Ph.D. Core Exam – Macroeconomics

15 August 2011 – 8:00 am to 3:00 pm

Part A: Answer question **A1 or A2**, plus question **A3**.

A1. Raising the Debt Ceiling

The last-minute deal reached by Congress to raise the debt ceiling and avoid default by the U.S. government calls for substantial cuts in government spending over the next year, to be followed by further spending cuts and (perhaps) tax increases in subsequent years. You have been asked to analyze how the U.S. macroeconomy will respond to this policy change over time.

Assuming that the capital stock and technology remain constant, your analysis is based on an aggregate demand model with static inflationary expectations and a wealth effect in the goods market. Real wealth is held in the form of money balances and/or government bonds, i.e., $V = (M+B)/P$.

$$Y = E(Y - T, r, V, G) \tag{IS}$$

$$M/P = L(Y, R) \tag{LM}$$

where $r = R,\ 0 < E_{Y-T} < 1,\ 0 < E_V < 1,\ E_r < 0,\ E_G = 1$, and $L_Y > 0,\ L_R < 0$.

1. Show how the endogenous variables are affected by the fiscal contraction *in the short run*, while wages and prices are sticky:
   (a) Calculate the relevant derivatives using Cramer's Rule.
   (b) Explain how your answer changes if the Fed seeks to hold interest rates constant.

2. Show how the endogenous variables are affected by the fiscal contraction *in the longer run*, when wages and prices are fully flexible:
   (a) Illustrate graphically and explain verbally how the new equilibrium is reached.
   (b) Explain how your answer changes if future spending cuts are "balanced" with tax increases.

3. What other factors or variables should be considered to make the analysis more relevant or realistic? Discuss at least two items and explain how each would affect your analysis.

A2. Strategic Monetary Policy

Consider the following deterministic version of the Barro-Gordon model:

$$y = y_n + b(\pi - \pi^e) \qquad \text{where } b > 0 \qquad \text{(Lucas supply curve)}$$

$$L = \frac{1}{2}(y - y^*)^2 + \frac{1}{2}(\pi - \pi^*)^2 \qquad \text{where } y^* > y_n \qquad \text{(social loss function)}$$

The variables are: y = real output, y_n = natural level of output, y^* = target level of output, π= inflation, π^e = expected inflation, and π^* = target level of inflation. The policymaker directly chooses inflation so as to minimize the social loss due to output and inflation deviations from their target levels. Expectations are formed rationally.

1. Suppose the policymaker, who is concerned about the upcoming elections, announces a zero inflation rule. Explain whether or not this policy announcement is credible. Calculate the (time-consistent) equilibrium inflation rate and the corresponding value of the social loss function.

2. Now suppose that a structural change in the economy reduces the impact of unexpected inflation on output relative to its natural level. Compared to case (1), is society made better or worse off by this change? Explain intuitively and support your explanation mathematically.

3. Describe a modified version of the model with repeated interactions between the policymaker and the public. Explain intuitively how reputation effects lead to a lower equilibrium inflation rate.

A3. Statements

Select any four (4) of the following statements and explain carefully why each is either true, false, or indeterminate. You must use graphical and/or mathematical analysis to support your arguments. Your score depends on the quality and completeness of your explanations.

1. The neutrality of money depends primarily on the presence or absence of wealth effects on the aggregate demand side of the economy.

2. In the classical model, an earthquake that destroys part of the capital stock causes output, employment, and real wages to fall while interest rates and prices rise.

3. Rational expectations models of aggregate demand/supply imply that a disinflation is costless as long as it is preannounced and credible.

4. In an open economy, fiscal policy is more effective the higher the degree of capital mobility and the larger the country.

5. In a small open economy subject to domestic random shocks in the goods market, policymakers can stabilize output in the short run by adopting fixed rather than flexible exchange rates.

6. In a stochastic world, whether to fix the money supply or the interest rate is a matter of style rather than substance.

Part B: Answer <u>BOTH</u> questions.

B1. Taxation in the Ramsey Model

Consider the Ramsey model of an economy in competitive equilibrium. There is a representative household and a representative firm. The household's utility functional is

$$U \equiv \int_0^\infty \ln c_t e^{-\rho t} dt,$$

where there is no population growth, and $\rho > 0$.

The representative firm has a constant returns to scale per worker production function $f(k_t) = Ak_t^\alpha$. For simplicity, assume capital does not depreciate after production ($\delta = 0$). At every point in time, the household must pay a fraction τ of its income to the government. [Hint: remember that income equals the wage plus the return on assets. Thus, the after-tax income is simply the income minus the tax, or $(1 - \tau)$ income.]

Find the competitive equilibrium of this economy, using the following steps.

a) Write down representative household's maximization problem, solve it, and derive the 4 equations that characterize the solution. Explain in words, intuitively, what the Hamiltonian function means, and what the 4 equations represent. Does τ show up here? Explain why or why not?

b) Write down firm's maximization problem and the first-order conditions for this problem. Translate these conditions into intensive form. Derive the 2 equations that characterize the solution. Does τ show up here? Explain why or why not?

c) What are the 3 equilibrium conditions for this economy? Does τ show up here? Explain why or why not?

d) Combine your answers to parts a) - c) and derive a pair of differential equations for the variables c and k.

e) Draw the phase diagram, carefully identifying (and deriving mathematically) all the important points.

f) Do the following comparative dynamics exercise: $\tau' > \tau$. Explain why there is no need to assume that the substitution effect dominates the income effect. As usual, the baseline economy starts in its steady state at time $t = 0$. The modified economy starts at time $t = 0$ (with the same amount of capital as the baseline economy. Remember that capital is the state variable!). Draw (i) the phase diagram for both cases, indicating what is different, and (ii) the time paths of c and k for both cases. In interpreting your results, notice that we completely ignored what the government may do with the tax revenues. For simplicity, we *de facto* assumed that the government wasted the taxes, "dumped them into the ocean", or "opened a Swiss bank account" with them. Thus, there is no positive effect of government spending countering the income tax.

B2. OLG

Consider an economy consisting of an infinite sequence of two period lived, overlapping generations. N_t agents are born in period t, with $N_{t+1} = N_t$. In each period there is a single final good that is produced using a constant returns to scale technology with capital and labor as inputs. Let k_t denote the time t capital-labor ratio, and let $f(k_t)$ denote the intensive production function. Let f have the Cobb-Douglas form $f(k_t) = k_t^\alpha$, with $0 < \alpha < 1$. One unit of the final good that is not consumed at t converts into one unit of capital at $t+1$. Assume capital does not depreciate after production ($\delta = 0$). Agents have the utility function

$$u(c_1, c_2) = \ln c_1 + \ln c_2$$

Notice that there is no discount factor, i.e. $\beta = 1$.

a) Write down the household's maximization problem and derive the equations that characterize the solution (a_t, c_1, c_2).

b) The solution to the firm's maximization problem is given by

$$f'(k_t) = R_t \tag{4}$$
$$f(k_t) - k_t f'(k_t) = w_t \tag{5}$$

c) What are the equilibrium conditions for this economy?

d) Define a competitive equilibrium. Derive a *Law of Motion* (LOM) equation that defines a difference equation for the variable k. Graph it carefully, find the steady-state solutions and describe them. Show what determines the speed of convergence.

e) Is the non-trivial steady-state Pareto optimal? Carefully show why, or why not.