Harvard University
Department of Economics

Economics 2010d: Final Examination and
General Examination in Macroeconomic Theory

Spring Term 2005

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.	25 minutes
II.	25 minutes
III.	25 minutes
IV.	80 minutes
V.	80 minutes

For those taking the **FINAL EXAMINATION** in Economics 2010d
(**not the General Examination**):

1. You have **THREE** hours.

2. Answer **ALL QUESTIONS** in Parts IV and V.

3. **DO NOT ANSWER** the questions in Parts I, II and III.

Alberto Alesina
General Exam 2005

Question 1

True, false or uncertain. Explain. Answer all the questions

1) In wage contracts model real wages are countercyclical and this is not consistent with the empirical evidence.
2) In a model with strategic complementarities you have multiple equilibria. If you multiple equilibria they can be Pareto ranked.
3) In a model with Calvo type price adjustments only unexpected policy changes affect output if price setters have perfect foresight.
4) Aggregate demand policy can influence the level of employment only if there are nominal price rigidities.

Question for spring 2005 macro theory generals

For given preferences relating departures of inflation and output from their respective optimal levels, and given forward-looking behavior of both aggregate demand and aggregate supply, 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 policy response becomes stronger or weaker, or remains invariant, as the short-run Phillips curve becomes either flatter or steeper. Be as explicit as you can about whatever assumptions underlie your answer.

Part III (25 minutes) *Please BRIEFLY answer each question (all parts within each question are equally weighted).*

1. *(Investment with moral hazard and repudiation risk)*

A small country is populated by entrepreneurs with utility function $U = C_2$, who can borrow abroad at world interest rate r. Each entrepreneur has initial wealth Y_1, which can be used to invest in a project that yields output $\overline{Y}$ with probability $\pi(I)$, and yields $\underline{Y} > 0$ with probability $1 - \pi(I)$; $\pi'(I) > 0$, $\pi''(I) < 0$. (returns are independent across individual investors.) Thus

$$Y_2 = \begin{cases} \overline{Y} \text{ with probability } & \pi(I) \\ \underline{Y} \text{ with probability } & 1 - \pi(I). \end{cases}$$

Initial wealth Y_1, however, is insufficient to achieve the efficient level of investment $\bar{I}$, defined implicitly by $\pi'(\bar{I})(\overline{Y} - \underline{Y}) = 1 + r$. Thus entrepreneurs would like to borrow $D = \bar{I} - Y_1$, but they are constrained by the fact that foreign creditors can only observe whether the project actually succeeds or fails, and cannot observe investment I directly. Potential creditors worry that once the entrepreneur has been given funds, she will sneak them into secret foreign bank accounts rather than invest.

a. Define $Z \equiv \overline{Y} - \underline{Y}$, and $P(Z) \equiv P(\overline{Y}) - P(\underline{Y})$, where P represents the state-contingent payment to lenders. Use a graph with these two variables to ilustrate the determination of equilibrium. Given equal technology and equal access to global capital markets, why might investment be lower in an initially poor country than a rich country?

b. Assume further, that in addition to moral hazard, there is repudiation risk so that lenders can only seize a fraction η of second-period output, in either state, so that $P(Y) \leq \eta Y$. Again show how to illustrate the equilibrium graphically. Note that the constraint $P(\underline{Y}) \leq \eta \underline{Y}$ will always bind, whereas the condition $P(\overline{Y}) \leq \eta \overline{Y}$ may or may not bind depending on the parameters of the model. How does repudiation risk affect investment?

2. In "first-generation" speculative attack models, the government mechanically prints money at a constant rate while at the same time trying to fix the exchange rate.

a. Briefly, how can a perfectly anticipated speculative attack on government foreign exchange reserves arise in such a setting? (You may use a diagram if you like but certainly no algebra is required.) Would an attack be possible if the public firmly believed that the central bank *always* gives primacy to its exchange rate target above its money growth target?

b. In practice, interest differentials between domestic and foreign bonds 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? Does it matter whether we are talking about short-term versus long-term interest differentials? What about a stochastic model with shocks to government borrowing needs? Why is it a problem that, for most countries that have experienced speculative attacks, government foreign exchange reserves (e.g. dollars, US Treasury bills, gold) have often been far in excess of what is needed to repurchase the country's entire supply of high-powered money (currency plus bank reserves at the central bank), even at the pre-crisis exchange rate?

c. Briefly describe a "second-generation" (Barro-Gordon type) model of exchange rate attacks in which speculative attacks can occur, but need not occur, and in which the government sets monetary policy to minimize a loss function that depends on inflation and deviations of output from a target rate. YOU NEED NOT USE ALGEBRA. Does such a model give a satisfactory explanation of why interest differentials are typically so small prior to attacks (until a month or two before)?

True, False, or Partially True (3 parts taking 30 minutes in total). Please explain whether the following statements are True, False, or Partially True. You will be graded on the quality of your *explanation.*

Part 1: If income is expected to increase 10% next year, then consumption will increase nearly that much this year.

Part 2: In steady state, the average rate of household consumption growth will equal the average rate of household income growth.

Part 3: If an investment tax credit is anticipated before it starts, then investment will rise above its steady state level before the investment tax credit starts.

Discrete time dynamic programming (20 minutes): Each period (over an infinite horizon) a consumer draws a job offer from a uniform distribution with support in the unit interval: $x \sim u[0,1]$. The consumer can either accept the offer and realize NPV x, or the consumer can wait another period and draw again. Once you accept an offer the game ends. Waiting to accept an offer is costly because the value of the remaining offers declines at rate ρ between periods. The Bellman equation for this problem is:

$$v(x) = \max\{x, \exp(-\rho)Ev(x_{+1})\}.$$

Derive the optimal stopping rule:

$$x^* = (\exp\rho)\left(1 - \sqrt{1 - \exp(-2\rho)}\right).$$

Dynamically inconsistent preferences (4 parts taking 30 minutes in total).

Consider the following model with three periods. In period 0, the consumer can purchase quantity $c_0 \geq 0$ of cigarettes. The consumer does not consume c_0 in period 0 (think of this period as a short buying opportunity on the morning commute to work). In period 1, the consumer is able to buy more cigarettes ($c_1 \geq 0$) and also to consume cigarettes (think of this as the bulk of the consumer's day). Total consumption is $c = c_0 + c_1$. In period 2, the consumer uses any remaining resources to consume a different good x.

We assume that the consumer faces the following budget constraint:

$$1 = c_0(1 + \tau_0) + c_1(1 + \tau_1) + x$$

where τ_0 and τ_1 are taxes on c_0 and c_1 respectively.

The game is summarized in the following timeline:

- Period 0: purchase amount $c_0 \geq 0$ at after-tax price $(1 + \tau_0)$.
- Period 1: purchase additional amount $c_1 \geq 0$ at after-tax price $(1 + \tau_1)$. Consume $c = c_0 + c_1$.
- Period 2: purchase and consume x at price 1 with remaining resources: $1 - c_0(1 + \tau_0) - c_1(1 + \tau_1)$.

The consumer has a quasi-hyperbolic intertemporal discount function: 1, $\beta\delta$, $\beta\delta^2$, $\beta\delta^3$,.... We assume $0 < \beta \leq 1$, so this function captures the idea that consumers discount more sharply in the short run than in the long run, implying dynamically inconsistent preferences.

Good, c, generates both immediate rewards and delayed costs. Since c resprresents cigarette consumption the immediate rewards are pleasure and relaxation and the delayed costs are health-oriented. Assume the following functional forms.

The immediate benefit from smoking c cigarettes is $(\alpha + \Delta)\ln(c)$, where α and Δ are deterministic taste shifters (in other words, they may vary across consumers). Assume also that $\alpha > 0$, $\Delta > 0$. The delayed health *cost* from smoking c cigarettes is $\alpha \ln(c)$. The benefit of residual consumption of x is assumed to be linear to reflect the fact that "all other goods" will show little if any diminishing marginal utility relative to the curvature of a single good like c.

From the period 0 perspective, the utility function is

$$U_0(c, x) = \beta\delta\,(\alpha + \Delta)\ln(c) - \beta\delta^2\alpha\ln(c) + \beta\delta^3 x.$$

To simplify analysis and to reflect the fact that we are thinking about high frequency choices (at the daily level), we set $\delta = 1$. Therefore, the period 0 utility function becomes

$$\begin{aligned} U_0(c,x) &= \beta\left(\alpha+\Delta\right)\ln(c) - \beta\alpha\ln(c) + \beta x \\ &= \beta\left[(\alpha+\Delta)\ln(c) - \alpha\ln(c) + x\right] \\ &= \beta\left[\Delta\ln(c) + x\right]. \end{aligned}$$

From the period 1 perspective, the utility function is

$$U_1(c,x) = (\alpha+\Delta)\ln(c) - \beta\alpha\ln(c) + \beta x.$$

Part 1: Show that this agent has dynamically consistent preferences if $\beta = 1$. Show that this agent has dynamically inconsistent preferences if $\beta < 1$.

Part 2: Assume that $\tau_0 = \tau_1 = 0$. Derive the optimal *commitment* path from the perspective of the period 0 self. This is the policy function that maximizes the period 0 utility function and which the period 0 self would like future selves to follow. Specifically, prove the following proposition:

Proposition 1 *Under perfect precommitment,*

$$c = \Delta,$$

and

$$U_0 = \beta\Delta\ln\left(\Delta\right) + \beta\left(1-\Delta\right).$$

Part 3: Again assume that $\tau_0 = \tau_1 = 0$. Additionally, assume that precommitment is not possible, so cigarettes can be bought in every period. Prove the following Proposition:

Proposition 2 *With no precommitment, no taxes, and free markets,*

$$c = \frac{\alpha\left(1-\beta\right)+\Delta}{\beta}$$

and

$$U_0 = \beta\Delta\ln\left(\frac{\alpha\left(1-\beta\right)+\Delta}{\beta}\right) + \left(\beta - \alpha\left(1-\beta\right) - \Delta\right).$$

Part 4: Consider a tax structure in which there are no taxes in period 0 ($\tau_0 = 0$) and infinite taxes in period 1 ($\tau_1 = \infty$). Call this an Early Decision tax regime (since it prevents any cigarette purchases in period 1). Explain *intuitively* why the following Proposition holds. Also, explain *intuitively* why U_0 in Parts 2 and 4 is greater than U_0 in Part 3.

Proposition 3 *An Early Decision tax regime implements the same consumption stream as commitment:*

$$c = \Delta$$

and

$$U_0 = \beta\Delta \ln(\Delta) + \beta(1 - \Delta).$$

1. (40 minutes)

Consider the determination of the long-run growth rate of real GDP per capita.

a. In the standard neoclassical growth model (Ramsey model), why is this growth rate zero in the absence of technological progress? That is, why is capital accumulation insufficient to generate a positive per capita growth rate in the steady state?

b. With exogenous technical progress at the constant rate, $x > 0$, what is the steady-state per capita growth rate in the neoclassical growth model? Does it matter whether this technical progress takes a labor-augmenting form or some other form?

c. In an endogenous growth model—such as the model of expanding varieties of intermediate products analyzed in Ch. 6 of *Economic Growth*—what is the steady-state growth rate of real per capita GDP? Is this growth rate positive if the R&D cost for inventing a new type of intermediate good is a constant quantity of goods, η? What if the R&D cost is a constant amount of labor?

2. (40 minutes)

Consider the effects of public debt. Suppose initially that the government raises tax revenue with lump-sum taxes.

a. In the standard neoclassical growth model (Ramsey model), how does the equilibrium change if the initial real public debt, $B(0)$, is higher? Explain the results.

b. How do the results differ in the Blanchard-Weil-type finite-horizon model? What accounts for the difference in results? If people live forever but new people enter the economy over time (say as immigrants), what are the results?

c. Suppose now that each period's real taxes are raised by a proportional tax on that period's consumption, C_t. Redo part a. for this case (in the context of an infinite-horizon, Ramsey model).

d. What happens in part c. if the government varies the consumption tax rate over time?

e. Explain how considerations of strategic debt can enter the analysis.