Written Exam at the Department of Economics winter 2019-20

Macroeconomics III

Final Exam

13 February 2020

(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

Written Exam - Macroeconomics III

University of Copenhagen
February 13, 2020

Question 1

Consider an economy where individuals live for two periods and the population is constant. The utility for young individuals born in period t is

$$\frac{c_{1t}^{1-\sigma}}{1-\sigma} + \frac{1}{1+\rho}\frac{c_{2t+1}^{1-\sigma}}{1-\sigma}, \quad \rho > -1$$

where c_{1t} is consumption when young, c_{2t+1} is consumption when old. Young agents work a unit of time (i.e., their total labor income is equal to the wage rate). Old agents do not work and must provide consumption through saving. A representative firm hires labor and capital. Production is given by

$$Y_t = AN_t + BK_t, \quad A, B > 0$$

where K_t and N_t are the amounts of capital and labor hired by the firm (since there is no population growth, take the aggregate amount of labor, N_t, to be normalized to one). Capital fully depreciates within one period, so that the depreciation rate, δ, equals one. Markets for factors are competitive, resulting in factors being rewarded their marginal products:

$$\begin{aligned} 1 + r_t &= B \\ w_t &= A \end{aligned}$$

a Is the economy dynamically efficient?

b Find savings and capital accumulation in the steady state.

Suppose now that, at t_0, the government starts a pay-as-you-go social security system in which the young contribute an amount τ that is received by the old (you might think of τ as a subsidy).

c Is the social security reform supported by both the young and the old? Explain.

Question 2

Assume a continuum of identical households, whose total number is normalized to one. A representative agent i maximizes utility

$$U_i = C_i - \frac{1}{\lambda}L_i^{\lambda}, \; \lambda > 0$$

subject to the budget constraint

$$PC_i = P_i Y_i$$

where C_i is consumption, L_i labor supply, P the aggregate price level, P_i the price of good i and Y_i the quantity of good i. The production technology is:

$$Y_i = L_i^{\alpha}, \quad 0 < \alpha < 1$$

There is monopolistic competition in the goods market. The demand for good i is

$$Y_i = \left(\frac{P_i}{P}\right)^{-\eta} Y$$

where Y denotes aggregate output and $\eta > 1$. The aggregate demand equation is

$$Y = \frac{M}{P}$$

where M denotes nominal money. Agents have rational expectations. The following notation applies, for a generic non-negative variable X: $x \equiv \ln X$.

a Set up the utility maximization problem and provide the relevant first order condition for the representative household.

b Show that the desired (log) price level equals

$$p^* = c + \phi m + (1 - \phi)\, p \tag{1}$$

where $\phi \equiv \frac{\lambda - \alpha}{\alpha}$ and c is constant to be derived. [*hint: assume that each producer charges the same price, so that* $p_i^* = p^*$. *Moreover, since households are all the same and their total number is normalized to one,* $y_i = y$.]

From now on set $c = 0$, without loss of generality. Assume that a fraction $(1 - q)$ of the population of firms sets prices in a flexible manner, while the remaining fraction q has rigid prices. Let p^f denote the price set by a representative flexible-price firm and p^r the price set by a representative rigid-price firm. Flexible-price firms set their prices after m is known, while rigid-price firms set their prices before m is known (and thus must form expectations on m and p). All variables are in logarithmic terms.

Suppose flexible-price firms set

$$p^f = \phi m + (1 - \phi) p$$

while rigid-price firms set

$$p^r = \phi E[m] + (1 - \phi) E[p]$$

Expectations are subject to the information known when fixed-price firms set prices (thus, $p^r = E[p^r]$). Finally, $p = q p^r + (1 - q)\, p^f$, with $0 \leq q \leq 1$.

c Find p^f in terms of p^r, m and the parameters of the model. Then show that $p^r = E[m]$.

d Show that equilibrium y and p are, respectively:

$$\begin{aligned} y &= (m - E[m]) \frac{q}{\phi + (1-\phi) q} \\ p &= E[m] + (m - E[m]) \frac{\phi (1-q)}{\phi + (1-\phi) q} \end{aligned}$$

e What happens to the pass-through of unexpected monetary injections on p and y, as α increases? Explain [*hint: you might want to think in terms of the effect of α on the degree of real rigidity, as captured by ϕ*].