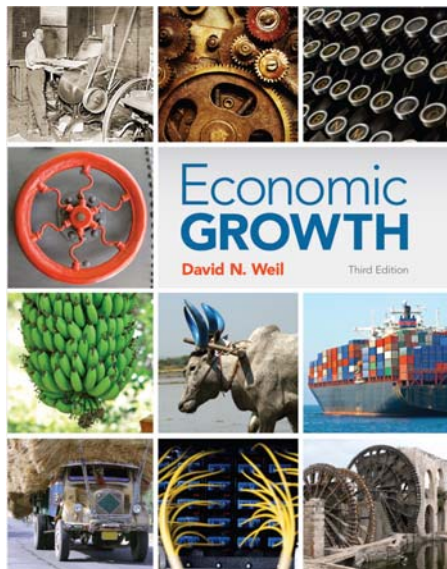


Chapter 3

PHYSICAL CAPITAL



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Nature of capital

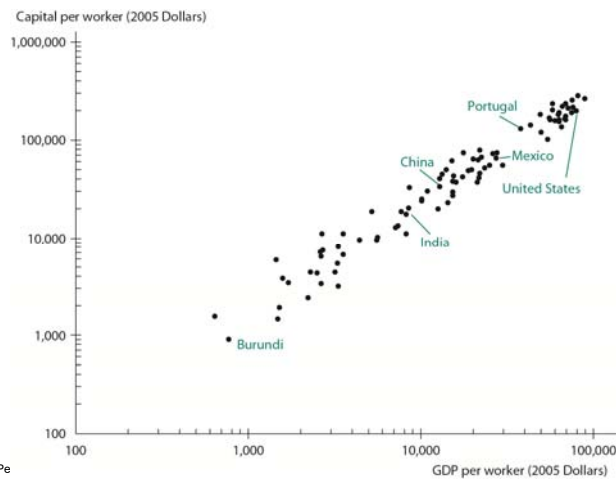
- Capital is productive
- But it has been produced itself...through investments. In other words capital is accumulated. Distinction between flows and stocks
- Capital depreciates
- Capital stock is made of machinery, tools, buildings, roads....
- It can private or public (mainly infrastructures)

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An interesting stylised fact: GDP and Capital per Worker, 2009



3-4

Early models of economic growth



- Harrod-Domar model
- Solow model

3-5

Capital's role in production



- Production function:

- $Y = F(K, L)$
- $Y/L = F(K/L, 1)$
- $y = f(k)$

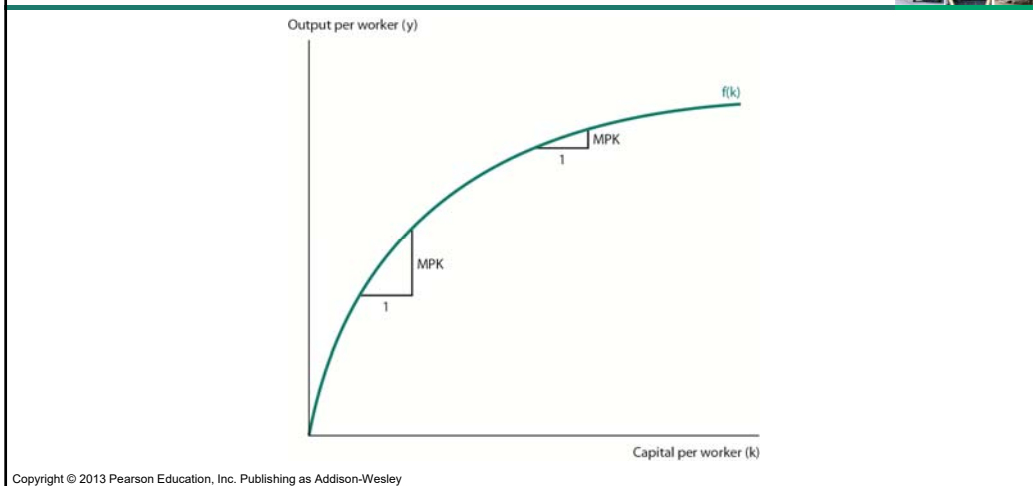
NOTE: in a competitive environment alpha is the capital factor share, in a Cobb-Douglas model this is constant

SOLOW model: Cobb-Douglas PF

- $Y = F(K, L) = AK^\alpha L^\beta$
- Usually $\alpha + \beta = 1$ (assumption of no economies of scale), in this case we can rewrite the function above as follows:
- $Y = F(K, L) = AK^\alpha L^{1-\alpha}$, which is also in per capita terms
- $y = A k^\alpha$

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Solow model: A Production Function with Diminishing Marginal Product of Capital



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Capital's role in production

In a competitive environment, where factors are paid according to marginal productivity,

alpha is the capital factor share, and in a Cobb-Douglas model this is constant:

$$MPK = \alpha AK^{\alpha-1} L^{1-\alpha}$$

– Quota of income to capital:

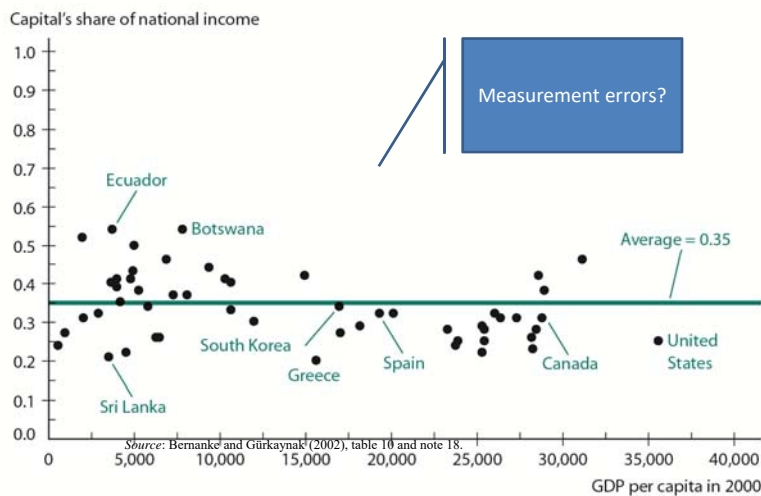
$$- (MPK * K) / Y = (\alpha AK^{\alpha-1} L^{1-\alpha} * K) / AK^{\alpha} L^{1-\alpha} = \alpha$$

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3-8



Capital's Share of Income (which is equal to α) in a Cross-Section of Countries

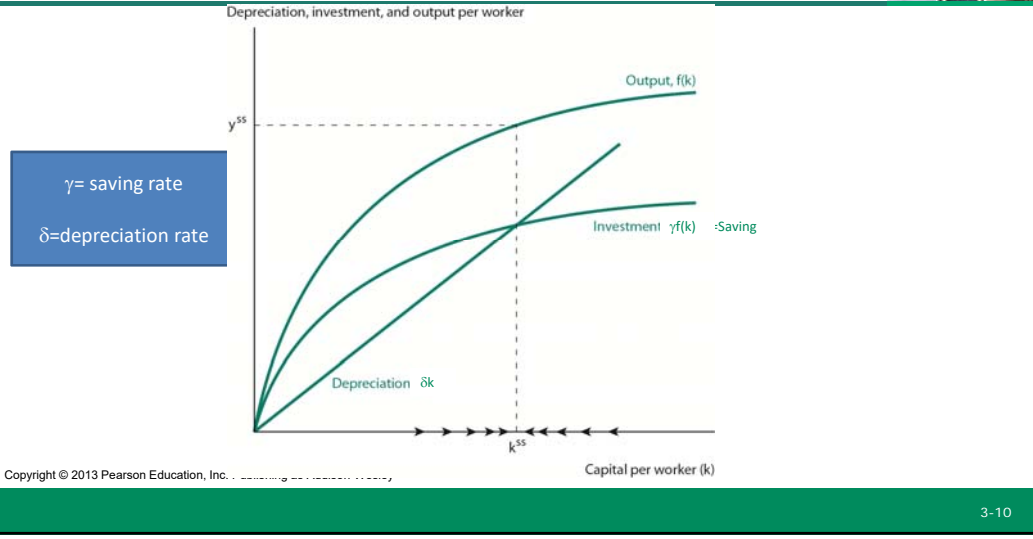


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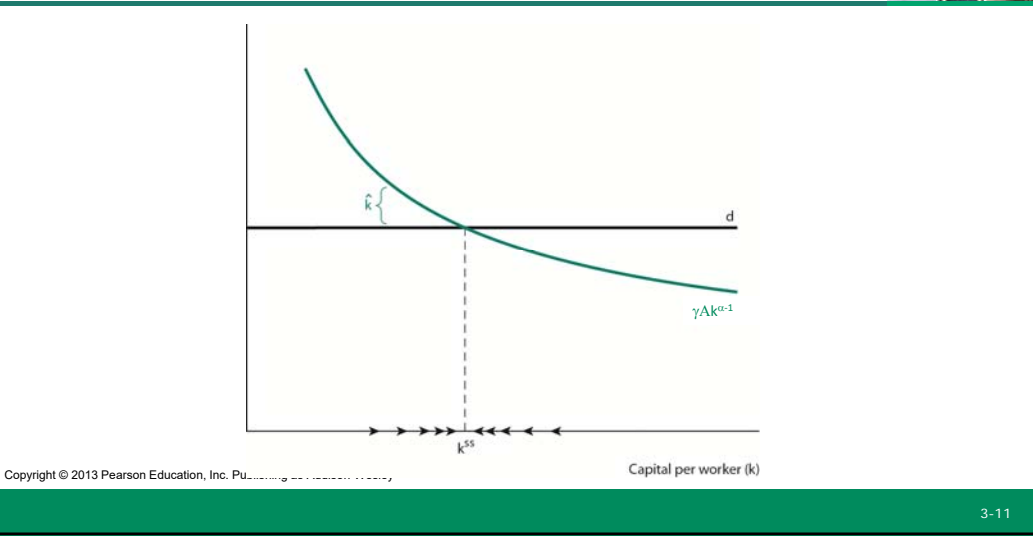
3-9



The Steady State of the Solow Model (with no population dynamics)



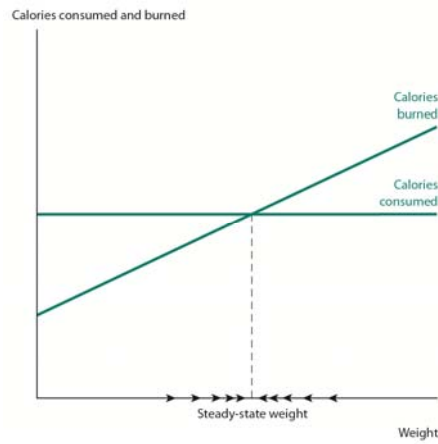
Speed of Convergence to the Steady State



A non economic example: Determination of Steady-State Weight

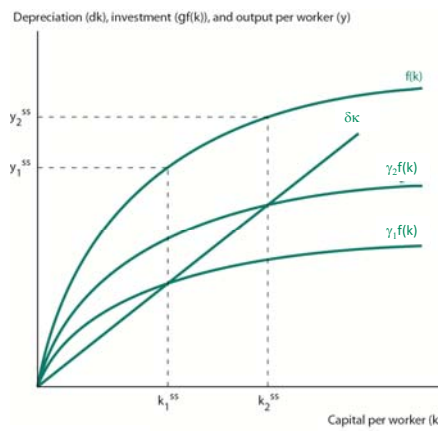


Think also about changes in the position of the two lines



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Effect of Increasing the Investment Rate on the Steady State



Note that $\gamma_2 > \gamma_1$

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Solow model calibration



Using $y = A k^\alpha$

- $\Delta k = \gamma A k^\alpha - \delta k$

In steady state Δk is equal to zero, that is

- $0 = \gamma A k_{ss}^\alpha - \delta k_{ss}$

Which implies that

- $\gamma A k_{ss}^\alpha = \delta k_{ss} \Rightarrow \gamma A k_{ss}^\alpha / k_{ss} \delta = 1 \Rightarrow \gamma A k_{ss}^{\alpha-1} / \delta = 1$

- $k_{ss} = (\delta / \gamma A)^{1/(\alpha-1)} = (\gamma A / \delta)^{1/(1-\alpha)}$

Solow model calibration



- $y_{ss} = A k_{ss}^\alpha = A^{1/(1-\alpha)} (\gamma / \delta)^{\alpha/(1-\alpha)}$

- If we take the value of y of steady state for country i and country j , we can compare them in the following way

- $y_{ss}^i / y_{ss}^j = (\gamma^i / \gamma^j)^{\alpha/(1-\alpha)}$

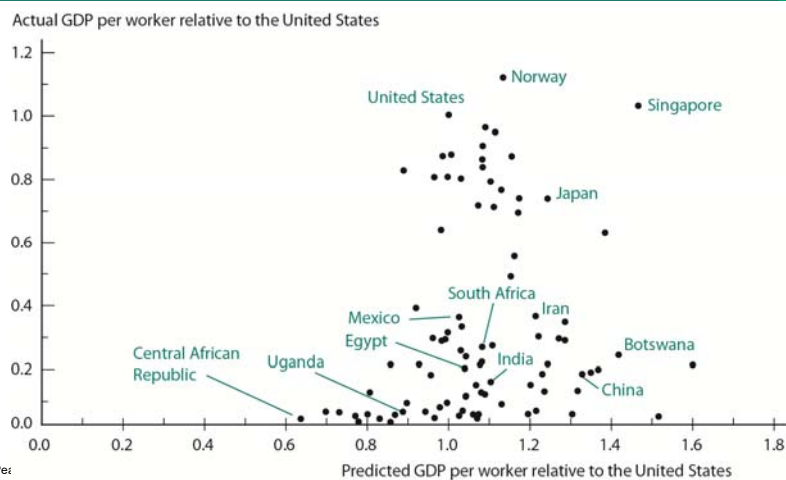
- Now let us assume that country i has an investment rate of 20% and country j of 5%

Solow model calibration



- With alpha equal to 0.33 the previous formula gives a value of 2....
- ... do you remember the example of Sylvania and Freedonia?

Predicted versus Actual GDP per Worker



The Solow model as a theory of relative growth rates (difference btwn s.r. and l.r.)



The Solow model does not provide a complete explanation of growth rates since once a country reaches its steady state there is no longer growth!

Despite this failing we may still ask whether the model has something to say about relative growth rates - that is why some countries grow faster than others...

The Solow model as a theory of relative growth rates (difference btwn s.r. and l.r.)



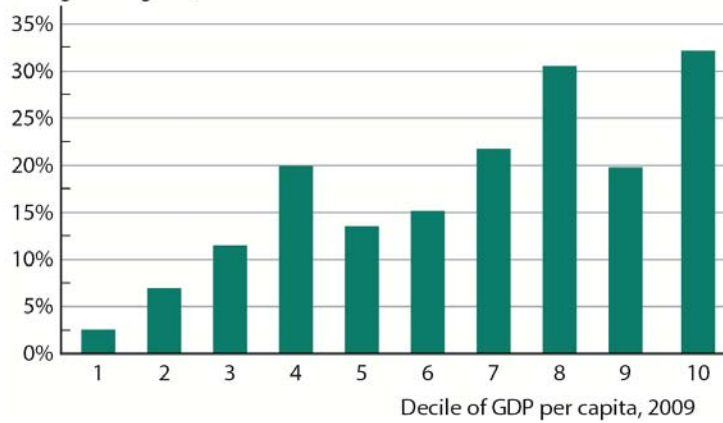
The key is to think about countries which are not in s.s.

- *If two countries have the same rate of investment but different levels of income, the country with lower income will have higher growth*
- *If two countries have the same level of income but different rates of investment, then the country with a higher rate of investment will have higher growth*
- *A country that raises its level of investment will experience an increase in its rate of income growth*

Saving Rate by Decile of Income per Capita



Average saving rate, 2009



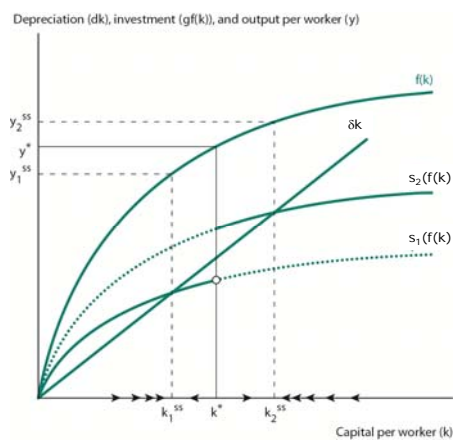
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Solow Model with Saving Dependent on Income Level



**Multiple equilibria =
Poverty traps**



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The rise and fall of capital revisited



- The belief that capital accumulation is the key ingredient for economic growth reached its peak after WWII (see Arthur Lewis and Soviet Union's success)
- Policies were designed accordingly
- Now economist have discarded the idea that development depends mainly on capital accumulation