Written Exam at the Department of Economics Winter 2017-R

Economic Growth

Final exam

August 28th.

(3-hour closed book exam)

Please note that the language used in your exam paper must correspond to the language for which you registered during exam registration.

This exam question consists of 3 pages in total

NB: *If you fall ill during the actual examination at Peter Bangsvej, you must contact an invigilator in order to be registered as having fallen ill. Then you submit a blank exam paper and leave the examination. When you arrive home, you must contact your GP and submit a medical report to the Faculty of Social Sciences no later than seven (7) days from the date of the exam.*

Question A: Verbal questions

1. Please, explain the key difference between the "Romer model" and the "Aghion-Howitt model".

2. Please, explain: (i) how Coe, Helpman and Hoffmaister ("North-South R&D Spillovers". *Economic Journal* 107, 143-49) propose to test for international R&D spillovers; (ii) what their main findings are; (iii) what, in theory, their findings suggest about the R&D investment level, relative to the social optimum, in "the North".

3. Explain why inequality may affect growth in the presence of imperfect credit markets. Do we expect the "sign" of the impact to be the same regardless of the level of average income in the economy? Please, explain.

4. Nordhaus ("Are We Approaching an Economic Singularity? Information Technology and the Future of Economic Growth". NBER WP No. 21547) recently provided a model of "the sigularity". What is "the singularity hypothesis" all about? Please, name three testable implications.

5. Please, explain how lightning strikes may help us understand the impact of IT on economic growth.

6. Discuss the role of "linkages and complementarity" in explaining cross-country differences in economic development.

B. Analytical questions

Consider the Aghion- Howitt model of growth via creative destruction, where final goods production is assumed to be Cobb-Douglas, $y_t = A_t x_t^{\alpha}$:

$$w_t = \lambda V_{t+1},\ \lambda > 0 \tag{1}$$

$$rV_{t+1} = \pi_{t+1} - \lambda n_{t+1} V_{t+1} \tag{2}$$

$$x_t = \left(\frac{\alpha^2}{w_t/A_t}\right)^{\frac{1}{1-\alpha}},\ p_t = \frac{1}{\alpha} w_t \tag{3}$$

$$\pi_t = (p_t - w_t)\, x_t \tag{4}$$

$$L = n_t + x_t \tag{5}$$

$$A_{t+1} = \gamma A_t,\ \gamma > 1. \tag{6}$$

t refers to innovation number (not time!). The notation is as follows: w is the wage rate; V is the value of an innovation; r is the real rate of interest, which is assumed constant and given by the rate of time preferences; x is intermediate goods; A_t is the level of productivity of the t'th innovation; L is the (constant) total labor force; n is R&D labor. It is assumed that one unit of labor produces one unit of intermediate good. When an innovation occurs a patent is obtained for production of the intermediate good that allows the use of it in final goods production. A new innovation is assumed to leave the previous innovation obsolete such that it is no longer in use. Accordingly, the intermediate goods sector produces under monopoly. Finally, innovations are stochastic events that follow a Poisson process with parameter λ. Hence, if one unit of R&D labor is employed the probability of a new innovation occuring within the next short amount of time is λ; if n people are engange with R&D the probability is λn.

1. Comment on equation 1-5 and explain why the variables and parameters enter into the equations in the manner suggested by the formulas.

2. What is the "Arrow replacement effect" and how is it visible in the model above?

3. A steady state of the model is such that $\omega_{t+1} = \omega_t = \omega$ and $n_{t+1} = n_t = n$, where $\omega_t \equiv w_t/A_t$. (a) Show that in the steady state the solution for R&D labor is implicitly given by:

$$1 = \frac{\lambda\gamma\left(\frac{1}{\alpha} - 1\right)(L - n)}{r + \lambda n}$$

(b) What is the (expected) growth rate of output in the steady state? (*Hint*: Recall that the number of innovations between two points in time are described by a Poisson process with expected value λn)

4. Greater exposure to international trade may *intensify* domestic competition. What is the impact of greater competition on growth in the present model? Explain how to measure "competition" in the model; provide formal derivations to back-up your conclusion, and provide a verbal interpretation of why the result comes out the way it does.

5. Greater exposure to international trade may lead to greater market access. What is the impact of a larger market on growth in the present model? Explain how to measure "market size" in the model, provide formal derivations to back-up your conclusion, and provide a verbal interpretation of why the result comes out the way it does.

6. What does the evidence say? Does trade increase growth? Please, provide a brief description of the empirical study (/studies) you draw on.