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Economics 404W
Lecture 5
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C. Findings for "typical" case

Last time, we developed a formula for growth in output per worker that isolated productivity growth and capital deepening: $\Delta \ln\left(\frac{Y}{L}\right) = \Delta \ln A + \alpha \Delta \ln\left(\frac{K}{L}\right)$. We saw:

1. Overall, TFP growth accounts for about 1/2 of total output growth.

2. There is lots of diversity in experiences (Chenery, Robinson, Syrquin, table 2.2). LDCs divide into 2 clusters. Suggests either severe measurement problems, or that there is nothing automatic about productivity gains.

3. Countries that have already industrialized exhibit relatively low L', high A' and moderate K'. In constrast, LDCs overall have high L', low A', moderate K'.

New material

Let's now focus on the "East Asian Tiger" countries, which are at the center of the controversy over what causes growth. It is popular to argue that these countries have done very well because they have had rapid productivity growth, and that this was due to outward orientation. But is this what the data show?

There is no question that output per capita has grown very rapidly in these countries. But this is not the same thing as rapid growth in output per worker:

Define: Y = output, N = population, L = labor force. Then output per capita is $\frac{Y}{N} = \left(\frac{Y}{L}\right) \cdot \left(\frac{L}{N}\right)$, or taking logs $\ln\left(\frac{Y}{N}\right) = \ln\left(\frac{Y}{L}\right) + \ln\left(\frac{L}{N}\right)$. Converting to growth terms,

$$\Delta \ln\left(\frac{Y}{N}\right) = \Delta \ln\left(\frac{Y}{L}\right) + \Delta \ln\left(\frac{L}{N}\right) = \left[\Delta \ln A + \alpha \Delta \ln\left(\frac{K}{L}\right)\right] + \Delta \ln\left(\frac{L}{N}\right)$$

That is, growth in output per capita is the sum of growth in output per worker (due to productivity growth or capital deepening), and growth in the labor force participation rate.

Using this decomposition, Alwyn Young challenged the claim that the super performance of the E. Asian Tigers was due to productivity growth. (He didn't address the question of whether this was in turn due to outward orientation.)

If you look at the growth rates in per capita income for these countries, there is no question that they have done extraordinarily well. Except for Botswana, no other country did better. (Botswana has diamonds):

	Annual Growth in Y/N	Annual growth in Y/L	Growth in L/N
Hong Kong (1966-1991)	5.7	4.7	.38→.49
Singapore (1966-1991)	6.8	4.2	.27→.51
So. Korea (1966-1990)	6.8	5.6	.27→.36
Taiwan (1966-1990)	6.7	5.4	.28→.37

Looking at growth in output per worker takes one or two percentage points off the per capita figures, however, so part of the spectacular growth has been due to rising participation rates, especially among women. The rising participation rates also reflect entry into the work force of post-war baby boomers.

This knocks the gang of four out of the top 5, except for Taiwan (which is number 4 in a field of 45 countries for which data are available), but they all remain in the top tercile in terms of performance.

Is this capital deepening, changes in factor quality, or TFP growth? Young spent a lot of time in the statistical offices of these countries, and put together enough data to study changes in the quality and quantity of factor inputs. His results are summarized below:

	Hong Kong	Singapore*	South Korea*	Taiwan*
Q/L growth	4.7%	4.2%	4.9%	4.8%
Growth in K/L (capital deepening)	2.0%	2.4%	1.7%	1.7%
Growth in L quality	0.3%	0.6%	0.7%	0.2%
Growth in K quality	0.1%	1.0%	0.8%	0.8%
Residual productivity growth	2.3%	0.2%	1.7%	2.1%

*Excluding agriculture.

So, all three sources of growth in per capita income matter. In fact, in Singapore, TFP growth after accounting for these factors was about zero. (The Singaporean government actually took this study to heart when it was described in the NYT(?) by Paul Krugman, and has begun a push to improve productivity.)

In the other countries, TFP growth still accounts for a substantial fraction of total growth, even when you adjust for input quality. But figures of 1-2% are hardly extraordinary. Similar figures obtain in the U.S. and other developed countries when similar methodologies are used.

Punchline: There was no magical productivity gain; no special payoff for being outward oriented. It was extraordinary factor accumulation—quantity and quality—that distinguished these countries.

Keep in mind there are lots of measurement problems, due to aggregation bias, adjustment costs, and poor data quality.

III. SIMPLE GROWTH MECHANICS

So far, we haven't done much to analytically explain the development process; we've just assembled a set of clues.

Now, want to begin more formal analysis. I should stress at the onset that we don't really have a universally accepted model of growth. All we have are some theories, each of which has major limitations.

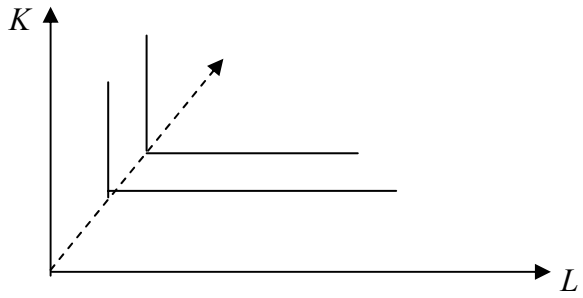
We'll begin with two famous models that focus on physical capital accumulation, which we have just seen is associated with growth in per capita income. Then, we'll go back and add in some other things that our empirical growth decomposition also highlights—technical progress and human capital accumulation. **Reading assignment: Chapter 3, including appendix**. Easterly book

A. The Harrod-Domar Model and its Decendants

We'll start with the simplest possible growth mechanism, first written down by Sir Roy Harrod (1939) and Evsey Domar (1946). The exclusive focus is on capital accumulation. (See Easterly, Chap. 2, for a wonderful discussion of the history of the HD model and its influence at international lending agencies.)

1) Model Mechanics

Production technology: $Y = \min[K/\theta_k, L/\theta_L]$, so isoquants are rectangular:



If labor is in excess supply, we can assume that $Y = K/\theta_K$, and capital is the binding constraint to development.

The key question becomes, what drives the capital accumulation process, or equivalently, how can differences in growth rates across countries be explained?

$$\frac{\Delta K}{K} = \frac{sY}{K} - \delta K = \frac{s}{\theta_K} - \delta ,$$

where δ is the rate of depreciation and *s* is the savings rate out of national income. Also, since capital is the binding constraint: $\frac{\Delta K}{K} = \frac{\Delta(\theta_K Y)}{\theta_K Y} = \frac{\Delta Y}{Y}$

2) Model implications

There are two ways to develop rapidly:

- generate lots of savings or aid (and investment)
- use your capital very efficiently: no domestic distortions, choose right technologies, right amount of infrastructure, trade and specialize in your comparative advantage. (Productivity growth is not in the model, but if we put it in, it turns out to be a good thing too.)

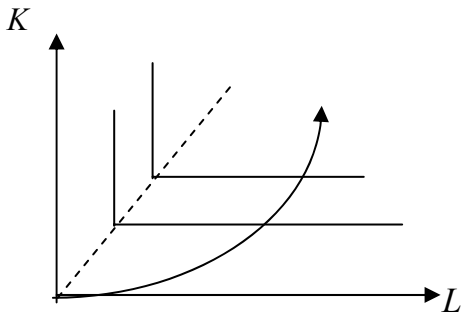
Back-of-the-envelope calculations are easy in this framework. For example, suppose

$$s = .20, \quad \theta_K = 3, \ \delta = .03, \quad implies \quad \frac{\Delta Y}{Y} = \frac{.20}{3} - .03 = .037$$

By varying savings rates and capital-output ratios, you can infer the growth effects:

- At a savings rate of *s*=0.25, growth is (.25/3) - .03 = .053.
- At a capital-output ratio of 2.5, growth is (.2/2.5) - .03 = .050.

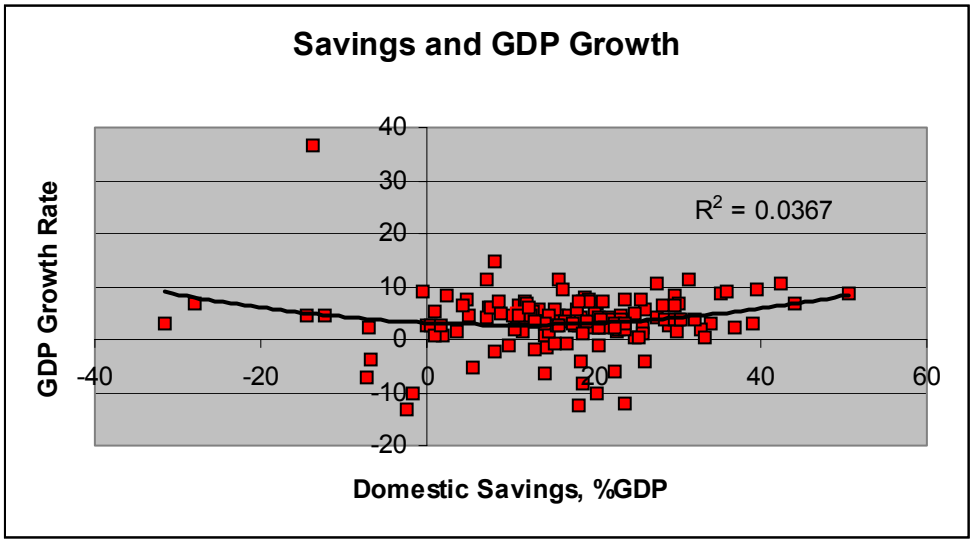
What about growth in the labor force? If $\frac{\Delta L}{L} = n < \frac{\Delta K}{K} = \frac{s}{\theta_K} - \delta$, surplus labor is gradually absorbed as the economy expands because *K*/*L* continually rises:

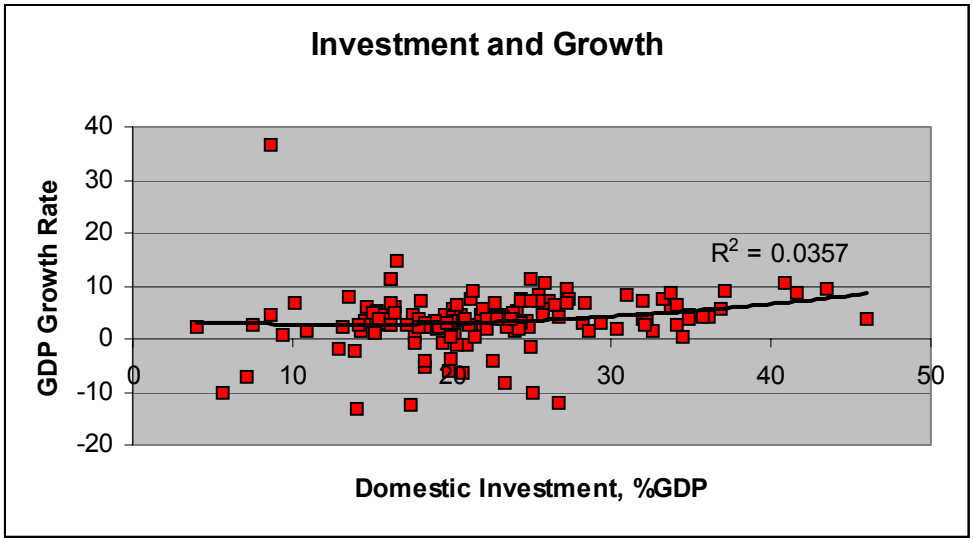


Per capita income, *Y*/*L*, continuously rises because output grows at the same rate as capital, which is growing more rapidly than income.

Once all the surplus labor is absorbed, $Y = K/\theta_K = L/\theta_L$, and capital is no longer the binding constraint. Thereafter, excess capital accumulates—a foolish prediction of the model.

Perhaps we can ignore this problem if there is perennial slack in the labor market, as some countries seem to exhibit. Does the model capture a fundamental truth by focusing on savings and capital accumulation as the key to growth?





The same picture emerges if we look at the relationship between lagged savings rates and current growth rates (Blomstrom, Lipsey and Zejan, 1996.)

Domar himself renounced his model in the 1950s because of these foolish implications, which in turn were a consequence of the lack of behavior in his model. Nonetheless, the international lending institutions focussed on capital accumulation as the key to growth throughout most of the second half of the 20th century: domestic savings too low and

labor in surplus (high population growth rates), so send in the foreign funds. Western countries gave $1 trillion between 1950 and 1995.

B. The Solow-Swan Model

In the 1950s, Robert Solow (1956) and Trevor Swan (1956) simultaneously showed that a growth model with no excess factor stocks, and with a standard neoclassical production function could be used as an alternative representation of economic growth.

The predictions of this model are surprisingly different.

1) Basic mechanics

Define $Y = F(K,L)$, as a standard constant returns neoclassical production function.

A representative isoquant: