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EC569 Economic Growth
Problem Set #3
Quiz open: Monday, March 16th 16:00 – Wednesday, March 18th 16:00
Note: Once you begin your quiz, you will have 2 hours to complete the quiz.
You can take the quiz only once.

You may discuss the problem set questions with your fellow students, but each of you should write his/her own work and take the quiz by himself/herself.

1. Wakanda and Zakanda are two neighboring countries. Wakanda has a highly advanced technology, whereas, Zakanda has a lower level of technology and lower income per capita. In the usual setting, we would expect Zakanda to learn about Wakanda's technology but Wakanda has been successfully hiding its technology from the rest of the world for centuries. At time $t = 0$, Wakanda has a productivity of 10, $A_w = 10$, and 20% of its labor force engage in R&D, $\gamma_{A,W} = 0.2$. Zakanda, on the other hand, has a productivity level of 6, $A_Z = 6$, and 10% of its population engages in R&D, $\gamma_{A,Z} = 0.1$. Each country has a labor force equal to 1, $L = 1$. Price of invention in each country is equal to 10, $\mu = 10$. Along the line, the following events take place:

- After long soul searching, at time $t = 10$, King T'Challa of Wakanda decides to open up Wakanda's technology to Zakanda.
- King T'Chala observes Zakanda's development for 10 periods. But, he is surprised that Zakanda did not imitate Wakanda's technology and it grows at its former pace, as before time $t = 10$. He appoints his sister and Chief Scientist of Wakanda, Shuri, as his technology ambassador to Zakanda at time $t = 20$.
- With the help of Shuri, Zakanda is able to imitate Wakanda's technology with a cost of copying equal to $\mu_c = \mu_i \left(\frac{A_L}{A_F}\right)^{-1/2}$, where A_L is the productivity of technology leader and A_F is the productivity of technology follower. Shuri convinces Zakanda to increase the fraction of workers engaged in R&D to 15%, $\gamma_{A,Z} = 0.15$
- After observing the progress made since $t = 20$, Zakandans increase the fraction of labor force engaging in R&D to 22%, $\gamma_{A,Z} = 0.22$ at time $t = 50$.

a) Using the appropriate models we covered in Lecture 7[1], simulate and plot Wakanda and Zakanda productivities and income per worker levels from $t = 0$ to $t = 250$ considering the events took place. Briefly comment on your graphs. In your graphs, make sure to highlight each event.

b) What might have prevented Zakanda from imitating Wakanda's technology from time $t = 10$ to time $t = 20$? Briefly explain. (In this question, I expect you to read section 8.4 (Barrier to international technology transfer) of Weil (2013).)

In questions 2 and 3, using Penn World Table, https://www.rug.nl/ggdc/productivity/pwt/, you will do development accounting and growth accounting. In these questions, use 'rgdpna' (Real GDP at constant 2011 national prices (in mil. 2011US$)) as a measure of real GDP, use 'rnna' (Capital stock at constant 2011 national prices (in mil. 2011US$)) as a measure of real capital stock, use 'emp' (Number of persons engaged (in millions)) as a measure of employment, and use 'hc' (Human capital index, based on years of schooling and returns to education) as a measure of human capital. You don't need to divide 'hc' with employment numbers as 'hc' is already a measure of average human capital in a society. Assume $\alpha = 1/3$ for questions 2 and 3.

2. Using 2017 values in Penn World Table, conduct development accounting of Argentina, Germany, Bulgaria and Japan relative to the United Kingdom. Create a table summarizing your results. Briefly comment on the table.

3. Conduct growth accounting of Italy, Greece, Spain, South Korea and the United Kingdom. Examine data from 1970 to 2017. Create a table summarizing your results. Briefly comment on the table.

[1]You need to employ one-country model of technology creation and growth and two-country model of technology creation and growth in answering this question.