Written Exam at the Department of Economics summer 2019

Macroeconomics III
Final Exam

June 7, 2019

(3-hour closed book exam)

Answers only in English.

This exam question consists of 4 pages in total

Falling ill during the exam If you fall ill during an examination at Peter Bangs Vej, you must:

- *contact an invigilator who will show you how to register and submit a blank exam paper.*
- *leave the examination.*
- *contact your GP and submit a medical report to the Faculty of Social Sciences no later than five (5) days from the date of the exam.*

Be careful not to cheat at exams! You cheat at an exam, if during the exam, you:

- *Make use of exam aids that are not allowed*
- *Communicate with or otherwise receive help from other people*
- *Copy other people's texts without making use of quotation marks and source referencing, so that it may appear to be your own text*
- *Use the ideas or thoughts of others without making use of source referencing, so it may appear to be your own idea or your thoughts*
- *Or if you otherwise violate the rules that apply to the exam*

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

According to the basic real business cycle model, the observed fluctuations of consumption and investment reflect the optimal households and firms responses to exogenous supply shocks. Thus, government intervention to smooth consumption volatility is not desired.

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

Assume that the productivities of tradables, g_T^i, and non-tradables, g_{NT}^i, respectively grow at the same rates across countries, with the productivity of non-tradables growing at a faster rate than the productivity of tradables. Since governments spend mostly on non-tradable goods, countries where the size of the public sector relative to GDP increases at a faster rate experience a real exchange rate appreciation.

3 (20 points) Answer true, false, or uncertain. Justify your answer.

The Meltzer and Richard (1981) model provides an explanation for the observed increase in transfers in the postwar period as a result of the extension of the voting franchise and technological improvements in tax collection.

4 (60 points) Consider the following version of the Ramsey model with population growing at rate 1+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 capital from households, 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 ($\delta = 0$). A large number of identical households maximize the following intertemporal utility function, that depends on per-capita consumption c_t:

$$MaxU(c_t) = \sum_{t=0}^{\infty} \frac{c_t^{1-\theta}}{1-\theta} \beta^t (1+n)^t$$

subject to their dynamic budget constraint:

$$\begin{aligned} a_{t+1}(1+n) &= R_t a_t + w_t - c_t, \\ with\ a_0 > 0\ given\quad and &\quad R_t = 1 + r_t^D\ (as\ \delta = 0) \end{aligned}$$

We have that $a_t = d_t + b_t^h$ is wealth (lower case variables represent quantities in per capita terms), where b_t^h is net lending to other households in the economy. Assume $\beta(1+n) < 1$. In this economy there are financial intermediaries that take deposits d_t from households paying them the rate r_t^D for this. 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: $r_t^L(1-\gamma) = r_t^D$.

You can 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.

Hint: Note the equilibrium relation between a_t, d_t and k_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. As a function of saving per capita, a_t, what is the income that the representative household member receives on his/her saving? And for his/her labor services?

b) Write the Lagrangian and find the first order conditions that characterize the behavior of households, and from these the Euler equation (a.k.a. the Keynes-Ramsey rule). Give an economic interpretation to this equation. Find the equations that characterize steady state and draw the phase diagram that describes the dynamics in this economy.

c) Assume that the economy is initially in the steady state. Now unexpectedly γ is permanently increased (e.g. think that there is a permanent exogenous increase in volatility that makes the economy unstable unless reserves are increased). How does this shock affect the phase diagram? 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.

5 (60 points) Consider how price setting takes place in this economy. There are a large number of firms whose desired optimal prices are (lower case letters are variables in logs)

$$p_t^* = \phi m_t + (1-\phi)p_t,$$

where m_t captures nominal aggregate demand, p_t is the price level, and ϕ is a measure of real rigidity. Assume that every period a fraction α of firms can change prices, setting a price x_t that will remain fixed until they get another chance to reset prices. Importantly for these firms the probability of changing prices is independent of when they last changed prices, and this probability is the same for every firm and is constant over time.

Given the model assumptions the price level in period t is given by

$$p_t = \alpha x_t + (1-\alpha)p_{t-1}.$$

a) Show that under the assumption that households own firms (such that firms want to maximize profits for households), and discount the future at rate β, that the optimal price to set in period t is given by the following weighted average of the expected optimal p^*

$$x_t = \sum_{j=0}^{\infty} \frac{\beta^j(1-\alpha)^j}{\sum_{k=0}^{\infty}\beta^k(1-\alpha)^k} E_t[p_{t+j}^*],$$

and that this can be rewritten as

$$x_t = (1 - \beta(1-\alpha))p_t^* + \beta(1-\alpha)E_t[x_{t+1}].$$

b) Substract p_t from the previous equation, and using that $m_t - p_t = y_t$, find the new Keynesian Phillips curve (for this use that $\pi_t = p_t - p_{t-1} = \alpha(x_t - p_{t-1})$, and similar relations for π_{t+1}, and write $x_t - p_t = (x_t - p_{t-1}) - (p_t - p_{t-1})$)

$$\pi_t = \frac{\alpha}{1-\alpha}(1 - \beta(1-\alpha))\phi y_t + \beta E_t[\pi_{t+1}].$$

Interpret this equation.

c) Solve the previous expectational difference equation for inflation as a function of current and future expected output. Interpret.