An Increase in Research Productivity

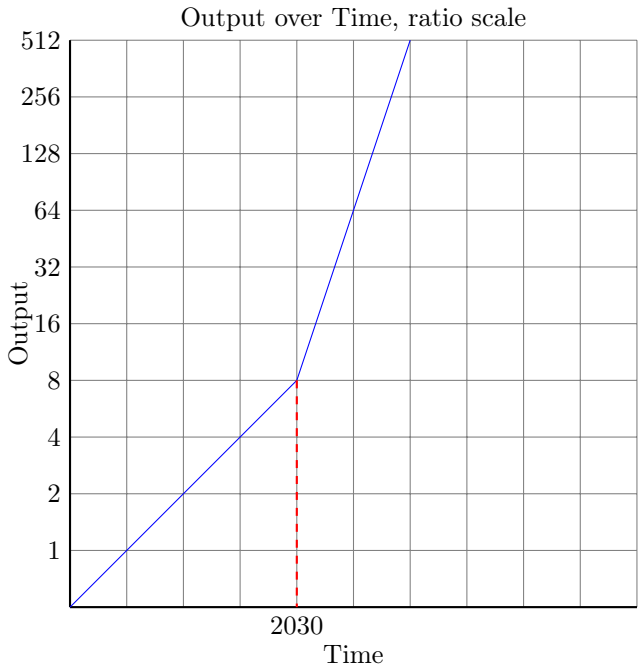
Suppose that the economy is on a balanced growth path in the Romer model. Then, in 2030, research productivity $\overline{z}$ rises immediately and permanently to $\overline{z}'$.

(a) Make a graph of y_t over time using a ratio scale.

(b) Why might research productivity increase in an economy?

Solution

(a)



(b)

Research productivity might increase in an economy if the government undertakes large scale investments in education or increases the prizes or patents that it provides to new research that entices different types of innovations.

Numbers in the Romer Model

Suppose the parameters in the Romer model are as follows: $\overline{A}_0 = 100$, $\overline{\ell} = 0.1$, $\overline{z} = 1/500$, and $\overline{L} = 100$.

(a) What is the growth rate of output per person in this economy?

(b) What is the initial level of output per person? What is the level of output per person after 100 years?

(c) Suppose research share were to double. How would you answer parts (a) and (b)?

Solution

(a)

The growth rate of output is equal to the growth rate of A, which is equal to:

$$\begin{aligned} g_a &= \overline{z}\overline{\ell}\overline{L} \\ &= \boxed{0.02} \end{aligned}$$

(b)

The initial level of output per person is equal to:

$$\begin{aligned} y_0 &= \overline{A}_0(1-\overline{\ell}) \\ &= \boxed{90} \end{aligned}$$

$$\begin{aligned} y_{100} &= \overline{A}_0(1-\overline{\ell})(1+\overline{z}\overline{\ell}\overline{L})^{100} \\ &= \boxed{652} \end{aligned}$$

(c)

If research share were to double, we would get the following results:

$$\begin{aligned} g_a &= \overline{z}\overline{\ell}\overline{L} \\ &= 0.04 \end{aligned}$$

$$\begin{aligned} y_0 &= \overline{A}_0(1-\overline{\ell}) \\ &= 80 \end{aligned}$$

$$\begin{aligned} y_{100} &= \overline{A}_0(1-\overline{\ell})(1+\overline{z}\overline{\ell}\overline{L})^{100} \\ &= 4041 \end{aligned}$$

A Variation of the Romer Model

Consider the following variation:

$$\begin{aligned} Y_t &= A_t^{1/2} L_{yt} \\ \Delta A_t &= \overline{z} A_t L_{at} \\ L_{yt} + L_{at} &= \overline{L} \\ L_{at} &= \overline{\ell}\overline{L} \end{aligned}$$

There is only a single difference: we have changed the exponent on A_t in the production of the output good so there is now a diminishing product to new ideas in that sector.

(a) Provide an economic interpretation for each equation.

(b) What is the growth rate of knowledge in this economy?

(c) Solve for the level of output per person at each point in time.

(d) What is the growth rate of output per person in this economy?

Solution

(a)

- In the first equation, we are assuming that output is a function of ideas, A, which have diminishing marginal product, and labor output.
- In the second equation, the rate of new idea production is equal to the product of $\overline{z}$, the research productivity, and L_{at}, the labor force dedicated to research output, as well as the previous year's research (since we are assuming no "idea depreciation").
- In the third equation, we have our resource constraint — namely, that there is a finite number of laborers, split between labor output and research output.
- In the fourth equation, we are defining the research labor to be a certain fraction, $\overline{\ell}$ of the total labor force $\overline{L}$.

(b)

$$\Delta A_t = \overline{z}\overline{\ell}\overline{L}A_t$$
$$\frac{\Delta A_t}{A_t} = \overline{z}\overline{\ell}\overline{L}$$

$$g_a = \boxed{\overline{z}\overline{\ell}\overline{L}}$$

(c) and (d)

$$\begin{aligned} Y_t &= A_t^{1/2} L_{yt} \\ y_t &= A_t^{1/2}(1-\overline{\ell}) \\ &= A_0^{1/2}\left((1+\overline{z}\overline{\ell}\overline{L})^t\right)^{1/2}(1-\overline{\ell}) \\ &= A_0^{1/2}(1+\overline{z}\overline{\ell}\overline{L})^{t/2}(1-\overline{\ell}) \end{aligned}$$

$$g_y = \frac{\overline{z}\overline{\ell}\overline{L}}{2}$$

Methodologies Used by Macroeconomists to Conduct Research

How do the articles about development aid illustrate the various techniques used by economists to conduct research? Specifically, create a list of the various techniques that are discussed in these articles. Briefly, describe these techniques with concrete examples from the articles.

Solution

In "Do conflicts cause poverty, or vice versa," the authors cite the technique of instrumental variables estimation to isolate the effects of conflicts vs. drought and other hardships, and found that poverty/drought does lead to conflicts. They also discuss typical correlations such as OLS.

In the case of "Incentives to learn," the authors looked at a randomized set of schools whose students were eligible to receive merit scholarships and tracked their academic performance as a result of cash incentives.

Similarly, in "Deciphering the Demand for Clean Water," the study authors used randomized trials to find the effects of different clean water interventions and the willingness to pay on the part of households.

Development Aid

Development Aid. Based on the findings from the articles about development aid, how can development aid (1) reduce conflicts, (2) increase human capital attainment and (3) increase access to water.

Solution

(1) Development aid can reduce conflicts by being used to alleviate droughts during periods of emergency.

(2) Development aid can increase human capital attainment by providing incentives to students to increase their education levels.

(3) Development aid can increase access to water by funding water treatment and other measures to remove contaminants.