Prof. Tybout

Economics 404W
Lecture 2
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III. The transition period

Before we get into theories of underdevelopment, we need to know what we're trying to explain. We know LDCs have low per capita incomes, but there is more that is distinctive about these countries.

Let's begin by taking stock of these distinctive features of developing countries, and the way they evolve as countries grow richer.

A. Introduction

Countries can exist for centuries in a kind of "low level equilibrium." Most production is done in the household, though significant fraction (40-50%) of activity is non-agric. Most (80-90%) of population is rural. Population grows, but output merely keeps pace, either through technical improvement (e.g., new crops, double-cropping, increase in inputs like fertilizers), or through use of new land. Reynolds calls this stage "extensive growth" and argues that most all countries have passed through it at one time.

When output growth significantly outpaces population growth for an extended period, we say "intensive growth" has begun. As Moshe Syrquin (1988) notes, there is a phase of <u>growth acceleration</u>, and then a settling down into lower, sustained intensive growth: "In every decade since 1950, middle income countries have grown faster than groups with lower or higher incomes." Today I want to characterize this accelerated growth period.

Lloyd Reynolds argues this stage of accelerated development occurred for most countries either during (1) industrial revolution (1850-1913) or (2) post WWII boom (1945-1973). The latter are, roughly speaking, what we think of as "developing countries.

Unlike Reynolds, who takes a very broad view, we will limit ourselves to these countries considered to be "developing" during the post-WWII period.

We want to identify fundamental changes associated with development—a first step in deciding what is important (capital accum., education, population control, trade, etc.). Looking across countries, moving from poor to rich (measured by GDP per capita), what contrasts do we find in:

(1) processes of physical and human capital accumulation
(2) changes in domestic resource allocation and int'l trade
(3) demographic characteristics
(4) poverty and income distribution
(5) productivity growth

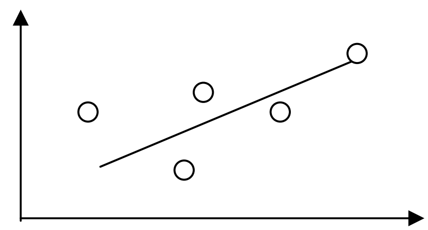
What is the "typical path" of these variables over time?

- -qualitative shape
- -extent of variation
- -range of income over which most change occurs

Also, how do particular types of LDCs deviate from the typical path?

B. A digression: Regression Analysis

Amounts to approximating functional relationships using observed data—the "typical" or average Y value at each X value. (Draw line and scatterplot.) Need a way to choose line—the principle is to minimize sum of squared residuals.



Exp.

Y_i = savings rate, country i
X_i = per capita income, country i

$$Y_i = \beta_0 + \beta_1 X_i + e_i \qquad \min \sum_{i=1}^{n} (Y_i - \beta_0 - \beta_1 X_i)^2 \Leftrightarrow \min \sum_{i=1}^{n} (e_i)^2$$

To summarize the tightness of the clustering around the line, we use a normalized measure of the sum of squared residuals:

$$R^2 = 1 - \frac{\sum_{i=1}^{n} e_i^2}{\sum_{i=1}^{n} (Y - \overline{Y})^2}$$

The denominator must be greater than the numerator because it is the sum of squared residuals one obtains when the slope is restricted to zero. Thus $0 \le R^2 \le 1$. A value of one corresponds to a perfect fit.

We can be more general by allowing for non-linear functional forms (add quadratic term) or adding variable (include pop. of the country).

$$Y_i = \beta_0 + \beta_1 X_i + \beta_2 X_i^2 \qquad \min \sum_{i=1}^{n} \left(Y_i - \beta_0 - \beta_1 X_i - \beta_2 X_i^2\right)^2 \Leftrightarrow \min \sum_{i=1}^{n} (e_i)^2$$

This allows for parabolas. (Consider alternative sign patterns.)

One other kind of transformation is especially useful: logarithms.

Often relationships between variables involve exponents:

$$Y_i = AX^{\beta_1}$$

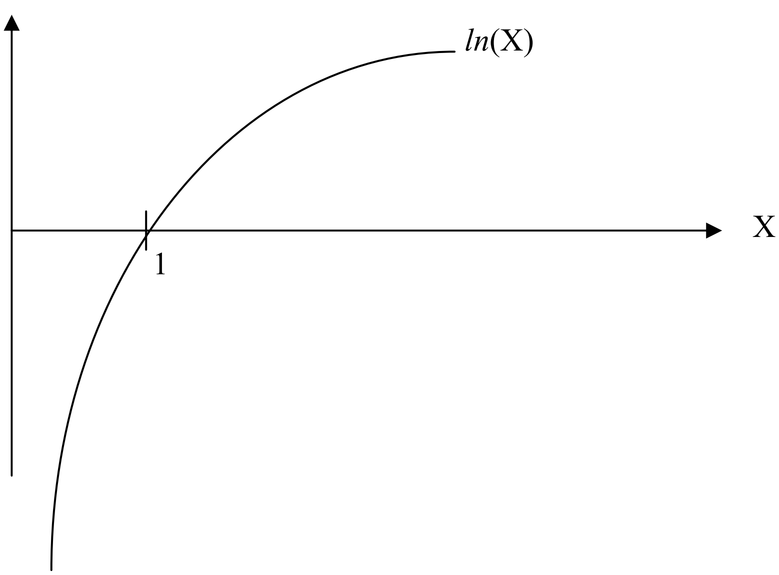
This type of function implies the elasticity of *Y* with respect to *X* is a constant. We can convert this to a linear relationship using logarithms.

To see how, lets review some preliminary facts:

There exists a special number *e*: $\lim_{n \to \infty} \left(1 + \frac{1}{n}\right)^n = e = 2.71828...$

<u>Def'n</u>: *ln*(X) is that number such that $e^{\ln(X)} = X$

<u>Note that</u>:
ln(1) = 0
ln(2.71828) = 1
ln(2.71828^2) = 2, etc.
logarithms can be negative, but the log of a negative number is undefined.



When we measure GDP in logarithms, we're asking what power we have to raise *e* to in order to get that number. For example $\ln(400) \approx 6.0$, and $\ln(5000) \approx 8.5$.

<u>properties of logarithms</u>

1. $\ln(AB) = \ln(A) + \ln(B)$

proof: $e^{\ln(AB)} = AB = e^{\ln(A)}e^{\ln(B)} = e^{\ln(A)+\ln(B)}$

2. $\ln(A^{\alpha}) = \alpha \ln(A)$

   proof: $e^{\ln(A^{\alpha})} = A^{\alpha} = \left(e^{\ln(A)}\right)^{\alpha} = e^{\alpha \ln(A)}$

3. If a variable grows by some small fraction, g, then its logarithm changes by roughly *g*. (Example: if $\Delta \ln(X) = .05$, then *X* has increased by the factor 1.05, or 5 percent—e.g., ln(105)-ln(100)=.05.) This only holds precisely for incremental changes, but it's a good approximation for changes in logs less than about .1

Using properties 1 and 2, we thus see that whenever two variables are related to one another by functions of the form $Y = AX^{\beta_1}$, we can convert this to a linear relationship using logarithms:

$$\ln(Y) = \ln(A) + \beta_1 \ln(X)$$

Now let's return to the issue of how LDCs are different from their more developed counter-parts, and how these characteristics change as they develop.

C. Findings for "typical" case

1. Accumulation Variables

a) <u>**Capital accumulation**</u>**: As per capita income (in 1980 dollars) increases 400 to 5,000 (i.e., as log(GDP per capita) increases from 6 to 8.5), the typical I/GDP ratio increases from .17 to about .24.** Savings rates behave similarly.

The relationship isn't that strong—note the $R^2 = .11$

Do cross-country patterns reflect temporal patterns within countries? Crudely speaking, this one does. In time series regressions with 106 separate countries, negative slopes in only 20 cases; 56 cases had positive slopes greater than .10. Also find slope <u>declines</u> with per capita income, suggesting a leveling off of I and S rates.

<u>rising I/Y and S/Y suggests</u>:
-rising income allows everyone to save more (APS shifts)
-changing demographics
-changing returns to savings
-note causality can go investment to income, too

b) **As GDP per capita increases 400 to 5,000, (G, T) goes from .10 to .21**. This is a tighter relationship than the one with savings, but still substantial heterogeneity across countries. (R^2 = .395)

<u>suggests</u>:

- increasing ability to pay
- redistribution among taxable groups; perhaps toward the corporate sector
- active gov't might "cause" development advances with provision of infrastructure, for example.