Economic Growth and Income Disparity

ECO 305: Intermediate Macroeconomics

Explore multiple growth theories to explain...

1. Income disparities: Why do some countries never catch up to more developed countries

2. Poverty traps: Why some impoverished countries grow slowly

- Chapter 8, pp. 281-290: Using the Solow growth model to explain international differences in income per capita

- Chapter 8, pp. 290-300: Endogenous growth model with human capital accumulation

- **Canvas Quiz due Wed 11:59 PM**.
  Multiple-choice, 15 questions, unlimited attempts allowed, only best score counts

- **Homework/Exercise due Thursday 11:59 PM**. We will work together in class on Thursday

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Differences in Access to Technology   3/ 14

- Not all countries may have the same total factor productivity
- Implementing new technologies may require high levels of existing infrastructure (eg: factories, internet connectivity, etc.)
- Countries with low levels of capital stock may have limited access to technologies
- Countries with low k may also have low z

Solow Growth Models
Endogenous Growth: Human Capital Accumulation

Differences in Access to Technology
Differences in Population Growth Rates
Increasing Marginal Product of Capital

Differences in Access to Technology 3/ 14

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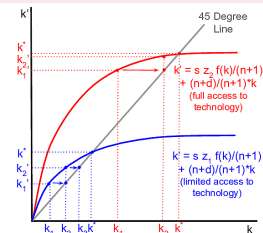
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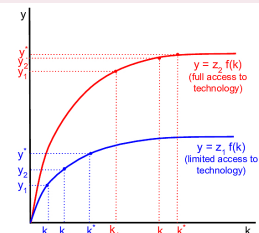
Differences in Access to Technology

Capital Evolution

Limited access to technology:
Slow growth toward low k*
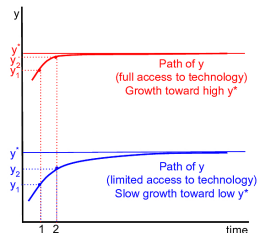
Full access to technology:
Growth toward high k*

Output Growth

Limited access to technology:
Slow growth toward low k*, y*

Full access to technology:
Growth toward high k*, y*

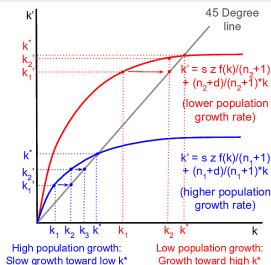## Time Path for Output

Result for countries with low capital stock & low access to tech

- Grow at slow rates

- Converge at low levels of capital stock per worker

- Converge at low levels of real GDP per capita

Differences in Population Growth Rates

Capital Evolution

High population growth:
Slow growth toward low k*

Low population growth:
Growth toward high k*

Output Growth

High population growth:
Slow growth toward low k*, y*

Low population growth:
Growth toward high k*, y*

Time Path for Output

Result for countries with low capital stock & high population growth

- Grow at slow rates
- Converge at low levels of capital stock per worker
- Converge at low levels of real GDP per capita

Increasing Marginal Product of Capital
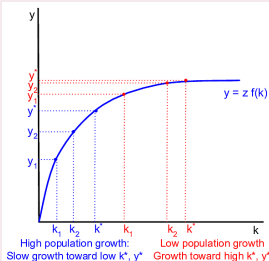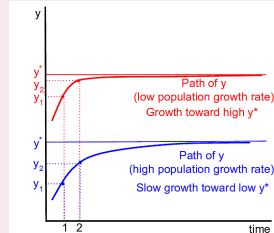
- Typical assumption of **diminishing returns:** As capital stock increases, the marginal product of capital decreases

- At lowest levels of capital stock, increasing marginal product of capital is possible

- Positive externalities to capital production: When infrastructure and markets are small to non-existant in lesser-developed countries, new firms and new capital help productivity of other firms.

  - Example: a single factory would be more productive if there was a shipping and warehousing company to ship products and supplies.

- Small companies, small facilities, may take advantage of economies of scale

  - Eventually companies may get large enough and diminishing returns sets in

- Likely possibility for small lesser-developed economies, not likely at an aggregate level for highly-developed economies

Increasing Marginal Product of Capital 6/ 14

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Production Function with Increasing Returns

Increasing Returns

- Increasing MP_K at low levels of capital stock per worker
- Eventually, diminishing returns sets in after k_{IP}

Production Function

Production Function
with Increasing Returns

$y = z\,f(k)$

Increasing MP_K
at low levels of k

y_{IP}

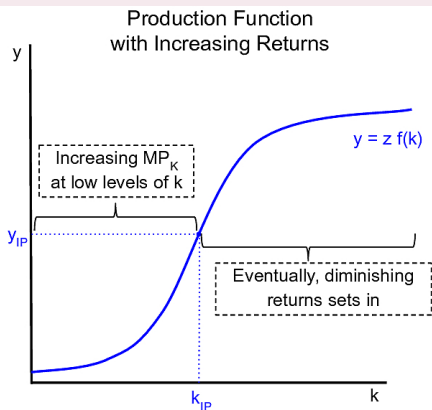Eventually, diminishing
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Production Function with Increasing Returns 7/ 14

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Production Function

Production Function with Increasing Returns

Multiple Steady States with Increasing Returns

Increasing Returns

- When k is low and below intersection with 45-deg line, economy shrinks, converges to impoverished levels
- When k is higher and above intersection, economy grows, converges to developed levels
- Case for government assistance is when k is in poverty trap

Capital Evolution

Capital Evolution with Increasing Returns

Multiple Steady States with Increasing Returns   8/ 14

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Capital Evolution

Capital Evolution with Increasing Returns

$$k' = \frac{(n+d)}{(1+n)} k + \frac{s_N z \, f(k)}{(1+n)}$$

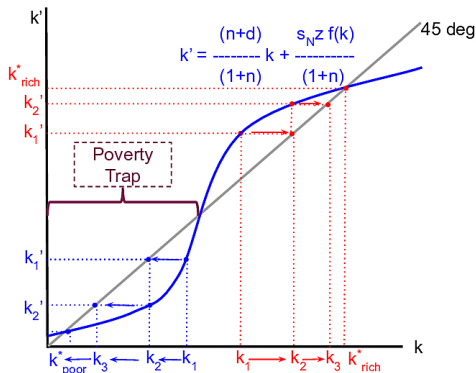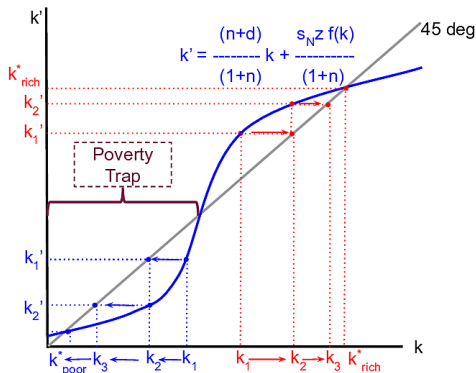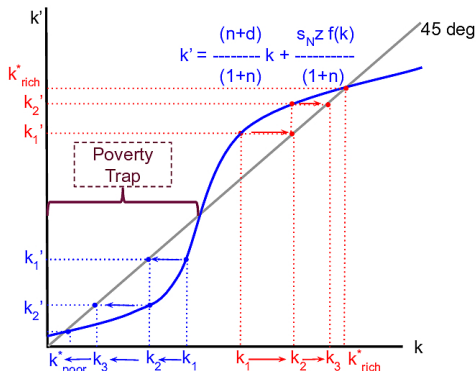# Multiple Steady States with Increasing Returns   8/ 14

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Capital Evolution

Capital Evolution with Increasing Returns

Solow Growth Models
Endogenous Growth: Human Capital Accumulation

Human Capital Properties
Human Capital Accumulation
Higher Investment in Education

Human Capital Properties   9/ 14

- Human capital is a factor of production we have ignored so far

- **Human capital:** knowledge and skills of workers that can be used in the production of goods and services

- Argued that human capital does not exhibit diminishing returns

    - Knowledge accumulation is **non-rivalrous**. One person learning something doesn't diminish or prevent another person from learning something.

    - Knowledgeable workers can have **positive externalities**. Not only is a knowledgeable worker more productive, other co-workers may benefit and be more productive

    - Acquiring and sharing knowledge gets easier as it grows. Example: Calculus, and you're no Isaac Newton.

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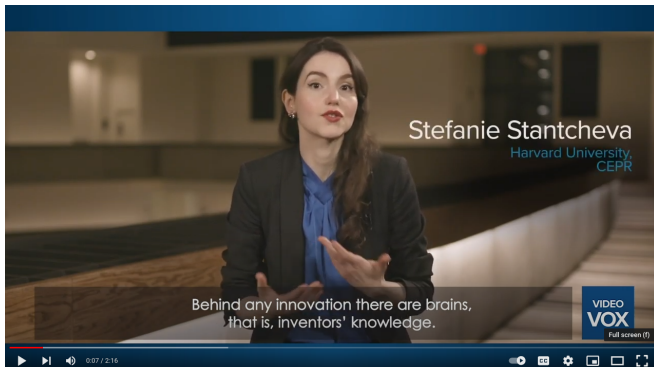## Increasing Returns to Human Capital 10/ 14

Being knowledgeable not only improves your own productivity and opportunities, it **also makes it easier for your peers and co-workers to acquire acquire knowledge.**

https://www.youtube.com/watch?v=U5wfxjmIwtE

Human Capital Accumulation

- Let human capital per worker evolve according to:

$$h' = (1 - d)h + buh$$

  - h: average level of human capital per worker
  - $d \in (0, 1)$ depreciation rate of human capital
  - $u \in (0, 1)$ fraction of time spent with training and education
  - $b > 0$: measure of efficiency/effectiveness of training and education

- Some algebra shows...

$$h' = (1 - d + bu)h$$

  - Coefficient on h is greater than 1.0 when...
  - $bu > d$: Effectiveness and time spent on training/education outweigh forgetting stuff.
  - When coefficient > 1, $h' > h$ always, human capital grows unbounded, forever

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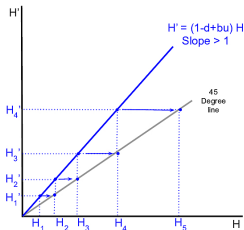
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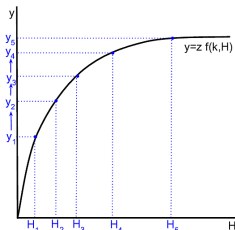 - When coefficient > 1, $h' > h$ always, human capital grows unbounded, forever

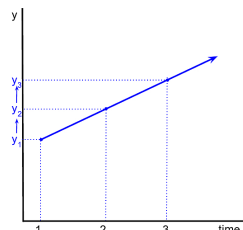# Human Capital and Output Growth   12/ 14

Human Capital

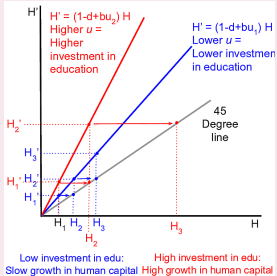
Output Growth

Time Path for Output

Result for human capital and output growth

- Human capital grows unbounded
- Even with diminishing returns, real GDP per capita grows unbounded with human capital
- There is no convergence: Countries with lower levels of human capital can grow, but still remain behind others with higher levels of human capital
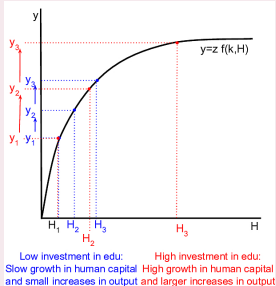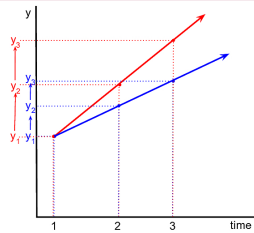
Human Capital and Output Growth

Human Capital

H'

$H' = (1-d+bu_2) H$
Higher $u =$
Higher investment in education

$H' = (1-d+bu_1) H$
Lower $u =$
Lower investment in education

45 Degree line

H_2'
H_3'
$H_1' \, H_2'$
H_1'

$H_1 \, H_2 \, H_3$
H_2
H_3
H

Low investment in edu:
Slow growth in human capital   High investment in edu: High growth in human capital

Output Growth

y

y_3
y_3
y_2
y_2
y_1 y_1

$y=z \, f(k,H)$

$H_1 \, H_2 \, H_3$
H_2
H_3
H

Low investment in edu:
Slow growth in human capital
and small increases in output   High investment in edu:
High growth in human capital
and larger increases in output

Time Path for Output

y

y_3
y_2
y_2
y_1 y_1

1   2   3   time

Result for human capital and output growth

- Even when initial levels of human capital & output are the same
- More investment in human capital leads to permanently faster growth
- Growth paths diverge (no convergence)

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