

# Economic Growth II

9/11/2008

## Today's Agenda

1. Evaluating Harrod-Domar
2. Motivating the Solow Model: Diminishing Returns to Scale
3. Solow, simply.
4. Prediction of Solow for levels of income

## 1. Evaluating Harrod-Domar

Last time:  $g=(s/\theta)-n-\delta$

### A. Causality?

- Simplest model of growth—everything exogenous.
- Not only do  $s, \theta, n, \delta$  affect growth, but there may be feedback as well
- Thus,  $s, \theta, n, \delta$  are endogenous
- Estimates of effect of  $s, \theta, n, \delta$  on  $g$  are biased

### B. Endogeneity of Savings ( $s$ )

- How can income affect savings?
- Growth rate ( $g$ ) will evolve in a way that follows the income-savings rate dynamic.
- Extreme case—say  $g=s$ ; then previous arguments imply low and high income countries save more and have high  $g$  whereas middle income have low  $g$

### C. Endogeneity of Population ( $n$ )

- What happens to fertility as countries become richer?
- Demographic transition: 3 main stages
  - i) Low development: Death rates and birth rates are both high
  - ii) Developing: Death rates low, birth rates high
  - iii) Developed: Both low

### D. Endogeneity of Depreciation ( $\delta$ )

- What do you think?

### E. Endogeneity of Capital-Output ratio ( $\theta$ )

- What happens as countries increase income and capital per worker increases?
- HD says workers will just produce that much more output
- But not very realistic.

## 2. Motivation for the Solow Model

That does not mean there is no causal relationship between variables and growth, but just that we need to incorporate this into our theory. Models in growth theory get progressively more complicated as you try to endogenize above. As one of the simplest but more powerful, the Solow model endogenizes  $\theta$  by using a specific kind of production function.

### A. Production Function

$y=f(k)$  that is, income per capita is a function of capital per capita

- Key feature of Solow model:  $f(k)$  has diminishing returns to capital per capita

- Common production function is Cobb-Douglas  $y=Ak^\alpha$
- Common because it does a good job of fitting the data on inputs and outputs
- $\alpha$  has value between 0 and 1

#### **4. Solow, simply.**

##### **A. Basic building blocks**

Example: Say in 2000, capital stock per worker was 100, output per worker was 50, savings rate was 20% and depreciation rate was 5%. What is capital stock per worker in 2001?

##### **B. Steady state**

- **Steady State:** where the variable of interest (in our case capital stock per worker and output per worker) are not changing.
- ii. **How does changing investment rate affect steady state level of output? Depreciation?**

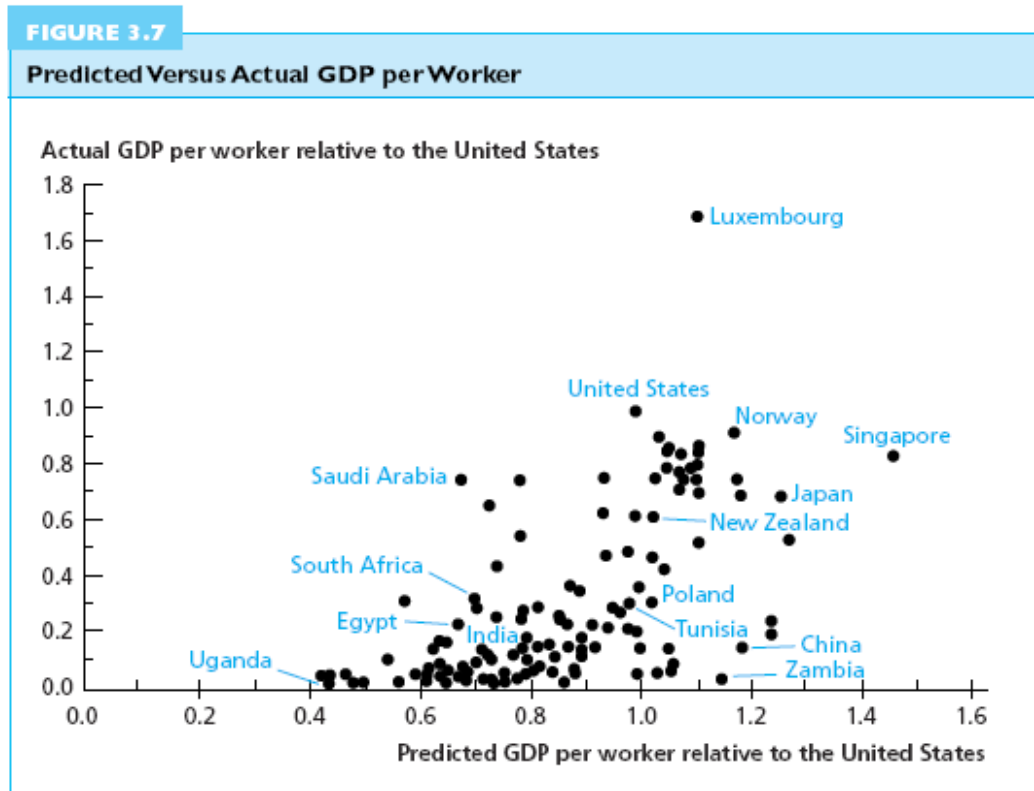
**iii. Let's confirm-- solving for the steady state using a Cobb-Douglas production function**

**3. Solow's Predictions**

- Prediction: if a country has a higher rate of savings/investment, it will have a higher rate of steady-state output. Does this fit the data?

Example: Say there are two countries, identical in all respects ( $A, \delta$ ) except their investment rate. Country 1 has  $s_1=20\%$  and Country 2 has  $s_2=5\%$ . What will be their relative levels of steady-state output? (Assume both are in steady-state level)

- Some real data



Sources: Calculations based on Heston et al. (2006) and World Bank (2007a).

**Next time:** Prediction for relative growth rates, endogenous savings/investment rate, quick overview of other growth theories (Chapter 4)