Written Exam at the Department of Economics summer 2020-R

Macroeconomics III

Final Exam

17 August 2020

(3-hour open book exam)

Answers only in English.

The paper must be uploaded as <u>one PDF document</u>. The PDF document must be named with exam number only (e.g. '127.pdf') and uploaded to Digital Exam.

This exam question consists of 4 pages in total

This exam has been changed from a written Peter Bangsvej exam to a take-home exam with helping aids. Please read the following text carefully in order to avoid exam cheating.

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

- Copy other people's texts without making use of quotation marks and source referencing, so that it may appear to be your own text. This also applies to text from old grading instructions.
- Make your exam answers available for other students to use during the exam
- Communicate with or otherwise receive help from other people
- 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
- Use parts of a paper/exam answer that you have submitted before and received a passed grade for without making use of source referencing (self plagiarism)

You can read more about the rules on exam cheating on the study information pages in KUnet and in the common part of the curriculum section 4.12.

Exam cheating is always sanctioned with a warning and dispelling from the exam. In most cases, the student is also expelled from the university for one semester.

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

A permanent increase in government spending does not crowd out investment if spending is funded through lump sum taxes.

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

In an overlapping generations endowment model, money can lead to the first best allocation when the decentralized equilibrium with no money is inefficient.

3 (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 ($g_T^i = g_T$ and $g_{NT}^i = g_{NT}$ for all countries i), with the productivity of tradables growing at a faster rate than the productivity of non-tradables, ($g_T > g_{NT}$). Countries with a larger than average tradable sector will experience a real exchange rate appreciation.

4 (60 points) Consider a Ramsey economy with a continuum of households and firms operating under perfect competition. Population grows at constant rate $n > 0$, and the representative household is infinitely lived, has a unitary endowment of time each period which it supplies inelastically, and maximizes the following objective function under perfect foresight:

$$\max_{c_t, k_{t+1}} \sum_{t=0}^{\infty} (\beta(1+n))^t \log c_t,$$

subject to a given initial level of capital per capita, k_0, and to the budget constraint:

$$c_t + k_{t+1}(1+n) = w_t + R_t k_t,$$

where c_t is household consumption, w_t is the wage rate, $k_{t+1}(1+n)$ is saving assumed to be in capital, and $R_t = 1 + r_t - \delta$ is the gross return on saving, and $0 < \beta < \frac{1}{1+n}$ is the time discount factor.

Production technology is Cobb-Douglas such that the representative firm i takes factor prices and aggregate capital as given and maximizes profits

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

where K_t^i is the demand for capital and L_t^i the demand for labor, and $0 < \alpha < 1$.

a) Write the Lagrangian for households' problem and derive its first order conditions with respect to c_t, and k_{t+1}. Derive the Euler equation and interpret it. Find the wage and interest rate as a function of capital per capita, and the steady state capital per capita for this economy, k^*. Represent graphically the dynamics and how initial consumption is determined when $k_0 = \frac{k^*}{2}$.

Suppose that this economy is in steady state and it is unexpectedly hit by a pandemic at time $t = 0$. Due to unmodeled health reasons (both relating to individual decisions and public policy) labor supply will be reduced by a fraction $0 < \theta < 1$ from period 0 to period T, returning afterwards to its normal, unitary level. We make the assumption that the duration of the pandemic is known at time $t = 0$, i.e. there is no uncertainty about T.

b) When the shock hits, what happens with the wage and the interest rate? And with wage income? What are the short and long run effects of a surprise pandemic on consumption, capital accumulation and output? Explain

Now assume that households not only reduce their labor supply but also discount the future at rate $p\beta$, where $p < 1$ the subjective probability of not dying. Furthermore, this second effect is permanent, as households remain concerned of future pandemics after this one is over.

c) What happens in this case with the wage and the interest rate when the pandemic arrives? And with wage income? What are the short and long run effects of a surprise pandemic on consumption, capital accumulation and output in this case? Explain

5 (60 points) Consider an economy where individuals live for two periods, and population is constant. It is composed of residents and a permanent flow of temporary immigrants. These arrive when young, have same preferences as residents, and are assumed to get employment. They have no children and leave the country just before they die. The ratio of temporary immigrant workers to native resident workers is $n > 0$. Both immigrants and residents receive the same wage, but only residents make contributions to, and receive benefits from, social security (to be described below). Immigrants only use their capital income to fund their old age consumption.

Identical competitive firms maximize the following profit function:

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

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

$$U_t = \ln(c_{1t}) + \beta \ln(c_{2t+1}), \quad \beta > 0$$

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

Suppose that the government runs a pay-as-you-go social security system in which each young resident household contributes a fraction $0 < \tau < 1$ of their wages in period t that is used to provide benefits to the current old, i.e. $b_t = \tau w_t$ are the benefits received by the old in period t.

a) Characterize saving behavior by solving the individual's problem of optimal intertemporal allocation of resources. How does saving differ for residents and immigrants?

Find the capital accumulation equation that gives k_{t+1} as a function of k_t (where k is capital per worker). Find the level of capital per worker in steady state. [Hint: capital is the aggregate of the, possibly different, savings of residents and immigrants]

Assume that the economy is initially in the steady state, and that parameters are such that the economy is always dynamically efficient. Now unexpectedly a pandemic hits the world and migration inflows stop completely ($n = 0$). Assume this is a permanent shock.

The government keeps the social security tax unchanged at initial level τ. Note that to solve what follows you have to consider the general equilibrium effects that the change in the flow of immigrants has on wages and the interest rate.

b) What is the effect of the shock on capital accumulation in the first period (compared to capital accumulation in the previous steady state)? And on the new steady state? Explain (if you prefer not to do the math you can explain in words what is the intuition).

c) Are the initial old better off? What is the effect on the disposable income of the first young generation of residents. Explain.