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

Part A (Prof. Laibson): 60 minutes  
Part B (Prof. Barro): 60 minutes  
Part C (Prof. Farhi): 60 minutes  
Part D (Prof. Gourinchas): 60 minutes
True, False, or Partially True (40 minutes): Please explain whether the following statements are True, False, or Partially True. You will be graded on the quality of your explanation.

a. If a 20 year-old consumer receives an annuity that pays out a $1,000 per year until she dies, then her new consumption level will be $1,000 above the amount she would have consumed before she received the annuity.

b. If $x$ is geometric Brownian motion, such that

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

than from the perspective of time 0, $\ln[x(t)]$ has mean $\ln[x(0)] + \mu t$ and variance $\sigma^2 t$.

c. The option value of being able to close a firm goes to zero as uncertainty about the future goes to zero.

d. Time discounting makes dynamic optimization problems computationally tractable.

e. If the cost of adjustment of the capital stock contains a fixed cost component and no variable cost component, then upward adjustments in the capital stock will generate jumps to the same level of the capital stock as downward adjustments in the capital stock.

f. If the cost of adjustment of the capital stock contains a fixed cost component and no variable cost component, then (non-zero) investment will always be equal in absolute value.
Optimal investment problem. (20 minutes)

- Every period you draw a cost $c$ (distributed uniformly between -1 and 1) for completing a project. Note that the support of $c$ goes from -1 to +1, which is not what you saw on the problem set.
- If you undertake the project, you pay $c$.
- Each period in which the project remains uncompleted, you pay a late fee of $l$.
- The game continues until you complete the project.

a. Write down the Bellman Equation assuming no discounting.

b. Derive the optimal threshold: $c^*$. 
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 long-term data, average real rates of return on stocks exceed average growth rates of real GDP; this pattern contradicts the neoclassical growth model.

2. Economic behavior in North and South Korea following the de facto end of the Korean War in 1953 provides strong evidence in favor of the convergence hypothesis.

3. Ricardian Equivalence implies that the multiplier for government purchases should be zero (that is, an increase in government purchases has no effect on real GDP).

4. In the Blanchard/Weil “finite-horizon” model, an increase in the ratio of public debt to GDP lowers the capital-labor ratio.

5. In the varieties model of endogenous growth, the higher the level of a country’s population the higher the rate of economic growth.

6. In the quality-ladders model of endogenous growth, the ”business-stealing” effect makes the growth rate inefficiently high.

7. The transversality condition implies that the risk-free real interest rate must be positive.

8. Tax-rate smoothing implies that the average marginal income-tax rate should never change.
Farhi’s part

August 19, 2015

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 order to match the data, the RBC model requires a large elasticity of labor supply. This is consistent with the microeconomic evidence on the elasticity of labor supply.

2. Explain what 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. 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.

4. 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 ($\rho, \phi_{\pi}$) 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?
5. Consider the New-Keynesian model with productivity shocks. Assume first that the labor tax is set to offset monopoly power. Characterize optimal monetary policy. Is commitment required to implement this outcome? Assume now that the labor tax is zero. Characterize optimal monetary policy under commitment and under no commitment, and explain why the two differ.

6. Consider the New-Keynesian model with cost-push shocks. Explain how to interpret cost-push shocks. Characterize optimal monetary policy under commitment and under no commitment, and explain why the two differ.

7. 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

Consider an economy consisting of a constant population of infinitely-lived individuals. The representative individual maximizes $\sum_{t=0}^{\infty} \beta^t u(C_t)$ where $u(C_t) = C_t - \theta C_t^2$ (assume that $C_t$ is always in the range where $u'(C_t)$ is positive). Output is linear in capital, plus an additive disturbance $Y_t = RK_t + \epsilon_t$ and there is no depreciation so that $K_{t+1} = K_t + Y_t - C_t$. Assume that $\beta R = 1$. Finally, the disturbance follows an AR(1) process $\epsilon_t = \rho \epsilon_{t-1} + \epsilon_t$ where $\rho \in [0, 1]$ and $\epsilon_t$ is i.i.d. with mean zero.

1. Derive the Euler equation for consumption.

2. Guess and verify that the policy function for consumption is of the form $C_t = \alpha_0 + \alpha_K K_t + \alpha_\epsilon \epsilon_t$ and derive the values of the coefficients $\alpha_0$, $\alpha_K$ and $\alpha_\epsilon$.

3. Derive the policy function for capital.

4. What are the effect of a one-time shock to $\epsilon$ on the paths of $Y$, $K$ and $C$?

5. Explain how the effect of a one time shock on capital accumulation depends on the persistence $\rho$ of the shock.
Part IV GOURINCHAS

August 21, 2015

Instructions: Please answer all three questions in this section. You do not need to give every intermediate step. All parts have equal weight. Please put your answer to Q3. in a separate bluebook. If you are having trouble with analytics in Q1 or Q2, try to give an intuitive answer.

Q1. Parity Conditions

Consider a two-country discrete-time economy with a complete set of nominal contingent claims. Each country has its own currency. \( E_t \) denotes the nominal exchange rate, defined as the domestic price of the foreign currency. Denote \( M_{t,t+1} \) the domestic nominal stochastic discount factor (SDF) in domestic currency. This means that \( E_t [M_{t,t+1} R_{t+1}] = 1 \) for any nominal gross asset return \( R_{t+1} \) measured in domestic currency. Similarly, denote \( M^{*}_{t,t+1} \) the foreign nominal SDF in foreign currency. This means that \( E_t [M^{*}_{t,t+1} R^{*}_{t+1}] = 1 \) for any nominal gross asset return \( R^{*}_{t+1} \) measured in foreign currency.

1. Using the fact that markets are complete, derive a relationship between the rate of depreciation of the nominal exchange rate \( \Delta \ln E_{t+1}/E_t \), and the domestic and foreign nominal SDFs \( M_{t,t+1} \) and \( M^{*}_{t,t+1} \). Does this relationship hold in expectations, or almost surely (i.e. for all states and periods)? [Hint: remember that when markets are complete there is a unique SDF, in any given units]

2. Derive a relationship between the domestic one-period risk-free nominal interest rate \( i_t \) and the domestic nominal SDF \( M_{t,t+1} \). Derive a similar relationship between the foreign one-period risk-free interest rate \( i^*_t \) and the foreign nominal SDF, \( M^{*}_{t,t+1} \).

3. Using your answers to the previous questions, derive an approximate relationship between the expected rate of depreciation of the nominal exchange rate \( E_t \Delta \ln E_{t+1} \), the difference between nominal domestic and foreign one-period risk-free interest rates \( (i_t - i^*_t) \), and a risk premium that you will characterize as a function the domestic and foreign stochastic discount factors. [Hint: use the approximation \( \ln(1 + i_t) \approx i_t \)]

4. The empirical literature often assumes that (a) expectations are rational and (b) the risk premium is constant over time. Explain how these additional restrictions allow to test empirically the parity condition you derived above.

5. Figure 1 below shows the spread between the U.S. dollar Libor rate and the FX swap-implied dollar rate for the Euro, the Pound Sterling and the Japanese Yen between January 2007 and
January 2009. The FX swap-implied dollar rate for the Euro is the dollar interest rate obtained by borrowing in Euros and covering the dollar-euro currency exposure through forward foreign exchange transactions.

(a) Explain what arbitrage condition is violated in this figure and whether it differs from the parity condition you derived in part 3.

(b) Discuss where the deviations in the figure might be coming from.

Figure 1: Spread between dollar LIBOR and FX-swap implied dollar rate for the Euro, Pound Sterling and Japanese Yen.

Q2. Rollover Crises

Consider a small open economy with two periods, \( t = 0 \) and \( t = 1 \). In the first period, the government needs to roll-over a maturing debt \( D_0 \). The government does not have any fiscal revenues this period and must issue some new debt with face value \( D_1 \) (i.e, \( D_1 \) is the promised repayment in period 1) at some price \( q(D_1) = 1/1 + r \) that we will characterize. In period 1, the government receives a primary surplus \( S = \bar{S} \epsilon \) where \( \bar{S} > 0 \) is the expected level of the fiscal surplus and \( \epsilon \) is uniformly distributed on the interval \( [\epsilon_{\text{min}}, \epsilon_{\text{max}}] \), with \( \epsilon_{\text{min}} > 0 \) and \( E[\epsilon] = 1 \). This means that the density of \( \epsilon \) is \( g(\epsilon) = 1/\Delta \epsilon \) where \( \Delta \epsilon = \epsilon_{\text{max}} - \epsilon_{\text{min}} \). The government is non-strategic: in period 1, it defaults only if it cannot repay the full amount \( D_1 \).

1. Define \( \pi \) the probability of default in period 1. Express \( \pi \) as a function of the outstanding debt \( D_1 \) and \( \bar{S} \), and plot \( \pi \) against \( D_1 \) for \( D_1 \geq 0 \).

2. The government borrows from risk-neutral lenders. In case of default, we make the extreme assumption that lenders lose everything. The lenders’ opportunity cost of funds is the risk free rate \( 1 + r^* \). Write down the arbitrage equation that must hold for the price \( q(D_1) \) of domestic government debt as a function of \( r^* \) and of the probability of default \( \pi \).
3. In period 0 the government can raise revenues \( H(D_1) \equiv q(D_1)D_1 \). Based on your answer to the previous questions, characterize qualitatively the function \( H(D_1) \) and represent it graphically.

4. As a function of \( D_0 \), discuss whether there are situations of insolvency (where the government cannot repay its debt in period 0) and/or illiquidity (where the government may be unable to repay its debt in period 1). Is there a ‘safe region’ where the government faces no risk of crisis and if so why or why not?

5. Which policies would eliminate liquidity crises in this model?

Q3. Please give SHORT answers to ANY TWO of the following four short-answer essay questions.

(a) Discuss briefly possible explanations for the decline in world real interest rates.

(b) Financial contracts are difficult to enforce when the borrower is sovereign. Describe briefly how financial contracts between sovereigns can be supported in equilibrium. Explain why Ken Rogoff argues that reputational models are ‘fragile.’

(c) In speculative attack models with strategic complementarities, explain briefly how lack of common knowledge can eliminate multiple equilibria. What happens if speculators have access to a public signal of a given precision?

(d) Describe briefly the distortions that are present in New Keynesian open economy models and explain how optimal monetary policy should be set.