Written Exam at the Department of Economics summer 2020- R

Economic Growth

Final Exam

13 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 5 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 Short essay questions

Question 1.a

Based on the insights from Hsieh and Moretti (2019) and the other papers on misallocation on the syllabus, discuss the following proposition: Moving public sector jobs from Copenhagen to provincial towns is a good idea. Be clear about the assumptions you make in your answer.

Question 1.b

A key implication of so-called "AK models" of endogenous growth is that a higher investment rate leads to faster growth in the long-run (i.e., in steady state). How well does this prediction fit the data? Suppose a researcher runs the following panel regression for a large sample of countries (indexed by i):

$$\ln y_{it} = \theta_i + u_t + \beta_1 \ln y_{it-1} + \beta_2 \ln s_{it} + \beta_3 x_{it} + \epsilon_{it},$$

where y is GDP per capita, $\theta_i$is a fixed effect, u_t is a time fixed effect, s is the investment rate, x is a vector of control variables and ϵ is a noise term. The index t refers to calendar time. Imagine furthermore that when estimating the model you find $\beta_2 > 0$. Would you see this finding as evidence in favor of the AK-model? Explain why or why not.

Question 1.c

Pikkety's "second law of capitalism" asserts that the ratio of capital to net-output, κ, in the long run is given by

$$\kappa \equiv \frac{k}{\widetilde{y}} = \frac{\widetilde{s}}{g},$$

where $\widetilde{s}$ is the net savings/investment rate and g is the growth rate of GDP. Net output is defined as $\widetilde{y} = y - dk$. Clearly, if g tends to zero, κ tends to infinity. Is this prediction credible? Why/Why not?

2 Inflation and new products

In this question you are asked to analyze how the introduction of USB drives affected the measured rate of price inflation in digital storage. Table 1 presents a stylized example with four periods. In period 1, floppy disks were the only form of digital storage. In period 2, USB drives became available, but statistical agencies did not collect data on the number of drives sold until period 3. In period 4, USB drives had completely replaced floppy disks. Prices in the table are per gigabyte (GB), and quantities are likewise measured in gigabytes.

Table 1: Digital storage

Period	1	2	3	4
USB drive price/GB	n/a	4.0	2.5	2.0
USB drives sold (GB)	0	?	20	24
Floppy disk price/GB	3.00	3.15	3.30	n/a
Floppy disks sold (GB)	60	45	20	0

Question 2.a

Derive a price index for digital storage using the linking method. Set the index in period 1 to 100 and use standard chain weights in the calculation (i.e., use expenditure shares in period t-1 to compute inflation between period t-1 and period t). Report the index values for all four years. Explain why this measure of inflation in digital storage prices may be misleading.

Question 2.b

Derive an approximate COLI again using chain weights (hint: the first step is to use observed prices and quantities to derive the demand curve for USB drives). What problems does this new index solve compared to the linking method? Are there still problems left unsolved?

Question 2.c

Derive an approximate COLI using expenditure shares from period 3 as weights in all four periods. Comment on the results. What problem does this new index solve compared to the COLI with chain weights? Should we consider this new index an improvement over the chain-weighted version, or does it have its own problems?

Question 2.d

Now calculate the rate of inflation (or deflation) between period 1 and period 4 according to the three price indices that you have derived in the previous three questions. Compare the results to the true rate of inflation in the price per unit of storage. Are the results as you would have expected? Can you think of ways to improve the accuracy of estimated inflation beyond what you have done in the three questions above?

3 Stagnation and the natural rate of interest

Consider an overlapping generations model where economic activity extends into the infinite future. Specifically, we are considering a Diamond-model, where both population growth and exogenous technological change is ignored, and where preferences are logaritmic. Hence

$$u_t = lnc_{1t} + \frac{1}{1+\rho} lnc_{2t+1},$$

and the individual budget constraints are $c_{1t} + s_t = w_t$ and $c_{2t+1} = (1 + r_{t+1})\, s_t$. The notation is standard.

Question 3.a

Show that savings of the young is given by

$$s_t = \frac{1}{2+\rho} w_t.$$

Question 3.b

The representative firm operates the production technology, $y = f(k)$, where k is capital-labor ratio and y is the output-labor ratio. All markets are competitive, and firm profits can be written $f(k) - (r + d)\, k$. The parameter d is the rate of capital depreciation. The production function, $f\,(k) \equiv F(K/L, 1)$ where F exhibits constant returns to K and L. From now on, and without loss, we normalize the size of the labor force to one, $L = 1$.

Under these assumptions, show that profit maximizing behavior and competitive markets imply

$$r_t = f'\,(k_t) - d$$

and

$$w_t = f\,(k_t) - f'\,(k_t)\, k_t.$$

Question 3.c

Since individuals consume their total savings during old age the future capital stock only depends on the savings of the currently young, $k_{t+1} = s_t$. It has been used that the size of the labor force (and thus the size of the young generation) is normalized to one.
From now on we assume f'>0, f"<0. A standard requirement for endogenous growth to arise is that the marginal product of capital is bounded away from zero

$$lim_{k\to\infty} f'(k) = A > 0.$$

Show that this technology assumption leads to (asymptotic) stagnation in the present model. Why does positive exponential growth not arise, even though we have imposed the standard requirement for endogenous growth?

Question 3.d

The "natural real rate of interest" is usually defined as the real rate which is consistent with stable inflation and output at its structural level. Accordingly, the steady state predictions of the present model carries predictions regarding the long run movements in the natural rate of interest.

(a) How has the real rate of return changed over the last three decades empirically? (b) What could, within the present model, account for such changes?

Question 3.e

An interesting empirical finding is that the natural real rate recently seems to have ventured into negative territory. Is a negative natural rate a possibility in the present model? Explain.