

## Final exam, ECON 485F Economic Growth and Structural Transformation

There are five questions in this exam for a total of 120 points. Good luck!

### Question 1 (45 points)

The country of Eyekeea, in which people care a lot about interior design, has two sectors: In one sector carpenters build furniture, and in the other sector, artists paint pictures. In the furniture sector, the constant technology improvement in woodworking tools means that productivity doubles every 12 years on average. On the other hand, the time it takes painters to create nice pictures doesn't change much over time, so productivity in the painting sector stays constant over time. Eyekeea has a total labor force of 6 million people, all of which can work either as painters or carpenters.

Expressed in terms of their production function, the number of pieces of furniture produced is  $Y_F = A_F L_F$ , and the number of paintings produced is  $Y_P = A_P L_P$ , where  $A_F$  and  $A_P$  are productivity, and  $L_F$  and  $L_P$  are the number of workers in the respective sectors. For simplicity, you can assume that currently both  $A_F = 1$  and  $A_P = 1$ .

Households in Eyekeea have very specific ideas about how to decorate their homes: They want exactly 4 pieces of furniture and 1 painting in every room.

- Assuming that the economy is operating efficiently, how many people are currently working as carpenters vs as painters? (5 pts)
- What is the growth rate in the economy between now and 12 years from now (i.e. how much more furniture and paintings will be produced in year 12 compared to now)? How many painters and carpenters will there be in year 12? (14 pts)  
You may want to follow these steps:
  - What is the ratio of goods produced in the two sectors in year 12?
  - How much labor does it take in each sector to produce this ratio of goods?
  - How many goods are produced in each sector given labor and productivity?
- What is the growth rate in the economy between year 12 and year 24? (10 pts)
- In the long run, what will the economy's growth rate be? How many people will work as carpenters vs as painters? Explain what is going on in the economy in one paragraph. (8pts)
- In one paragraph, explain how the example economy of Eyekeea relates to the experience of the US over the past six or seven decades. (8pts)

### Question 2 (45 points)

Consider the following table with information from the lab excel sheet about factor inputs as well as production for the USA and Ghana:

	Capital $K$	Labor $L$	Human Capital $H$	Output $Y$
Ghana (2009)	823.6	23.9	2.35	28.2
USA (2009)	91170.0	307.0	3.28	12300.3

Production is given by the production function  $Y = A F(K, L, H) = A K^{0.3} L^{0.4} H^{0.3}$ . This production function explicitly accounts for the contribution of human capital in the form of education.

- a) Find productivity in Ghana relative to productivity in the United States in 2009,  $A_{\text{Ghana}}/A_{\text{USA}}$ . (10 pts)
- b) US technology growth has recently averaged 0.6%. Assuming that Ghana is currently using technology that lags 30 years behind US technology, what is the percentage difference in *efficiency* between the Ghanaian economy and the US economy? (10 pts)  
(Hint: If there were no differences in technology, how much higher would Ghana's productivity be? How much less than US productivity would it still be?)

For the two countries, Ghana and USA, consider the model of technology transfer where the USA is the technology leader and Ghana the technology follower.

- c) Which country has the higher growth rates in the long run according to this model? (3 pts)
- d) The USA decides to dedicate more workers to research, increasing their share of researchers in the workforce  $\gamma_{\text{A,USA}}$ . Describe with 1-2 sentences each what happens to
  - Output level and growth rate in the US
  - Output level and growth rate in Ghana
  - The level of technology in the US relative to Ghana (the "technology gap"). (8 pts)
- e) Now Ghana increases their share of workers that do research  $\gamma_{\text{A,Ghana}}$ . Describe with 1-2 sentences each what happens to
  - Output level and growth rate in the US
  - Output level and growth rate in Ghana
  - The technology gap (8 pts)
- f) Give a reason with an example for why technology transfer from the US to Ghana might be more difficult than suggested by the leader-follower model. (6 pts)

### Question 3 (10 points)

When you graduate from college, you will have had (an average of) 16 years of schooling. In the United States, the expected return to every additional year of schooling is a wage increase of 6%. Which fraction of your expected wage would a labor economist attribute to your human capital, and which fraction would they attribute to raw labor?

### Question 4 (10 points)

Consider the Solow model with technical progress. One country A has a higher rate of technology growth than another country B, so that  $g_{Z,A} > g_{Z,B}$ . But it also has a lower capital stock, i.e.  $K_{t,A} < K_{t,B}$ . Assume that the countries are otherwise identical, and that the technology growth rates  $g_{Z,A}$  and  $g_{Z,B}$  are exogenously given for each country.

Which country has the higher growth rate in per-capita income in the short run? Which country has the higher growth rate in per-capita income in the long run? Explain with a few sentences each.

### Question 5 (10 points)

Do you think the duration of patent protection for important drugs should be shortened? Discuss one argument pro and one con, and give an alternative to patenting in this context.