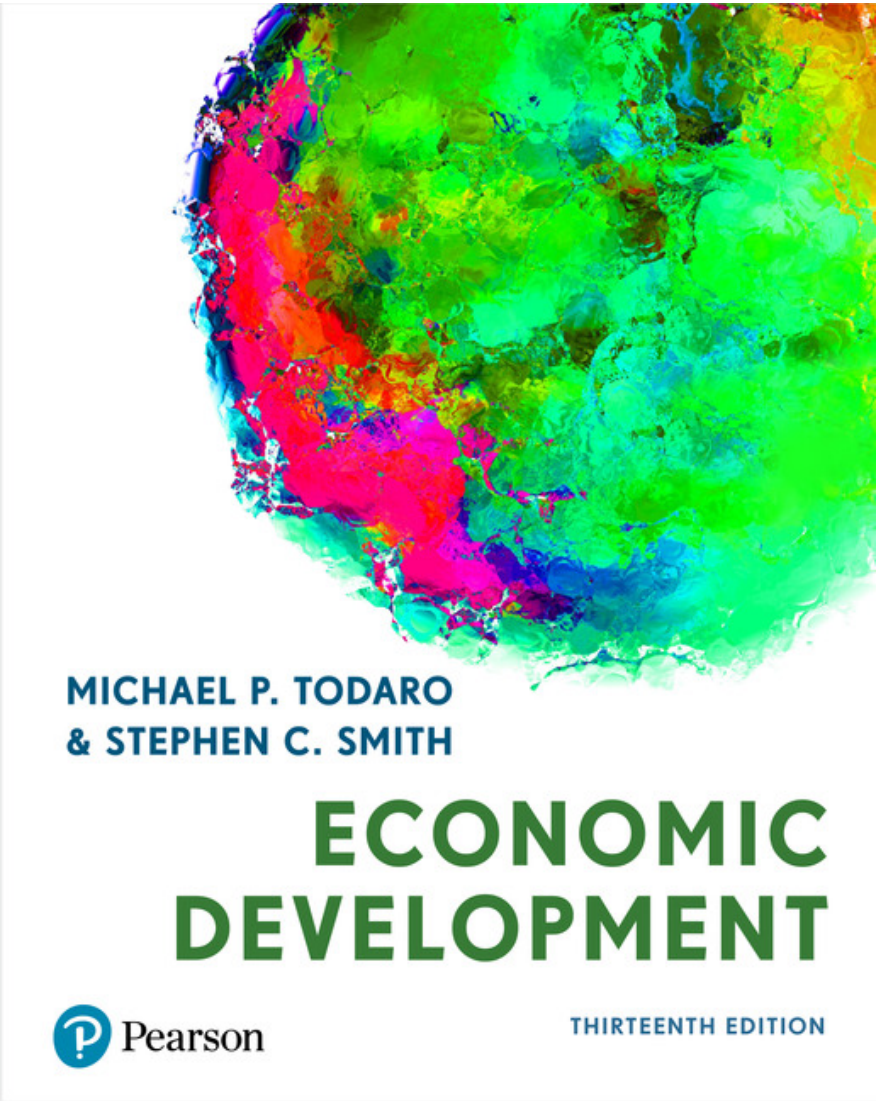
Economic Development

Thirteenth Edition



Chapter 3

Classic Theories of Economic Growth and Development

Chapter Summary

- "*There is no Economic Theory of Everything*"
  - Robert Solow, Nobel laureate
- In this chapter, we introduce the production function and look at the key determinants of growth.
- We will look at theories and patterns of structural change.
- We will examine the Harrod-Domar model as well as the Solow Model (details in appendix 3.2)

Omissions and Notes

- Most of these notes are notes that I created which are in more detail than those in the text. **Focus on these notes to study, not the text.**
- Omit: sections 3.3, 3.4 and 3.5.1and Appendix 3.3 and the Romer Model in the appendix. You may find the info in Appendix 3.1 good reference but you are not required to read it.

- Sustained development and poverty reduction cannot occur without economic growth.
- Some countries like those in sub-Saharan Africa actually have had negative growth in the past (not counting episodes like the financial crisis/recession due to COVID-19 etc). Primarily, high growth rates have occurred in Asia, however, other regions have also had high growth rates.

Sources of Growth Analysis

- A different approach is to focus directly on the contribution of each term in the production function to eco growth

- This is referred to as Growth Accounting.

Growth Accounting Formula

Y = F (K, L, A) general format for PF

- A is referred to as TFP (total factor productivity)

- If we change the formula

$$g_y = a + (W_k \times g_k) + (W_L \times g_L)$$

Where *g* = growth rates of *Y, K and L*

W_L = wages share of total income

W_k = returns on *K* share of total income

Note: if you have taken 2152, that book uses ***z*** for TFP and ***n*** for labour rather than ***L***.

Example

- If 60% of all income comes from wages,
  $W_L = 0.60$, $W_K = 0.40$

a = rate of change in A (shift of PF)

Find ***a*** last, by plugging in actual values of others

GNP growth = 5%, K-Stock growth = 7%, LF growth = 2%

capital labour

$0.05 = a + 0.4\ (0.07) + 0.6\ (0.02)$

$0.05 = a + 0.028 + 0.012$

$a = 0.05 - 0.04$

$a = 0.01$

total factor profitability

- This means that TFP growth is 1% and accounts for 20% of GNP (0.01/0.05)
- K-stock growth accounts for 56% (0.028/0.05)
- LF growth accounts for 24% (0.012/0.05)
- a is also referred to as the Solow residual
- We will do another example in the problems

Problems with this formula

- ***a*** embodies many things as it is a residual and will also capture any errors/omissions.

=> look for the pattern overtime would avoid these problem somehow

Over time, we see that technology is a higher source of growth for developed countries, even with a lower capital stock

there's must be a reason for the lower of productivity, no matter in a short run or in long run

=> we're focusing on how the productivity grow would shows on GDP

Characteristics of Rapidly Growing Countries

1) **Macro and Political Stability**
   - Relatively low budget deficits
   - Prudent monetary policy (low inflation)
   - Appropriate ER (exchange rates)
   - Suitable financial markets (well-functioning)

decrease cost for firm
government could profit from low ER

2) **Investment in Health and Education** Chapter 8
   - Improving life expectancy
   - Increased levels and improved quality and accessibility of education

3) Effective Governance and Institutions

- Secure property rights => more investment
- Strong legal system => healthy market competition
- Low levels of corruption => government level protect competition less monopoly
- Market regulating institution

4) Favourable Environment for Private Enterprise

- Less regulation/restrictions lead to a favourable climate for small-scale businesses
- Openness to foreign trade (period) => faster GDP growth for a period of time
- Low ER intervention

5) Favourable Geography

- Landlocked have higher transportation costs
- Most of the world's worst diseases in the tropics

Determinants of Economic Growth

- 1) Factor accumulation: land, labour, capital
- 2) Productivity growth
  - A) improving efficiency, skills, etc
  - B) technological change

The Production Function

- Factor accumulation represents a *movement along* the PF.
- Productivity growth represents a *shift* of the PF.

Diminishing Returns and the PF

- As we move *along* the PF, the slope gets flatter, which implies diminishing returns.

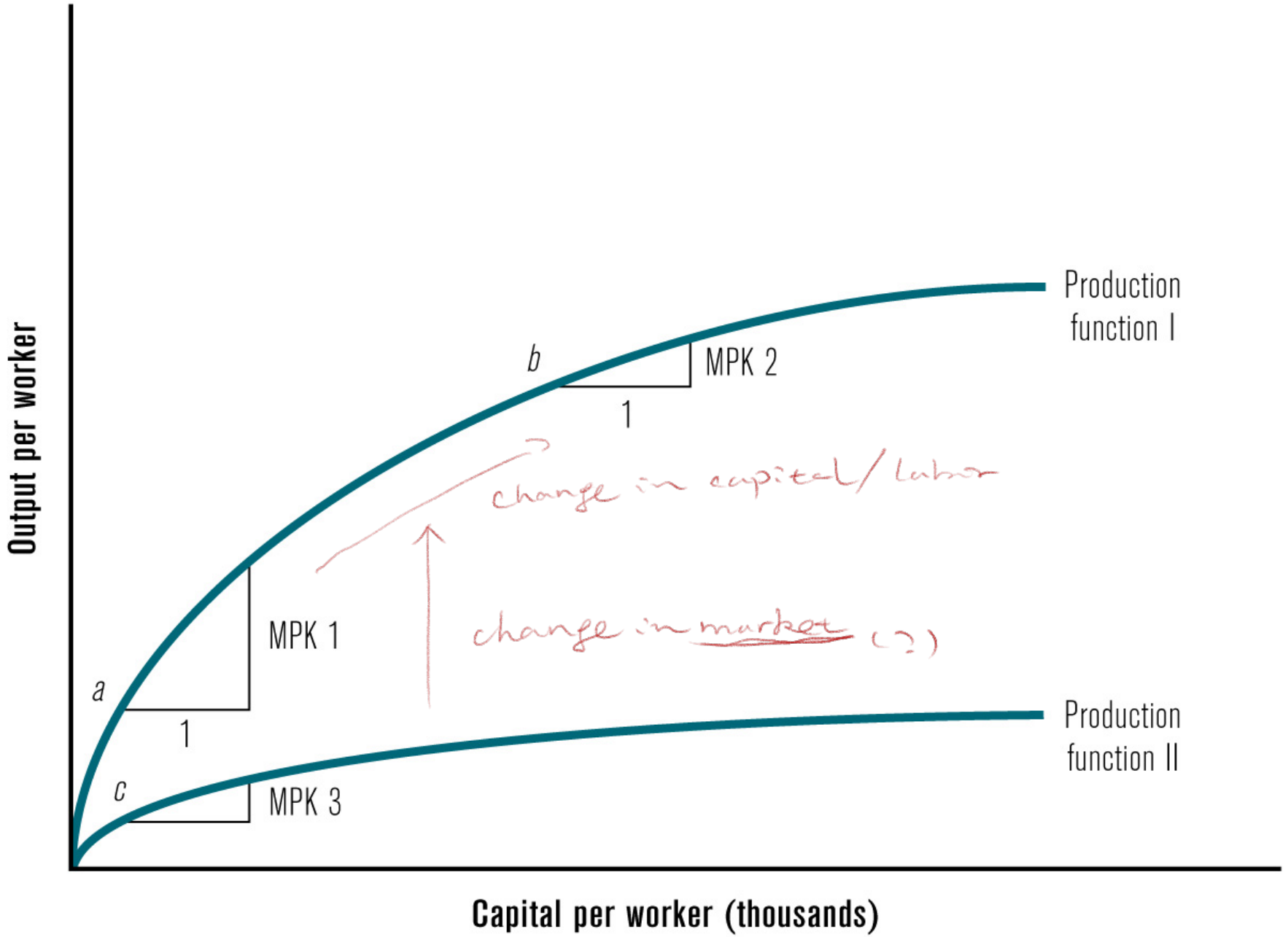


FIGURE 3.9 Diminishing Marginal Product of Capital

Implications

- 1) poor countries have the *potential* to grow more rapidly than rich
- 2) as countries become richer, growth rates tend to slow
- 3) since poor countries have the potential to grow faster than rich, they can catch up and close the gap in relative income →→ **CONVERGENCE**

- Using Solow, in order for exact convergence to occur, the countries must have the same.

PF, tech, and saving rates.

production function

Economic Growth and Structural Change

- As economies grow, we tend to see the following trends…
- 1) agriculture ↓→industry ↑→services ↑ as a percentage of total GDP.
- 2) labour force (LF) ↓ in agriculture (more slowly than above) and LF ↑ in industry and services.
- 3) urbanization ↑
- 4) a larger share of goods/services is sold in markets, rather than bartered or produced for own use.

- 5) As industry grows, the economy moves from labour-intensive to more K-intensive prod'n as industries substitute K for L and use more tech.
- 6) steady accumulation of human K
- 7) population growth rates first increasing and then decreasing with decline in family size

Why does agriculture decline?

Engel's Law:

1) As income increases, the proportion spent on food decreases.
2) Productivity gains in agriculture means that less people are employed in agriculture.

Key Models

- They are the **Harrod-Domar model (often referred to as the AK model)** which is short term is duration and Keynesian in spirit and
- **The Solow growth model** which is long term and neoclassical.
- **New Growth or Endogenous Models**
- We will not discuss the details of the Harrod-Domar model, only the conclusion. We will discuss Solow and changes to Solow which are similar to the "new growth" models

Basic Growth Model:

- Assume:
- 1) ignore the differences between the types of goods produced
- 2) one type of worker
- 3) one type of capital good
- 4) closed economy
- 5) no government

Key Equations:

- 1) Production Fn: $Y = F(K, L)$
- 2) Savings Function: $S = s\,Y$
- 3) S = I identity for closed econ. (all savings is invested)
- 4) net I = $\dot{K}$, $\dot{K} = I - (dK)$
- 5) Labour force growth rate = pop growth

- $\dot{L} = n\,L$
- n = pop growth rate and LF growth
- s = average savings rate (marginal propensity to save- MPS)
- d = constant depreciation rate

Combining equations:

- 6) $K = sY - (dK)$ since S = I

Saving, Investment and Capital Accumulation

- 1) new investment →↑K-stock as long as ↑K > depreciation rate, ***d***.
- 2) Investment is financed by savings.
- 3) Savings comes from current income.

- The lower is savings, the lower is growth.

- Short forms: ***K*** is physical capital and ***d*** is deprecation, ***s*** is savings rate

The Harrod-Domar Growth Model (1940s)

it's the first one look at growth

- Sometimes referred to as AK model since the K-stock is multiplied by a constant *A*.
- The PF is the base of every model of eco growth. The rel'nship between *K, L and Y* depends on scarcity/abundance of factors of prod'n (FOP), type of industry, tech, etc.
- Assumed production needed specific amounts of K and L to produce with little or no substitution between these factors of production.

Conclusions of Model?

- K created by investment is the main determinant of growth and saving makes investment possible
- Message: save more => make productive investment => growth.
- Note: we will not be going into the details of the model

The Solow (Neoclassical) Growth Model (mid 1950s)- Appendix 3.2

- The Model allows for sub between K and L and includes labour as a separate input
- We can use different combinations of K and L to produce the same output level
- Shows that with diminishing returns, growth cannot be sustained by K accumulation only
- Adds role for tech change

Basic Equations of Solow Model

- We express everything in per-worker/per person (pp) terms

1) $Y/L = F(K/L, L/L)$

$= F(K/L, 1)$? Y is a function of K

The book uses lower case to denote per worker terms.

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

Solow assumes diminishing MPK (marginal product of K) and CRS (constant returns to scale)

> 1 / < 1 / = 1.

2) $K/L = s\,(Y/L) - (n + d)\,K/L$

- K positively related to savings per worker
  - As s ↑ → I ↑ → K ↑

K negatively related to population growth and the depreciation rate

Textbook notation

$$sf(k^*) = (\delta + n)k^* \qquad (A3.2.5)$$

s is the savings rate;
***f*(*k**)** is the production function relating capital per worker to output; the function has diminishing returns; So,
***sf*(*k**)** is savings per worker
δ is the rate of capital depreciation; n is the rate of growth of the labor force;
Savings per worker *sf*(*k**) is just equal to the sum of:
***δk**:** the amount of capital (per worker) needed to replace depreciating capital, and,
n*k:** the amount of capital (per worker) that needs to be added - due labor force growth – to keep capital per worker from falling

Details of the model are examined in Appendix 3.2

- Capital Deepening: the process by which the economy increaseses k/L
- Capital Widening: increase in K-stock that just keep pace.
- with expanding LF and depreciation
- A country with a high savings rate can easily deepen its K-base and rapidly increase K/L thus providing basis for output growth.

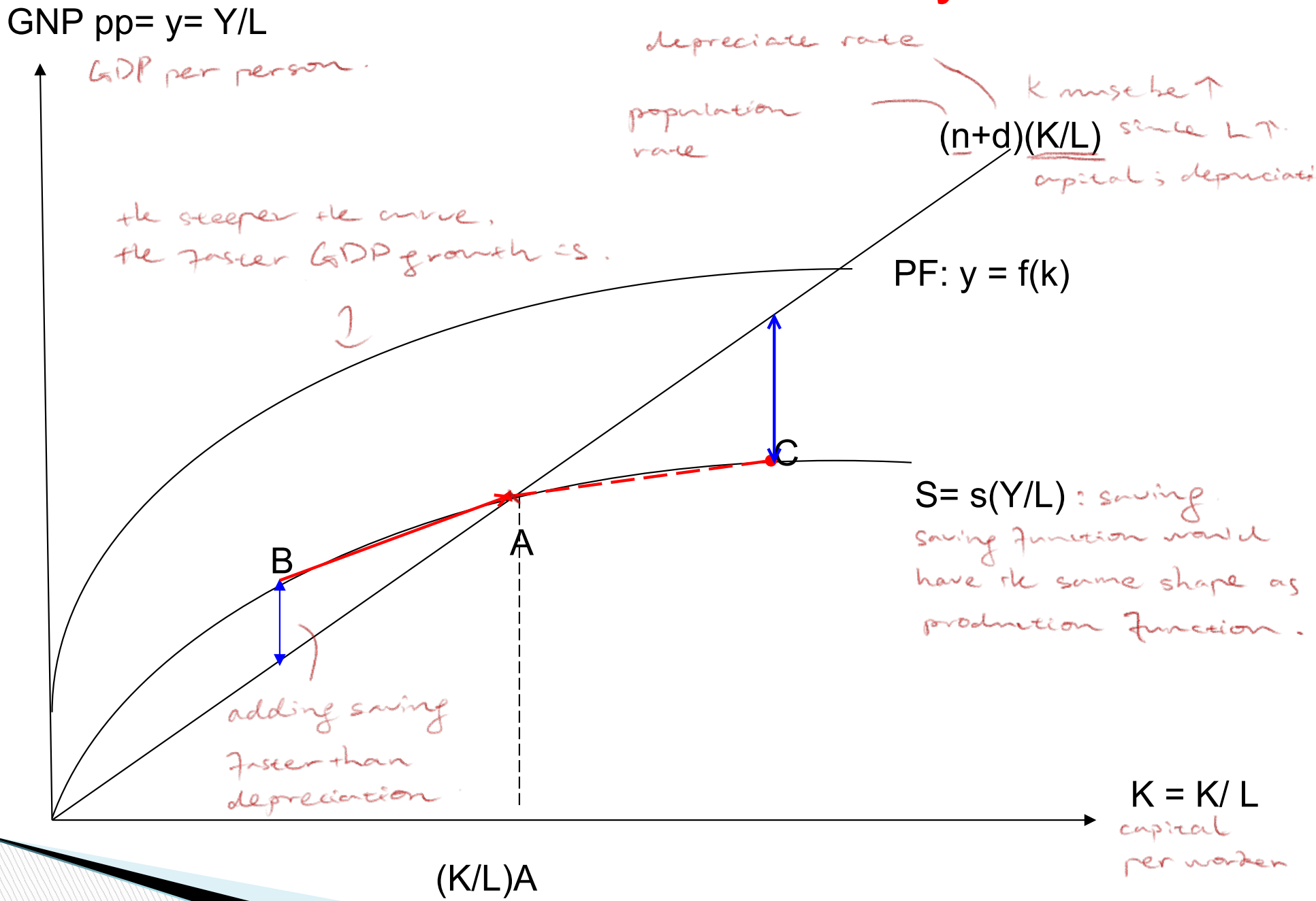
3) Capital Widening Line

$(n + d)(K/L)$

Slope is $n + d$

- This line represents the amt of new K needed as a result of growth in LF and depreciation to keep K/L constant. (Note in Williamson this is described as break-even investment)

Solow Growth Theory



Equilibrium

- Equil occurs at point A
- At Point B, savings pp exceeds pop growth plus depreciation

  s> n + d ? (K/L) ? ? A

- At C the opposite. S< n + d ? (K/L) ↓ ? A

- At A, s = n + d so that K/L is constant and Y/L is constant.

Equilibrium

- Point A is referred to as the steady-state(SS) equilibrium (no incentive for variables to change)
- this will provide the steady-state or LR (long run) or potential level of output per worker
- Note: Y/L is constant but Y is increasing.

- Points such as B tend to correspond with low income countries

For higher income countries, rate of growth of Y is smaller

- Implication: when countries have the same *potential* SS (steady-state) level of Y/L, poorer countries are expected to grow at faster rates than richer countries and eventually "catch up" to the same level of Y/L (Point A)…

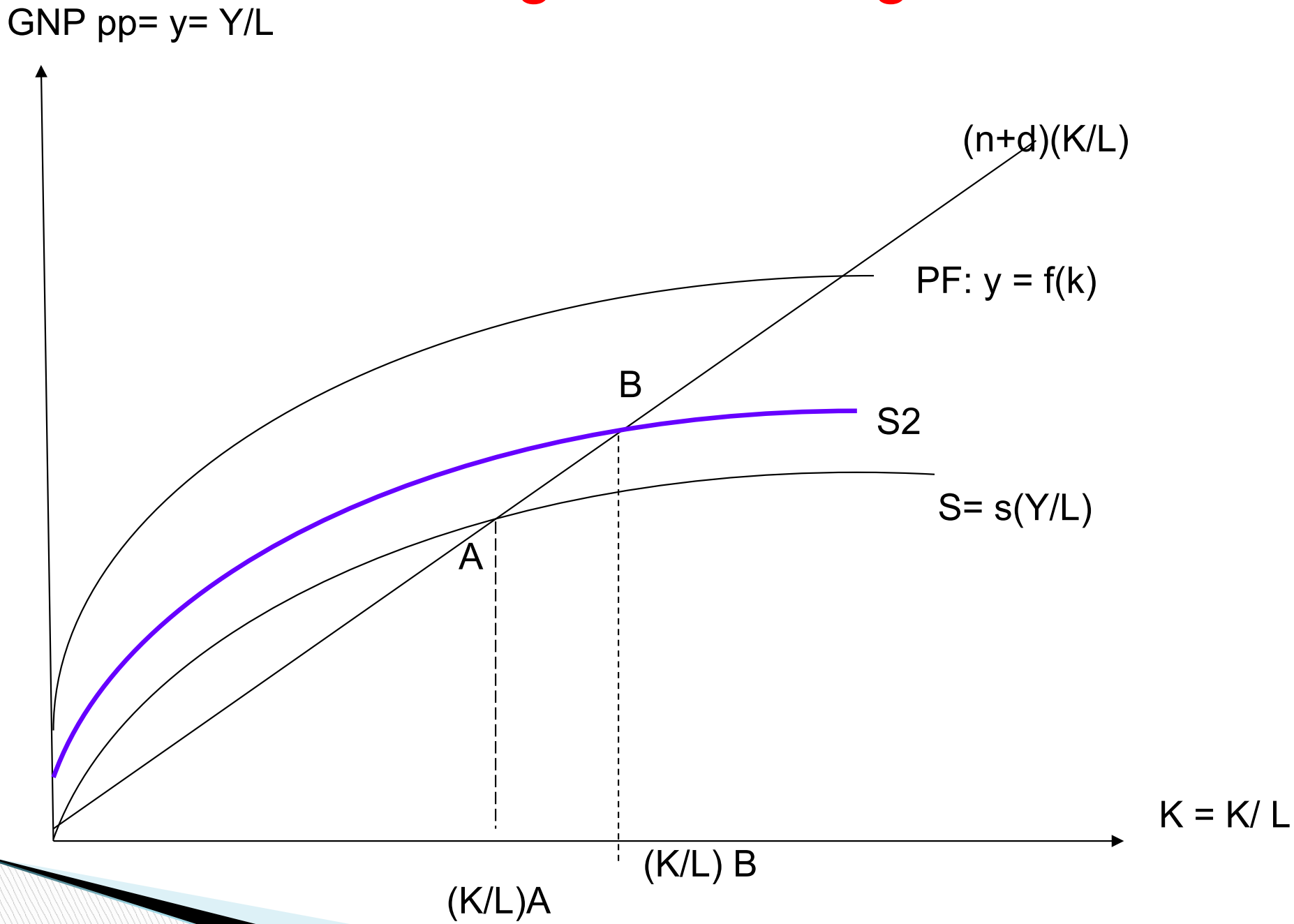
Numerical Example

- Note: This example addresses the capital per worker component, not production (output per worker)
- Income depends upon capital (K) per worker (L): i.e., K/L
- Before K/L can grow we must invest to make allowance for a) depreciation; and b) growth of the labor force L
- To illustrate, consider a 10-worker economy growing to 12 workers; initially K/L = 2; and depreciation = .05

Numerical example – cont'd

- To increase K/L to 2.5 we must invest:
  - 1 unit of K for depreciation allowance: (20)*(.05) = 1
  - 4 units of K for "capital widening" (equipping the new workers with the same capital as the existing workers)
  - 6 units of K for "capital deepening," to finally increase the K/L ratio, up to where each worker has 2.5 units of capital to work with
  - Overall, the K stock grows from 20 to 30, i.e., 30/12 = 2.5

Changes in Savings Rate



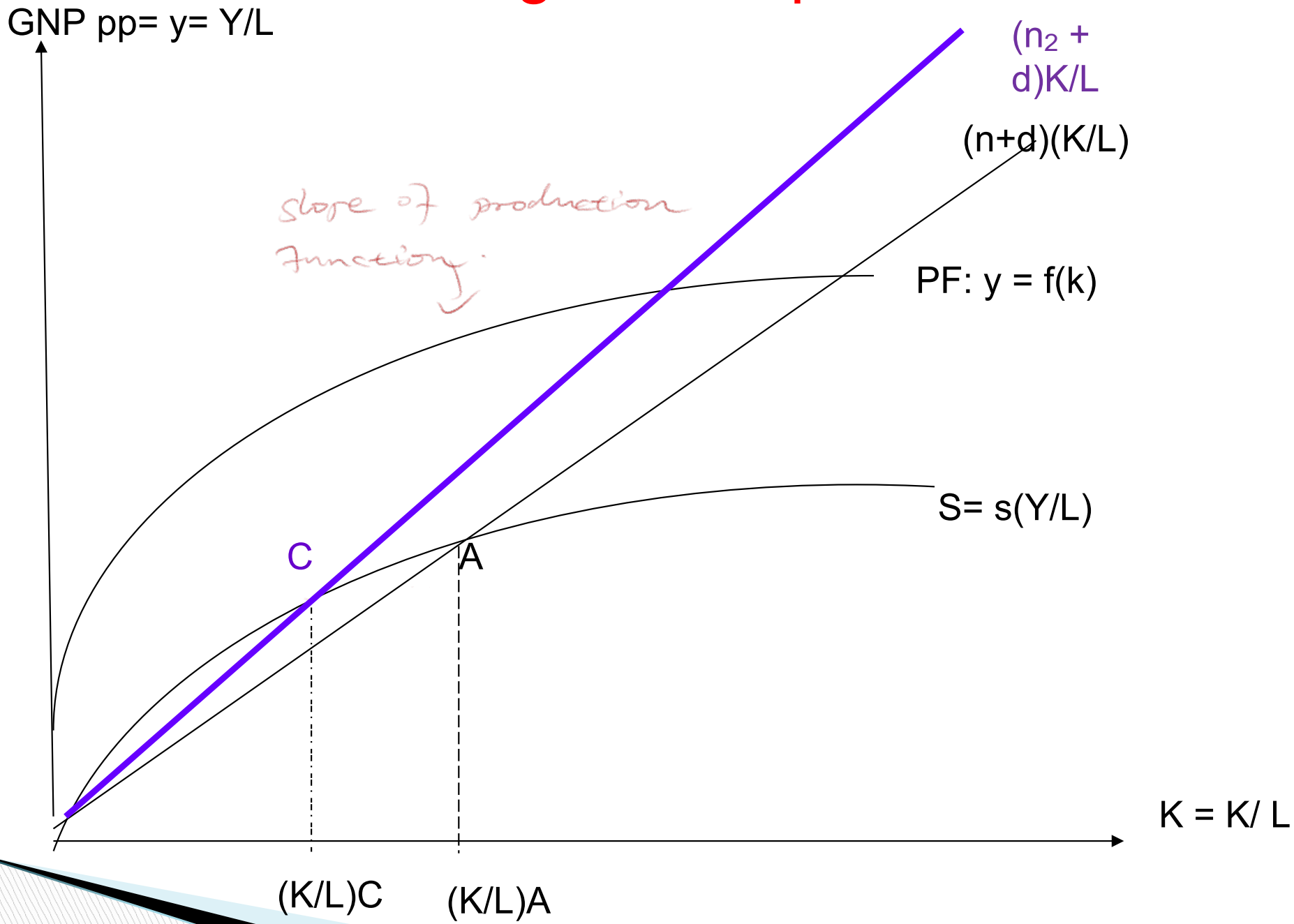
Change in the Savings Rate

- An **increase** leads to and **increase i**n K/L and Y/L, but the LR growth rate is still ***n***.
- At the original K/L, s greater than n+d

- Therefore, there is only a ***temporary*** increase in the growth rate. Think of why?

GDP ↑ approaches.

Changes in Pop Growth



Chg in Pop Growth

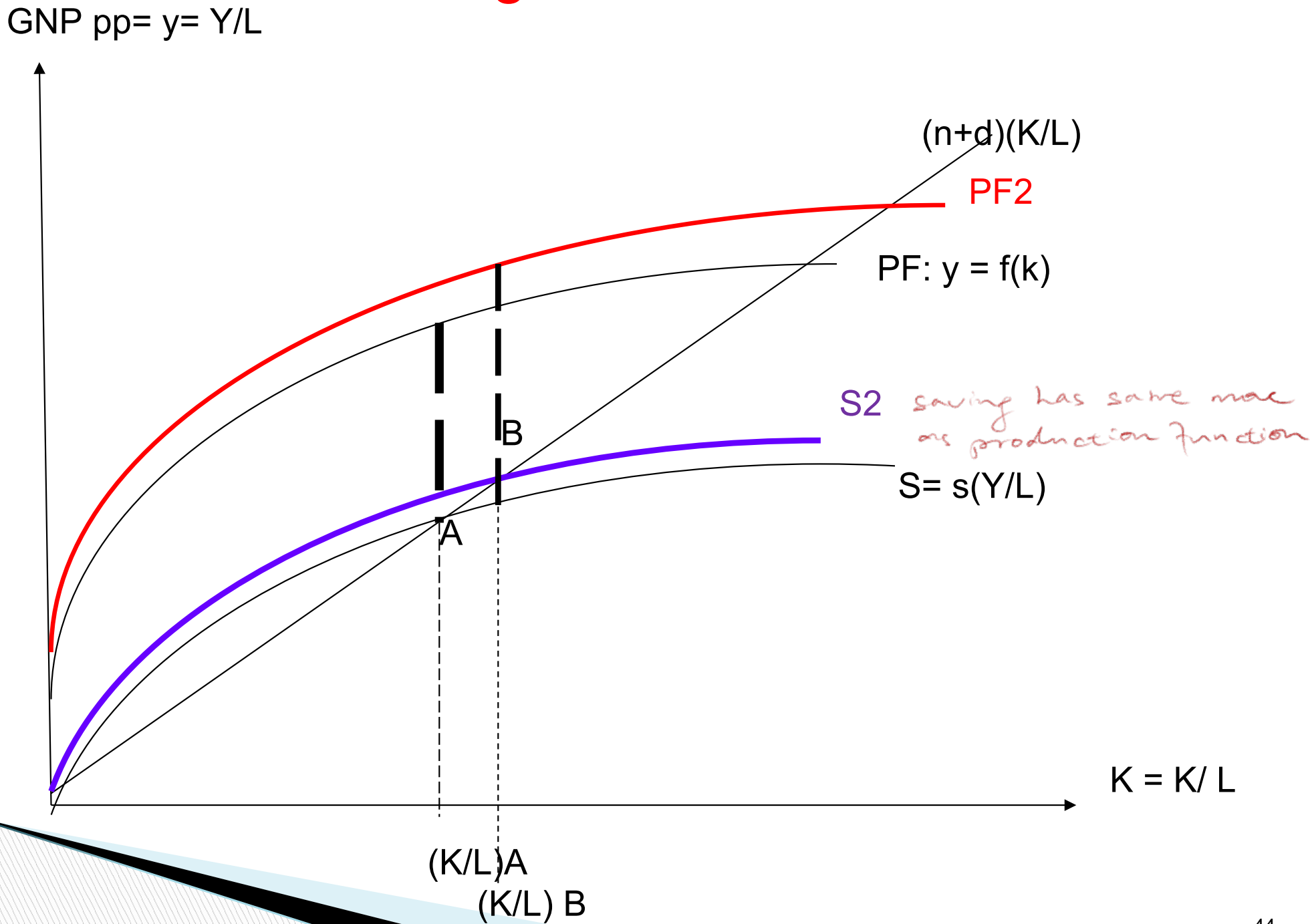
- An increase in pop growth pivots/rotates the K-widening line
- Since there are more workers,

  s< (n + d) ?(K/L)↓?(Y/L)↓

  => worse living standard.

- But **NEW** higher SS growth rate, ***n***

Changes in Tech



Change in Technology

- A change in tech has 2 effects:
  - GDP increases due to the shift UP of the PF
  - GDP increases due to the movement along the PF (due to savings increasing)
  - At A: s > n+ d, K/L rises and Y/L rises

Double effect on output

MPK increase, rather than decrease

Supplementary Note: The Role of Technology*

- If there is technological progress, income per worker can increase proportionately
- Think of K in the Solow production function as multiplied by a constant, A, "AK":
- So far we have implicitly set A to 1; but it can grow over time, representing productivity growth
- In equilibrium, if the "effective workforce" increases at rate ? then the Solow equilibrium is:
- $sf(k^*) = (? + n + ?)k^*$ $sf(k^*) =$
- The "effective workforce" then grows faster than the (actual) workforce, corresponding to an increase in output per worker

*This slide addresses a topic not explicitly explained or currently formalized in the text

Predictions of Solow

- Solow predicts that if one country has an investment rate of 20% and another has an investment rate of 5%, that income per worker will be higher in the country with the higher investment rate.
- In the **long run**, the growth of output is determined by the rate of growth of the labour force (population)
- An increase in the savings rate/investment rate encounters diminishing returns, therefore not leading to an increase in long term growth.

Solow predictions

- The level of per capita income DOES depend on the ratio of saving and investment to GDP and varies positively with savings and negatively with the population

Weaknesses of Solow

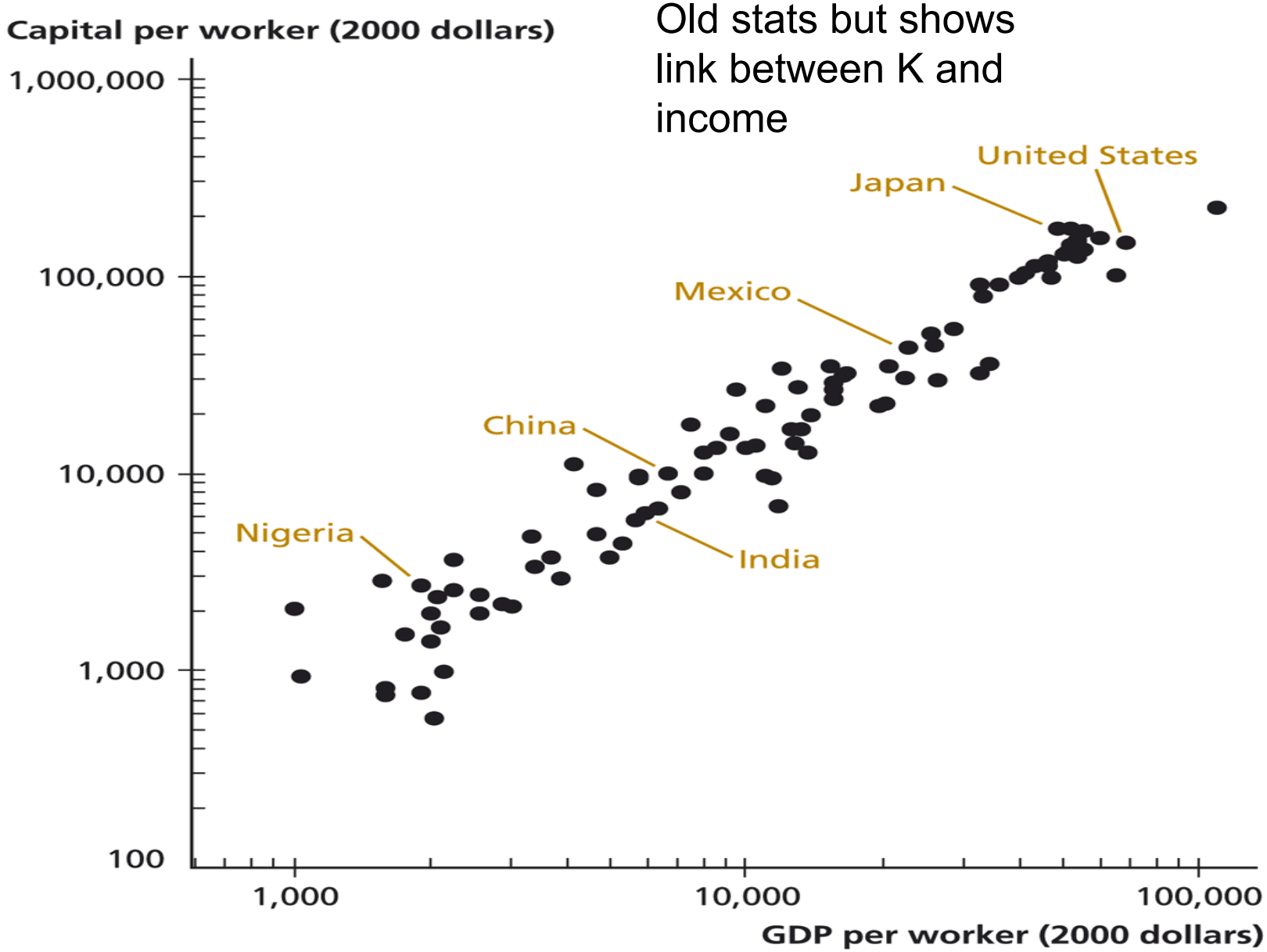
- 1) Does not explore fundamental determinants of factor accumulation and productivity.
- 2) Closed economy: allowing trade will lead to changes in the SS level and growth rate.
- 3) Model includes just one sector and omits the role of the allocation of K and L *among* different sectors.
- 4) holds *MPS, n,* skills and rate of tech change constant (for each SS equil)

Weaknesses of Solow

- 5) No government
- 6) Does not allow for connection between industries/technology spillover etc

- For exam: think of what would happen to the Solow model if we relaxed one of these restrictions. Think of drawing the new graph and explaining the change in the new equilibrium.

FIGURE 3.1
GDP and Capital per Worker, 2000



Old stats but shows link between K and income

Source: Calculations based on Heston et al. (2002).

GDP per worker and investment per capita, 2009 figures, 2005 dollars, all numbers taken from Alan Heston, Robert Summers and Bettina Aten, Penn World Table Version 7.0, Centre for International Comparisons at the University of Pennsylvania, May 2011.

Country	GDP per worker	Investment per capita
Canada	66276	21.59
Czech Republic	45801	19.99
Germany	63810	18.14
Hungary	39378	15.86
Korea	50015	30.55
Mexico	27550	20.75
Norway	93106	22.5
Spain	55089	24.64
Turkey	32698	15
UK	65115	14.39
US	81172	16.54

For interest

the consumption is high, technology is high also, a lot of US companies have activities oversides of the US.

- https://ourworldindata.org/grapher/share-of-investment-in-gdp-vs-gdp-per-capita?zoomToSelection=true&country=CAN~USA~DEU~GBR~KOR~ATG~SDN

Empirical Studies

- Applying Solow to a variety of countries, it works for some but not for others.

Also, the model doesn't work for the US.

WHY NOT?

- BUT
  - The model actually predicts that poor countries will grow faster than rich countries if they have the same potential Steady-state level of income
  - →convergence happens due to diminishing MPK in developed countries and higher MPK in developing countries

  - The model emphasizes the role of savings and empirically we find that in countries with higher savings rates, they have higher growth rates

3.6 Classic Theories of Development: Reconciling the Differences

- Governments do fail, but so do markets; a balance is needed
- Must attend to institutional and political realities in developing world
  - Development economics has no universally accepted paradigm
  - Insights and understandings are continually evolving
- Each theory has some strengths and some weaknesses

- **Dependency**
  - Existing international relations/ trade/ investment can place constraints on pattern of development
  - But, growing number of counter-examples of stronger versions of dependency theory; good performance of "globally" integrated countries
- **Market Fundamentalism**
  - Governments fail (e.g. in SOEs, planning) and we must account for this
  - But, markets also fail in developing countries; the East Asia experience shows that government role can be constructive

New Approaches to Growth

Endogenous Growth Models

- more sophisticated models
- assume increasing returns to scale (IRS) rather than constant returns to scale
- incorporate positive externalities from investment in research or education (spillover effects) which lead to investment in R & D

- Endogenous growth theories are basically like us shifting the PF for Solow, so that diminishing returns do not apply
- Endogenous growth theories show that rich and poor countries are NOT on the same PF

- New growth relaxes the theory of diminishing returns to capital by redefining capital to include improvements in human capital and new techniques in production through R&D
- →conditional convergence only

- it's possible an increase in the savings rate may lead to a permanent increase in the rate of eco growth

- These newer models do not necessarily imply convergence.

Barro and Lee (1993)

(How these items relate to growth rate, not GDP)

- Find the following to be reasons that explain the difference between fast growing and slow growing countries
- 1) initial level of per capita income (negatively related)

  low income => faster growth rate.

- 2) investment rate (positive)
- 3) ratio of government consumption to GDP (negative)
- 4) market distortions as measured by the black market value of the exchange rate (negative)
- 5) political instability (negative)

- Source: Barro, R. and Lee, J.-W (1993). "Losers and Winners in Economic Growth", *Proceedings of the World Bank Conference on Development Economics*. (Washington DC, World Bank).

Concepts for Review

- Capital-labor ratio
- Capital-output ratio
- Closed economy
- Dependence
- Free market
- Free-market analysis
- Harrod-Domar growth model
- Marginal product
- Market failure

Concepts for Review (Continued)

- Market-friendly approach
- Neoclassical counterrevolution
- Open economy
- Patterns-of-development analysis
- Production function
- Public-choice theory
- Self-sustaining growth
- Solow neoclassical growth model
- Surplus labor
- Underdevelopment