Long-Run Economic Growth

Chapter 4.3 and 4.4

Outline

- Malthusian stagnation and the demographic transition
- The Solow growth model

4.3 Malthusian Stagnation and the Demographic Transition

- Between 500 and 1500 per capita GDP unchanged in Europe
- Thomas Malthus (1798) proposed a model that accounted for long run stability in living standards
- **Malthusian model** – consistent with the lack of economic growth over the previous two millennia but inconsistent with the growth over the last two centuries

Malthusian Stagnation

Two theories:

- **Diminishing marginal productivity of labor** - agricultural society (land, capital, technology are unchanged)
- **Theory of fertility and mortality** – population needs a minimum level of output to avoid starvation

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Subsistence line

Malthusian Stagnation

- Along subsistence line – constant output per worker (Y/N)
- Above subsistence line – output per worker (Y/N) is greater than needed for subsistence ⇨ increase in birth rates and decrease in death rates ⇨population growth
- Below subsistence line - output per worker (Y/N) below the subsistence level ⇨ decrease in birth rates and increase in death rates (disease and starvation) ⇨ population decline

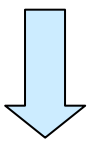
Malthusian Stagnation – Production Function

Combine the production function with diminishing MPN with the subsistence line:

- The economy is always somewhere on the production function
- Whether the economy's starting point is below or above the subsistence line, the outcome is Malthusian stagnation (the intersection of both lines).

Malthusian Stagnation – Production Function

- Output per worker just sufficient to maintain life – **no output growth**
- Population is constant – **no population growth**



NO ECONOMIC GROWTH

Malthusian Stagnation – Technological Change

- Even with **technological change** - still stagnation
- The output increase is matched by a population increase that leaves Y/N unchanged

Note: Y/N = output per worker

Was Malthus Correct?

Let's answer this question before Malthus wrote his theory and after.

Was Malthus Correct?

Malthus's prediction: Constant per-capita GDP in the long run

- Before 1800 – **Yes** – GDP and population grew at the same rate – Y/N unchanged
- After 1800 – **NO** – GDP grows faster than the population – Y/N grows sharply
- Specifically between 1960 and 2000 GDP grew at 4% per year and population grew at 1.8% per year – Y/N grew at 2.2% per year

What happened after 1800?

The Industrial Revolution and the Demographic Transition

The Industrial Revolution

- After 1800 – industrial revolution in Western Europe – ***increase in technological change***
- According to Malthus this should have led to an increase in population, leaving Y/N unchanged.
- Actually fertility rates increased between 1800 and1875 but technology grew faster than the population – so Y/N increased
- This slow progress from Malthusian Stagnation is called **Post Malthusian Regime** – Y/N increased but much more slowly than Y

The Demographic Transition

- Continued technological progress and ***sharp decline in fertility*** in Western Europe – much higher growth rates in Y/N after 1920s.

- The final step in this transition is the **Modern Growth Regime** of the last 85 years – technological progress + decline in fertility

4.4. The Solow Growth Model

- We have learned that the economy grows steadily over time.
- We are interested in the relationship between labor, capital and technological growth
- We will focus on a particular example: the U.S. economic growth path

Labor force

- Predicted to grow at 1% per year through 2020 (*Bureau of Labor Statistics*)
- Reliable forecast: people who will be in the labor force have already been born

Capital Stock

- Depends on how much investment there is each year – how much Americans save or foreigners invest
- More difficult to forecast – depends on private individuals and government (reduce deficit?)
- Instead: consider implications of a future where the growth rate of capital = growth rate of labor
- Such a steady path, a ***balanced growth path,*** where growth rates of capital and labor are balanced, will be the baseline of our model (**Solow neoclassical growth model**)

Solow Model: Saving and Balanced Growth

Assumptions:

- Closed economy (I = S)
- No technological change (Next chapter – technological change increases over time)
- Labor force grows at rate **n** (start level is N) – currently n=0.01 in US
- On the balanced growth path: growth rate of labor = growth rate of capital = n
- The production function has constant returns to scale (changes in K and N lead to proportional changes in output)

Balanced Growth Path

- Net investment = n*K

*Net investment = change in capital stock, n*K = balanced growth investment*

- Saving = s*Y

s = saving rate, fraction of income saved (Y=Income)

Saving = Net Investment

n*K = s*Y

(on the balanced growth path)

Balanced Growth Path

Another assumption: **The production function has constant returns to scale** – proportional changes in labor, capital and output.

$$\mathbf{Y = F(K,N,A)}$$

Divide by N: $Y/N = F(K/N,1,A)$

Ex: $Y = K^{1/3*}N^{2/3*}A$

$Y/N = (K/N)^{1/3*}(N/N)^{2/3*}A = (K/N)^{1/3}*1*A = F(K/N,1,A)$

So Y/N depends only on K/N (there is no growth of Y/N in the Solow growth model without technological change)

Balanced Growth Path – Per Worker

- **Net investment = n*K**

Net Investment per worker = **n*K/N**

- **Saving = s*Y**

Saving per worker = s*Y/N = s*F(K,N,A)/N = s*F(K/N,1,A)

- **Saving per worker = Net Investment per worker**

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Steady State Point

= the actual amount of investment determined by saving is the amount needed to keep the capital stock growing at the same rate as labor input.

Balanced Growth Path

What happens if the economy starts away from the **steady state point**?

- If k<k* - saving per worker > the amount needed to keep K/N constant – K/N increases
- If k>k* - saving per worker < the amount needed to keep K/N constant – K/N decreases
- It is a stable process – no matter where it starts it converges to the same steady state – with capital growing at the same rate as the labor force.

The Effect of Saving on Growth

- **The growth rate in the long run does not depend on the saving rate**
- Ex: If saving rate increases, $K/Y < s/n$, capital increases more rapidly than labor, so K/Y increases until the economy returns to the balanced growth path
- There is a **transition** path during which the growth rate is higher than the balanced growth path, followed by a return to the balanced growth path:
- In the long run, there is an increase in the Y/N level but not in the Y/N growth rate

The effect of changes in population on growth

- **The growth rate in the long run does not depend on the population growth rate**
- Ex: If population growth (= with growth of the labor force, n) increases, $K/Y > s/n$, so K/Y decreases until the economy returns to the balanced growth path.
- During the **transition** the growth rate of the economy is lower than the balanced growth path
- In the long run, there is a decrease in the Y/N level but not in the Y/N growth rate