Macroeconomics Analysis II, EC3102
Tutorial 9
(Romer model) [1]

Question 1 *Changes in model parameter: An increase in the initial stock of knowledge*

Suppose we have two economies: Earth and Mars - that are identical, except that one begins with a stock of ideas that is twice as large as the other:

$$A_0^{\text{Earth}} = 2 \times A_0^{\text{Mars}}.$$

The two economies are so far apart that they don't share ideas, and each evolves as a separate Romer economy. On the same axes (graph), sketch the logarithm of per capita GDP on Earth and Mars over time. What is the effect of starting out with more knowledge?

Question 2 *A look at the data: Intellectual property products.*

In 2015, the U.S. National Income Accounts began to "count" intellectual property products - such as R&D, computer software, books, music, and movies - explicitly as investment. More correctly, they had previously assumed these products were an intermediate good that depreciated fully when used to produce some other final good, but now they are included as part of investment and GDP. Examine the data on the investment in intellectual property products (IPP).[2]

a.

What has happened to the share of GDP devoted to investment in IPP over the last 60 years? What might explain this change?

b.

If this were the only change included in a Romer model (as described in question 1), what would happen to the growth rate of GDP per person over time? What might explain why this has not happened?

[2]U.S. Bureau of Economic Analysis, Shares of Gross Domestic Product: Gross Pri-vate Domestic Investment: Fixed Investment: Nonresidential: Intellectual Property Prod-ucts [*Y*001*RE*1*Q*156*NBEA*], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/Y001RE1Q156NBEA, September 6, 2017.

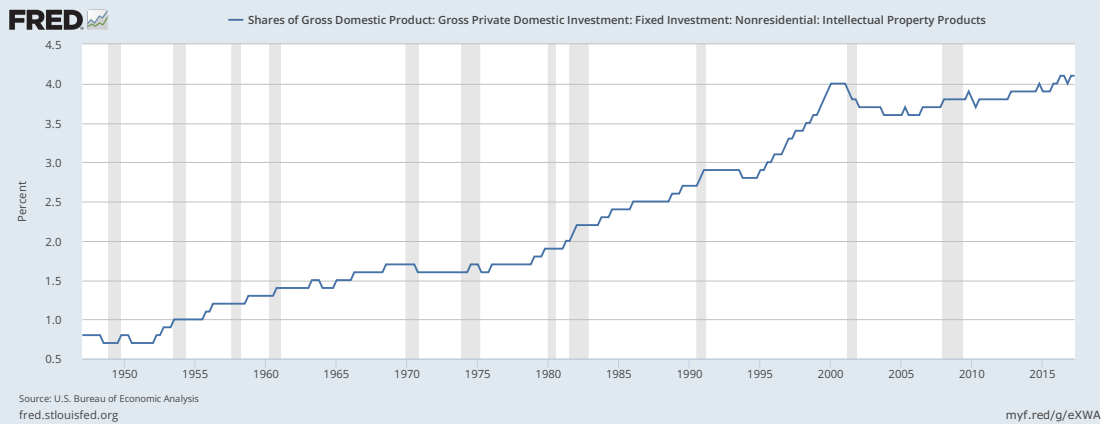

Figure 1: Investment in intellectual property products (IPP) as a share of GDP.

Question 3 *Combining Solow and Romer.*

Suppose an economy is on a balanced growth path in the following combined model, where aggregate output is:

$$Y_t = A_t K_t^{\frac{1}{3}} L_{yt}^{\frac{2}{3}},$$

law of motion of capital (capital accumulation equation) is:

$$\Delta K_{t+1} = \bar{s} Y_t - \bar{d} K_t,$$

law of motion of ideas (idea production function) is:

$$\Delta A_{t+1} = \bar{z} A_t L_{at},$$

labour resource constraint is:

$$L_{yt} + L_{at} = \bar{L},$$

and the allocation of labour is:

$$L_{at} = \bar{l} L,$$

where $\bar{s}$ is a fixed savings rate, $\bar{z}$ is a productivity parameter of the researchers, A_0 is the existing stock of ideas at time, $t = 0$, $\bar{L}$ is the total population and assumed to be constant, and $\bar{l}$ is the constant fraction of population who works in the research sector.

a.

On the balanced growth path, the growth rates of each of the endogenous vari-ables: Y_t, K_t, and A_t are constant (not necessarily identical). From the law of motion of capital stock (capital accumulation equation), show that the growth rate of output is equals to the growth rate of capital stock in this model along the balanced growth path. That is, $g_Y^* = g_K^*$, where the supercript $*$ denotes the fact that these variables are evaluated along a balanced growth path.

b.

Express the growth rate of output per capita along the balanced growth path, g_y^*, in terms the exogenous parameters of the model.

c.

Show that along the balanced growth path, output per capita is:

$$y_t^* \equiv \frac{Y_t^*}{\bar{L}_t^*} = \left(\frac{\bar{s}}{g_y^* + \bar{d}} \right)^{\frac{1}{2}} (A_t^*)^{\frac{3}{2}} \left(1 - \bar{l}\right).$$