Written Exam for the B.Sc. in Economics - Spring 2014

Macro C
Final Exam

August 5, 2014

3-hour closed book exam

Please note that the language used in your exam paper must correspond to the language of the title for which you registered during exam registration. If you are in doubt about which title you registered, please see the print of your exam registration from the students' self-service system.

The points for each question should guide you in allocating time to answering them (they add up to 180, thus proportional to the total time you have for the exam).

Question 1 (20 points) Answer true, false, or uncertain. Justify your answer.

When money is superneutral, changes in the rate of growth of money have no effects on real variables, c, k, and m (consumption, capital accumulation, and real money holdings). Thus from a policy perspective it is irrelevant which rate of growth of money to choose.

Question 2 (20 points) Answer true, false, or uncertain. Justify your answer.

When the volatility of supply shocks is large it is better to have a hard currency peg (one with no escape clause) than a currency peg with an escape clause, because the probability of invoking the escape clause is large and this is incorporated into expectations leading to output losses in normal times.

Problem 1 (80 points)

Consider the following version of the Ramsey model with population growing at rate n. Identical competitive firms maximize the following profit function:

$$\pi^F(K_t, L_t) = K_t^\alpha L_t^{1-\alpha} - w_t L_t - r_t^L K_t,$$

where r_t^L is the interest rate at which firms can borrow funds, w_t is the wage rate, K_t and L_t denote the quantities of capital and labor employed by the firm. Assume $0 < \alpha < 1$. There is no capital depreciation.

A large number of identical households maximize the following intertemporal utility function, that depends on per-capita consumption c_t:

$$U = \int_0^\infty \ln(c_t)\, e^{-(\rho-n)t} dt,$$

subject to their dynamic budget constraint:

$$c_t + \dot{a}_t + na_t = w_t + r_t^D a_t.$$

Take $a_0 > 0$ as given, a is wealth (lower case variables represent quantities in per capita terms), r_t^D is the interest rate that the household gets for its savings, and assume $\rho > n$. For simplicity we rule out private lending between households.

In this economy there are financial intermediaries that take deposits d_t from households paying them the rate r_t^D for this (households cannot borrow from intermediaries, i.e. $d_t \geq 0$). Intermediaries are regulated and are thus required to store the fraction γ of deposits as liquid assets on which they receive no return. The remaining fraction $1-\gamma$ they lend to firms at rate r_t^L. Competition between intermediaries implies that they make zero profits, i.e.

$$\pi_t^I = r_t^L(1-\gamma)d_t - r_t^D d_t = 0.$$

Thus the following relation must be satisfied at every point in time: $r_t^L(1-\gamma) = r_t^D$.

Note: Think of the fraction γ of deposits that the intermediaries must store as "reserves" that make the economy stable for reasons exogenous to our capital accumulation model. We take this fact as given.

For points a) to b) you will receive partial credit if you assume $\gamma = 0$.

a) Find the first order conditions for the firms' maximization problem that characterize how much capital and labor a firm demands at given factor prices. As a function of saving per capita, a, what is the income that the representative household member receives on his/her saving? (Hint: note the equilibrium relation between a, d and k) And for his/her labor services?

b) What are the control and state variables in the households' optimization problem? Write the Hamiltonian, find the first order conditions that characterize the behavior of households, and from these the Euler equation (also known as the Keynes Ramsey rule). Give an economic interpretation to this equation. Find the equations that characterize steady state as a function of control and state variables. Draw the phase diagram that describes the dynamics in this economy with a in the horizontal axis, and c in the vertical axis.

c) Assume that the economy is initially in the steady state. Now unexpectedly ρ is permanently decreased (still $\rho > n$ holds). How does this shock affect the $\dot{c} = 0$ and $\dot{a} = 0$ curves? Characterize the new steady state capital per capita, k and saving per capita, a. Find graphically the new steady state and the adjustment process for consumption and saving. Explain.

d) Is there a distortionary tax/subsidy on capital accumulation that would eliminate the effect of the decrease in ρ on steady state capital? Would this policy allow consumption to remain unchanged when the shock hits the economy? Would steady state consumption remain unchanged? Explain.

Problem 2 (60 points)

Consider an economy where individuals live for two periods, and population is constant. Identical competitive firms maximize the following profit function:

$$\pi^F(K_t, L_t) = AK_t^\alpha L_t^{1-\alpha} - w_t L_t - r_t K_t,$$

where r_t is the interest rate at which firms can borrow capital, w_t is the wage rate, K_t and L_t denote the quantities of capital and labor employed by the firm, and $A > 0$ is total productivity. Assume $0 < \alpha < 1$. Capital depreciates fully after one period. Utility for young individuals born in period t is

$$U_t = \ln(c_{1t}) + \frac{1}{1+\rho}\ln(c_{2t+1}), \quad \rho > -1$$

where c_{1t} is consumption when young, and c_{2t+1} consumption when old. Young agents work a unit of time (i.e. their labor income is equal to the wage they receive). Old agents do not work and provide consumption through saving and social security benefits (when a social security system is in place). The old get return r_{t+1} for their savings.

Suppose that the government runs a balanced pay-as-you-go social security system in which the young contribute a fraction $0 < \tau < 1$ of their wages that is received by the old (τw_t are then the benefits received by the old in period t).

a) Find the first order conditions for the firms' maximization problem that characterize how much capital and labor a firm demands at given factor prices. Characterize individual saving behavior by solving the individual's problem of optimal intertemporal allocation of resources.

b) Find the capital accumulation equation that gives k_{t+1} as a function of k_t. Find the level of capital in steady state. Can the economy be dynamically inefficient in this steady state? Explain.

Assume that the economy is initially in the steady state. Now unexpectedly the social security system is dismantled. No contributions are raised and no benefits are paid (i.e. τ is set to zero) neither in the present nor the future.

c) How does this shock affect the economy? What are the effects of the shock on consumption and capital accumulation in the first period (compared to consumption and capital accumulation in the previous steady state)? Characterize analytically the new steady state. Find graphically the new steady state and the adjustment process for capital accumulation. Explain. Do the young in the first period benefit from this policy change? And the old? Explain.