowment of good B, and country 2 has no endowment of good A).

a) Solve for Pareto optimal allocations.

b) Suppose that there are no financial markets but countries can trade goods after the state is realized. Show that the competitive equilibrium without financial assets is Pareto efficient.

c) Why is (b) an important result to consider when thinking about risk sharing across countries?

2. Sovereign Debt

Time runs to infinity. Suppose that every period, a country’s endowment is independent from the past and equals \( H \) with probability \( \pi \) and \( L \equiv xH \) with probability \( (1 - \pi) \) ; where \( H > 0 \), \( x \in (0, 1) \) and \( \pi \in (0, 1) \).

The utility of the country’s representative agent is

\[ \sum_{t=0}^{\infty} E \left[ \beta^t \frac{c_t^{1-\rho}}{1 - \rho} \right] \]

for \( \rho > 0 \) and \( \beta \in (0, 1) \).

Suppose that there are foreigners willing to lend to this country as long as they recover in expectation their opportunity cost of capital \( R > 1 \) (foreigners are risk neutral and face an international interest rate equal to \( R \)).

In particular, suppose the following one period debt contracts: Foreigners can lend an amount \( b > 0 \) to the country if the state is low in the expectation that the country repays in the following period an amount \( P \) if the state is high (if the state that follows is low, the
country pays nothing).

a) What's the value of $P$ consistent with a competitive international financial market?

b) Suppose that the state is $H$ and the country is called to repay $P$. What is the expected discounted utility for the country of remaining in the contract forever?

Suppose that the country can choose not to repay its debt (not to pay back $P$). We will consider two possible punishments that foreigners could impose on the country.

**Case 1. Punishment is Financial Autarky.** In this case, if the country defaults it cannot borrow nor it can save: it will consume its endowment.

c) What’s the expected discounted utility of the country if the state is $H$ and it decides not to pay back its debt $P$?

d) Show that if

$$\frac{\pi(1 - \pi)\beta}{R(1 - \beta(1 - \pi))} x^{-\rho} > 1$$

then there always exists a $b > 0$ such that the country prefers to payback the debt rather than default and fall into financial autarky forever.

**Case 2. Punishment is no more Borrowing.** Similarly to case 1, suppose now that if the country defaults the foreigners will not lend to it again. Differently from case 1, suppose now that the country can save in financial assets after default. In particular, at any point in time the country can buy two types of assets A and B. Asset A pays a return only if the state of the world is high tomorrow, while asset B pays only if the state of the world is low tomorrow. Both assets are risk-neutrally priced by the foreigners: one unit invested today in asset A returns tomorrow $\frac{R}{\pi}$ units if the state is high; while one unit invested in asset B returns tomorrow $\frac{R}{(1 - \pi)}$ if the state is low.

e) Show that the country will always find optimal to default for any $b > 0$ given that $R > 1$. 