

Practice Set 8 – KEY

Economic Growth

This set contains problems for your own practice. It is highly recommended to work on the problems on your own. Do not just read the provided solutions. Instead, try to solve the problems and use the solutions only when you cannot continue on your own. Reading problems that someone else has solved has the same value for your preparation like watching someone else running a marathon on TV and then expecting to be able to run it, too. If you have questions on this set, please ask your section's teaching assistant.

1. Explain the difference between *sustained growth* and *catch-up growth*.

Sustained growth is when GDP increases because of improvement in technology and in the productivity of human capital in a country. Catch-up growth is when GDP increases because of foreign investment or due to technological spillovers from other countries. For example, the iPhone is a contributor to the sustained growth of the USA because it was researched and designed by an American company which profited from its production. Moreover, the iPhone also contributed to the catch-up growth of China because it is assembled by Chinese factories.

2. Country A has a higher GDP per capita than country B but country B exhibits a higher growth rate than country A. Comment on the validity of the following statements.

(a) *"The gap between the GDP per capita of both countries will converge over time".*

The statement is accurate. Country B grows at a faster rate than A, and thus, the gap every year will keep closing.

(b) *"GDP per capita in Country B will eventually surpass that of country A".*

The statement will be correct provided that the growth rate in country B remains above that of country A for a sufficient number of periods.

3. *"GDP is 100 and it grows with 10% per year, thus it will take 6 years for GDP to become 160".* Explain if the statement is accurate.

The statement is false. If GDP per capita grows with 10% per year:

- *The first year it will be $100 \cdot (1 + 0.1) = 110$;*
- *The second year it will be $110 \cdot (1 + 0.1) = 121$;*
- *The third year it will be $121 \cdot (1 + 0.1) = 133.1$;*
- *The fourth year it will be $133.1 \cdot (1 + 0.1) = 146.41$;*
- *The fifth year it will be $146.41 \cdot (1 + 0.1) = 161.05$;*
- *The sixth year it will be $161.05 \cdot (1 + 0.1) = 177.16$.*

So, it will take a little less than five years to reach 160, not six years.

4. Explain the difference between 'actual GDP' and 'steady-state GDP'.

'Actual GDP' is the GDP that an economy currently produces. 'Steady-state GDP' is the potential GDP that this economy heads towards given its production function, saving rate and depreciation rate. When actual GDP becomes equal to steady-state GDP, the economy will be producing exactly as much physical capital as needed to offset the depreciation and it will neither grow, nor shrink anymore.

5. Explain the difference between 'depreciation' and 'depreciation rate'; and between "saving" and 'saving rate'.

Depreciation is total capital lost due to wear and tear or obsolescence ($d \cdot K$). Depreciation rate is the percentage rate of capital depreciation (d). Similarly, total saving is $s \cdot Y$, while the saving rate is s .

6. An economy's GDP is currently below its steady-state GDP.

(a) Is this economy expected to grow or shrink next year?

Every economy is heading towards its steady-state. If it is currently below it, we should expect that next year it will grow.

(b) Is this economy expected to grow forever?

No. The economy will keep growing in a diminishing rate till it reaches its steady-state. Once the steady-state is reached, growth rate becomes zero.

(c) If the production function, the saving rate and the depreciation rate remain constant, will this economy keep growing at a constant rate till it reaches the steady-state?

The reason why the economy grows when it is below the steady-state is that the new capital built ($s \cdot Y$) exceeds the capital lost due to depreciation ($d \cdot K$), and therefore, capital stock increases causing the production of GDP to increase, too. That is, the increase in capital is $\Delta K = s \cdot Y - d \cdot K$. As we have seen in the lecture, $s \cdot Y$ increases with K but at a decreasing manner because of diminishing marginal product. Conversely, $d \cdot K$ increases proportionally (linearly) to K . This means that as the economy approaches the steady-state, the difference $s \cdot Y - d \cdot K$ remains positive but becomes smaller. Thus, the closer the economy is to its steady-state, the slower it will grow.

(d) What should happen for an economy to keep growing forever?

Every economy always heads towards its steady-state. Therefore, sustained growth requires that the steady-state output is constantly increasing. This can be achieved in three ways: (i) increase in the saving rate (s), which by default cannot happen indefinitely; (ii) decrease in the depreciation rate (d), which also cannot happen indefinitely as capital naturally will tend to decay; (iii) improvement of the production function (Y) with technological progress or development of human capital, which is the main mechanism that can lead to sustained growth that can last indefinitely.

7. Consider an economy where the depreciation rate is 15%, the capital stock is currently 200, the GDP is 450 and the saving rate is 20%.

(a) How much capital will this economy have next year?

If the depreciation rate is 15%, the total amount of depreciation till next year will be $0.15 \cdot 200 = 30$. The new capital created for next year will be $0.2 \cdot 450 = 90$. So, next year this economy will have $90 - 30 = 60$ units more capital or 260 units of total capital stock.

(b) Is the depreciation of capital going to be higher next year?

Depreciation this year is $0.15 \cdot 200 = 30$. Depreciation next year will be $0.15 \cdot 260 = 39$. Next year more capital will depreciate because the depreciation rate is constant and more capital stock will exist to depreciate.

(c) Is this economy at its steady-state?

No. Since the capital stock is growing, more output will be produced next year. As long as the economy is growing, it cannot be at a steady-state.

8. Explain how it could be possible for an economy to be above its steady-state GDP.

An economy cannot naturally grow past its steady-state. The only way for an economy to currently have a GDP above the steady-state is after a crisis or some other negative shock. For instance, assume that an economy currently has a GDP of 90 and heads towards a steady-state GDP of 100. Suddenly, a big shock happens in the economy (crisis, war, coronavirus or something) and shifts the production

function downwards causing the steady-state GDP to fall from 100 to 80. Since the economy is already at 90, it is now above the new steady-state and it will reverse course to shrink towards 80.

9. Consider two economies with identical production functions, saving rates and depreciation rates. Explain whether the following situations are possible according to the Solow model.

- (a) The two economies have different steady-state GDPs.

It is not possible. Since the two economies will have the same production function, they will both have the same $s \cdot Y$ curve. Since they have the same depreciation rate, they will have the same $d \cdot K$ line. This means that the capital at which $s \cdot Y = d \cdot K$ is the same for the two economies, and therefore the steady-state Y will also be the same.

- (b) The two economies currently exhibit different growth rates.

As shown in (a) both economies head towards the same steady-state GDP. Since both economies are characterized by identical $s \cdot Y$ curves and $d \cdot K$ lines, they will approach the steady-state in the same manner at the same growth rates, if they have begun converging at the same time. However, there is the possibility that one economy has begun converging towards the steady-state several years earlier than the other one. As a result, the economy that is ahead, is closer to the steady-state and its current growth rate has already decelerated in comparison to the other economy that is still further away from the steady-state. So, it is possible for the two economies to currently exhibit different growth rates.

10. Donald Trump had once said regarding the trade war between the US and China: “What China does is unfair. If we were doing the same, our economy would grow faster than theirs. But we do not want to be unfair.” Use your knowledge from lecture 8 to explain the validity of this statement.

The statement is fundamentally wrong in two ways. First, China’s high growth rates over the past decades were mainly catch-up growth, not sustained growth like in the US. Second, the US, as a developed economy, is closer to its steady-state than China. Therefore, the US cannot be expected to grow at the same rate as China even if it was doing “whatever” China was accused of doing by ex-President Trump.