Economic Growth

ECO 305: Intermediate Macroeconomics

Goals / Reading

- Goals:
  1. Understand some economic growth facts from around the world and across time.
  2. Learn two models to understand why some countries have fast rates of growth, and some countries do not.
- Reading: Williamson, Chapter 7: 232-264.

1 Growth Facts

1.1 Over time

Economic Growth Facts Over Time

- Before the industrial revolution in about 1800, standards of living did not grow much over time.
- Since the industrial revolution, per-capita income growth has grown steadily in the richest countries
  - The average growth rate of per-capita income in the U.S. in the past century is about 2%.

1.2 Across Countries

Economic Growth Facts Across Countries

- Before the industrial revolution, standards of living were similar across much of the world.
- Differences in per-capita income across countries have grown significantly since the industrial revolution.
- Rich countries today are alike in terms of per-capita income growth, most around 2%.

- Lesser-developed countries today are less alike in terms of per-capita income growth.
  - China 24.4% in 2010
  - India 8.8% in 2010
  - Korea 6% in 2010
  - Russia 4.2% in 2010
  - Nicaragua 1.9% in 2010
  - Pakistan -0.2% in 2010

1.3 Covariates

Growth Covariates

- There is a negative relationship between population growth rates and per-capita income growth rates.
- There is a positive relationship between investment rate (as a percentage of real GDP) and per-capita income for lesser developed countries.
- There is a negative relationship between investment rate and per-capita income for more developed countries.

2 Malthusian Growth Model

2.1 Introduction

Malthusian Growth Model

- Thomas Malthus (1798), *An Essay on the Principle of Population*
- On causes for population growth.
- Population growth theory explained economic growth.

Mathematical Foundations

- Malthus did not construct a formal mathematical model. But we're better than that.
- Production is produced with labor and land. No capital - it's the 18th century.

$$Y = zF(L, N)$$

- Y: Real GDP; L: Land; N: Population = Labor; z: TFP
- Land is fixed.
- Population grows endogenously

2.2 Population Growth

Population Growth

- Population growth:

$$N' = N + Births - Deaths$$

- N denotes present population

- N' denotes future population (prime denotes future variable).
- Much of the population lives near a sustenance level.
  - Birth rate depends positively on consumption per capita.
  - Death rate depends negatively on consumption per capita.

Model

- Population growth:

$$\frac{N'}{N} = g\left(\frac{C}{N}\right) \tag{1}$$

  $g()$ is an increasing function of C/N

- Aggregate resource constraint, $C = Y$, implies,

$$C = zF(L, N) \tag{2}$$

- Substitute (2) into (1):

$$\frac{N'}{N} = g\left(\frac{zf(L, N)}{N}\right) \tag{3}$$

2.3 Model Solution

Solving the Model

- Remember from the last slide?

$$\frac{N'}{N} = g\left(\frac{zf(L, N)}{N}\right) \tag{4}$$

- Assume *constant returns to scale (CRS)*: If you increase *all* factors of production by the same percentage, output increases by the same percentage.
- This implies that...

$$N' = g\left[zf(L/N, 1)\right] N \tag{5}$$

- Assume diminishing marginal product of labor.
- Graph that!

Steady state

- There is a steady state level of the population.
- Population *growth rate* at the steady state is equal to...
- Recall the production function, $Y = zF(L, N) \ \rightarrow \ C = zF(L, N)$
- Using CRS yields a function showing consumption per person positively affected by technology and land per person.

$$\frac{C}{N} = zF(L/N, 1) \tag{6}$$

- Use the function $\frac{N'}{N} = g\left(\frac{C}{N}\right)$ to find *steady state* consumption per person.
  - It'll be sad :(

Use the model

- Suppose there is an improvement in technology for plowing fields with shovels.
- Describe and illustrate the change in steady state population, consumption per capita, land per person (page 233).
- Describe and illustrate the dynamics in consumption per capita and population as the economy moves from the first steady state to the new steady state.

2.4 Model Predictions and Shortcomings

Model Predictions

- Explains well why before the industrial revolution (importance of capital in production), per-capita income did not vary over time.
- Explains well why before the industrial revolution per-capita income did not vary much across countries.
- Possibly still relevant for the poorest countries on earth.
  - Malawi: Lowest Real GDP per capita on earth (2013) = $226.
  - 85% of the population live in rural areas.
  - Life expectancy is 55 years (United States is 79)
  - Agriculture is more than 1/3 of real GDP.
  - C02 per capita (2010): 0.1 metric tons (the U.S. was 17.6 metric tons)

Model Shortcomings

- The world starting changing right after Malthus:
- Does not allow for endogenous choices for population growth rates.
- Does not consider impact of capital accumulation.
- Population theory relevant only at the sustenance level.

3 Solow Growth Model

Solow Growth Model

More to come...