Chapter 6
Education, Human Capital, and Growth

6.1 How does education influence growth?

- Education is viewed as an investment in human capital. Paul Krugman claimed that the rapid economic growth of the East Asian Tigers attributed much to their rapid expansion of education.

- Evidence strongly suggests that there is a bi-directional relationship between education and economic growth. Education causes growth to increase and the increased growth in turn increases the demand for education.

- If education is viewed as human capital, it is subject to diminishing returns and capable of causing only short-run and medium-run economic growth.

- Investment in education may generate positive externalities, in which case the economy could overcome diminishing returns and enjoy long-run permanent economic growth.

- Amartya Sen says that educate part of the community and the whole of it benefits.

- Indeed, many classical economists argued strongly for government, active support of education on the grounds of the positive externalities that society would gain from a more educated labor force.

- Education provides the human capital needed for R & D activity, which will directly raise-long-run economic growth. Education is seen as an effort to increase the resources needed for creating new ideas, and thus any increase in education will directly accelerate technological progress.

- Education's greatest role may be in spreading ideas and knowledge. Education is necessary if the available ideas and knowledge are to be adapted.

6.2 Empirical evidence ion education and economic growth

- In general, empirical studies on education and economic growth have not been able to prove causality.

6.2.1 The conflicting statistical results

- Robert Barro found that schooling was closely correlated with economic growth. Each additional year of average school enrollment in 1960 was associated with about 0.3% faster annual growth of per capita GDP over 1960-1990 period.

- But other studies have not found as strong a relationship between education and growth.

- In the finding of Levine and Renelt, the inclusion of an education variable, along with an investment variable, an initial per capita output measure, and population growth, did not ensure statistical significance.

- Xavier-Sala-Martin did not find education to be one of the institutional explanatory variables which reflected a policy regime or a set of incentives that influenced people's behavior. Their results suggest that without the proper institutional framework, education cannot influence the rate of economic growth.

6.2.2 Further studies on education and economic growth

- Sanjeev Gupta, Marijn Verhoeven, and Eruin Tiongson found that white total spending may not matter for growth, greater public spending on primary and secondary education has a positive impact on widely used measures of education attainment.

- Mark Bits and Peter Klenow looked at the possibility that economic growth causes higher levels of education, and they found that reverse relationship to be much stronger than the direct effect of education on growth.

- Sebuem Kalemi-Ozcan, Harl Ryder, and David Wert, who concluded that it is the higher life expectancy that accompanies economic growth that causes people to invest more in human capital. A longer life span makes investment in education more profitable because people have more time to reap the rewards of their investments. Thus, education may be the result rather than the cause of economic growth.

- Borensztein, De Gregorio, and Lee confirmed that education plays a critical role in how well foreign direct investment transfers technology. Their finding seems to suggest that higher levels of education in the host country permit the technology

brought in by foreign direct investment to spread to the rest of the economy more easily. Their results could also reflect the likelihood that foreign investors transfer more technology when there are educated workers in the country who can handle the newer methods and more complex producers. To conclude, economic growth benefits from education.

- Jacques Morisset and Cesar Revoredo found that education positively influences savings in the long run.

- Se-Jok Kim and Yong Jin Kim suggests that education can stimulate economic growth by increasing the mobility of workers. Of education makes workers more mobile, structural change will occur more easily and more quickly, thus enhancing economic growth.

- Jonathan Temple concluded that there is clear evidence that output growth os positively related to the change in educational attainment.

6.3 Human Capital

- Expenditures on education, training, medical care, etc., are investments in capital.

- These produce human, not physical or financial, capital because you cannot separate a person from his or her knowledge, skills, and health.

6.3.1 Education and training

- They are the most important investments in human capital.

- High school and college education greatly raise a person's income.

- Whether because of school problems, family instability, or other forces, young people without a college education are not being prepared for work in modern economies.

- Human capital analysis assumes that schooling raises earnings and productivity mainly by providing knowledge, skills, and a way of analyzing problems.

- Even college graduates are not well prepared for the labor market when they leave

school, and they are fitted into their jobs through formal and informal training programs.

- On- the-job training is an important source of the very large increase in earnings as workers gain greater experience at work.

6.3.2 Human capital and the family

- Parents have a large influence on the education, marital stability, and many other dimensions of their children's lives.

- Richer families can pay for the training of their children, including the earnings forgone when children spent time in training rather than at work.

- Many pooper parents would be willing to lend their children money to help them obtain further training if the parents could except to get paid back later when they are old.

- But children may not carry out their part of their bargain since children often live far from their parents.

- One solution is for governments to lend money to students where their parents are unable or unwilling to finance the training.

- There is a negative relationship between families' total spending on each child and number of children. The reason is that an increase in the dollars or time spent on each child raises the cost of having an additional child.

- There is also a negative relation at the aggregate level between population growth and investments in human capita. Groups with small families generally spend a lot on each child's education and training, while those with big families spend much less.

- For example, Taiwan's birth rate was cut in half from 1960 to 1975, while the fraction of high school graduates doubled after Taiwan took off in the 1960's toward its remarkable economic growth.

6.3.3 Human capital and economic development

- persistent growth in income per person lies in the expansion of scientific and technical knowledge that raises the productivity of labor and other inputs in production.

- Apply scientific knowledge to production of goods has greatly increased the value of education, technical schooling, and on-the-job training as the growth of knowledge has embodied in people such as scientists, scholars, technicians, managers, and so on.

- All countries which have managed persistent growth in income have also had large increases in the education and training of their labor forces.

- However, the expansion in education as countries get richer, no more implies that education causes growth.

- The outstanding economic records of Japan, Taiwan, and other Asian economies show that the importance of human capital to growth.

6.3.4 Measuring human capital

- Education and human capital are not identical since human capital is acquired by many means other than formal education. Moreover, education does not always result in the creation of human capital.

- Expenditures on education, the percentage of children attending school, and the average years of schooling are measures that are available for a large number of countries and for different time periods.

- No other measures of human capital available for economists to use.

- There is not a strong correlation between the amount of money invested in education, the number of years spent in school, and the specific skills and knowledge acquired.

- The United States has one of the highest percentages of its population with low reading skills though its students spend among the longest numbers of years in school. Its absolute per-student expenditures on education are also among the very highest in the world. It also only country in which younger people exhibit a lower

reading ability than their parents.

- Reading skills differ across industries as much as they differ across countries.

- In the case of agriculture, reading skills in the United States are among the highest in the developed world. Only the Netherlands has fewer people with low reading skills employed in the agricultural sector. No country has a higher percentage of its agricultural workforce with high reading skills.

- In manufacturing the United States ranks among the lowest in terms of the reading skills of its workers, despite very high graduation rates from secondary education.

6.3.5 The augmented Solow model with human capital

- model education as a separate component of an augmented Cobb-Douglas production function, as N. Gergory Mankiw, David Romer, and David Werl (1992) did:

$$Y(t) = K(t)^{\alpha} H(t)^{\beta} [A(t) L(t)]^{1-\alpha-\beta} \quad \text{.....(1)}$$

$\alpha > 0, \beta > 0, \alpha + \beta < 1$

- where: **H** is the stock of human capital. **L** denotes the number of workers.

- A skilled worker supplies both one unit of **L** and some amount of **H**

- implies that there are constant returns to K, **H**, and **L**.

- The usual assumptions about the dynamics of **K** and **L**:

$$\dot{K}(t) = s_K Y(t) \quad \text{.....(2)}$$

$$\dot{L}(t) = nL(t) \quad \text{.....(3)}$$

where s_K ≡ fraction of output devoted to physical capital accumulation

- Assume no depreciation in physical capital.

- Follow the Solow model, constant and exogenous technological progress is assumed:

$$\dot{A}(t) = gA(t) \quad \text{.....(4)}$$

- The dynamic of human capital accumulation:

$$\dot{H}(t) = s_H Y(t) \quad \text{.....(5)}$$

where $s_H \equiv$ fraction of resources devoted to human capital accumulated

- Transform **(1)** in per-worker form:

$$\frac{dk}{dt} = \frac{d\left(\frac{K}{AL}\right)}{dt} = \frac{AL\left(\frac{dk}{dt}\right) - K\left[L\left(\frac{dA}{dt}\right) + A\left(\frac{dL}{dt}\right)\right]}{[A(t)L(t)]^2}$$

$$= \frac{1}{A(t)L(t)} \cdot \frac{dK(t)}{dt} - \frac{K(t)}{[A(t)L(t)]^2}\left(L\frac{dA}{dt} + A\frac{dL}{dt}\right)$$

$$= \frac{s_K Y(t)}{A(t)L(t)} - \frac{K(t)}{A(t)L(t)}\left\{\frac{1}{A(t)L(t)}\left[L(t)\dot{A}(t) + A(t)\dot{L}(t)\right]\right\}$$

$$= \frac{s_K Y(t)}{A(t)L(t)} - \frac{K(t)}{A(t)L(t)}\left[\frac{\dot{A}(t)}{A(t)} + \frac{\dot{L}(t)}{L(t)}\right]$$

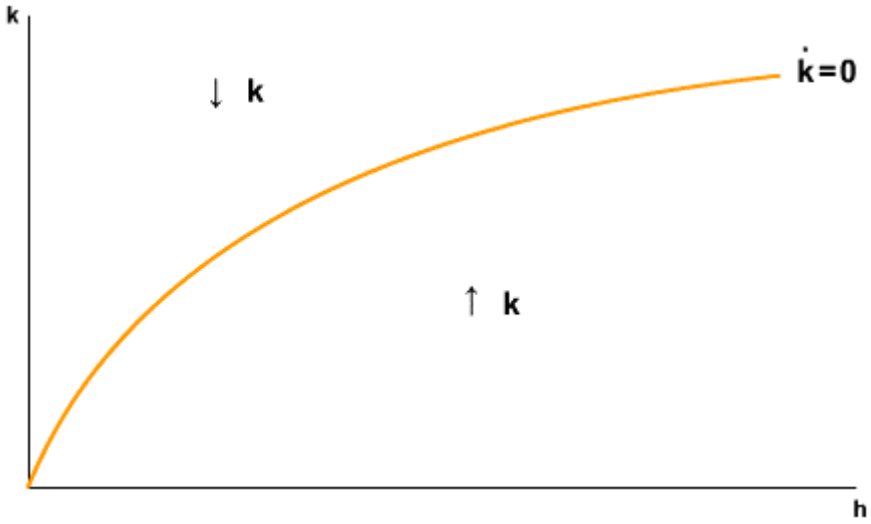
$$= s_K y(t) - k(t)(g+n)$$

$$= s_K k^{\alpha} h^{\beta} - (n+g)k(t) \quad \text{.....(7)}$$

- As $\dot{k} = 0$, **(7)** implies: $s_K k^{\alpha} h^{\beta} = (n+g)k(t)$ .....**(8)**

- **(7)** implies that $\dot{k}$ is increasing in **h**:

$$\frac{d\dot{k}}{dh} = \beta h^{\beta-1} > 0$$ => positive relationship



- To the right of the $\dot{k} = 0$ locus, $\dot{k}$ is positive, and vice versa.

- Replace a_K by s_H and **k(t)** by **h(t)**, **(7)** yields the dynamic of **h**:

$$\dot{h}(t) = s_H k(t)^{\alpha} h(t)^{\beta} - (n+g)h(t) \quad \text{.....(9)}$$

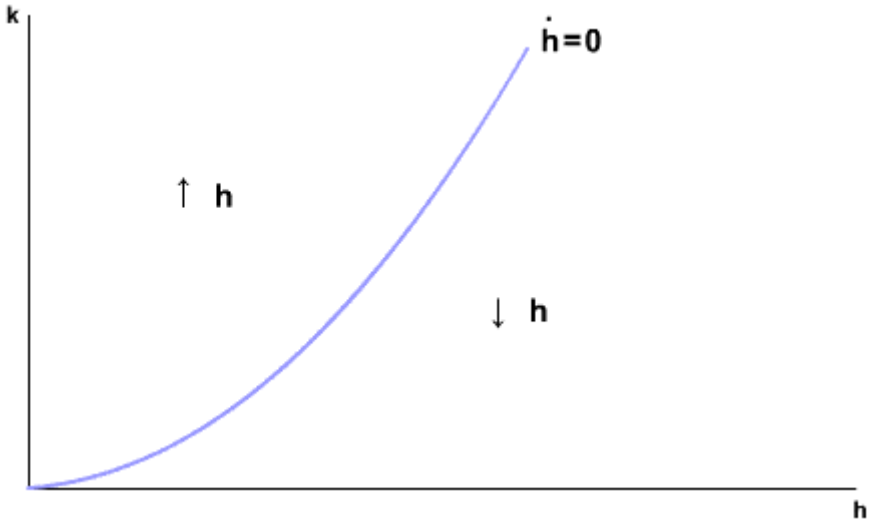
- As $\dot{h}(t) = 0$, **(9)** implies: $s_H k(t)^{\alpha} h(t)^{\beta} = (n+g)h(t)$ .....**(10)**

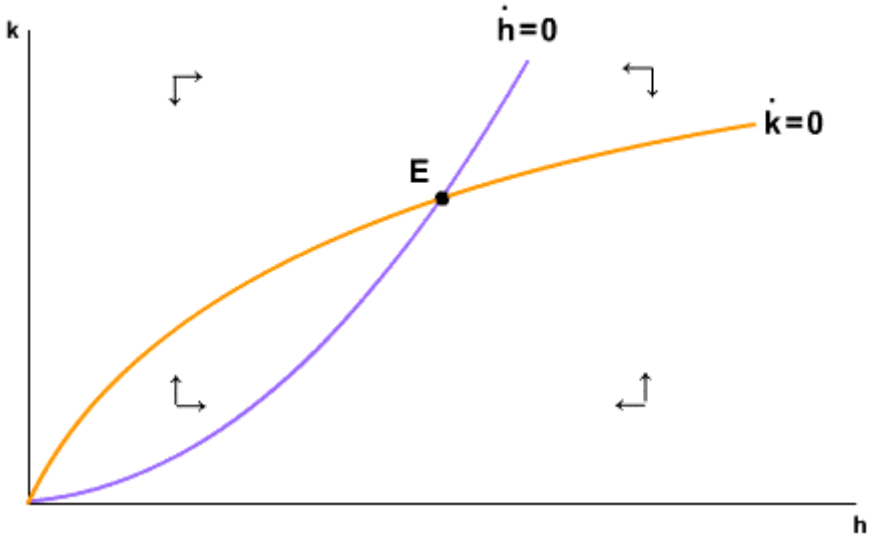
- **(9)** implies that $\dot{h}$ is increasing in **h**:

$$\frac{d\dot{h}(t)}{dk} = \alpha k(t)^{\alpha-1} > 0$$ => positive relationship

- $\dot{h}$ is positive above the **h = 0** locus, and vice versa.

- The initial values of **K**, **H**, **A**, and L determine the initial levels of **k** and h through **(7)** and **(9)**.





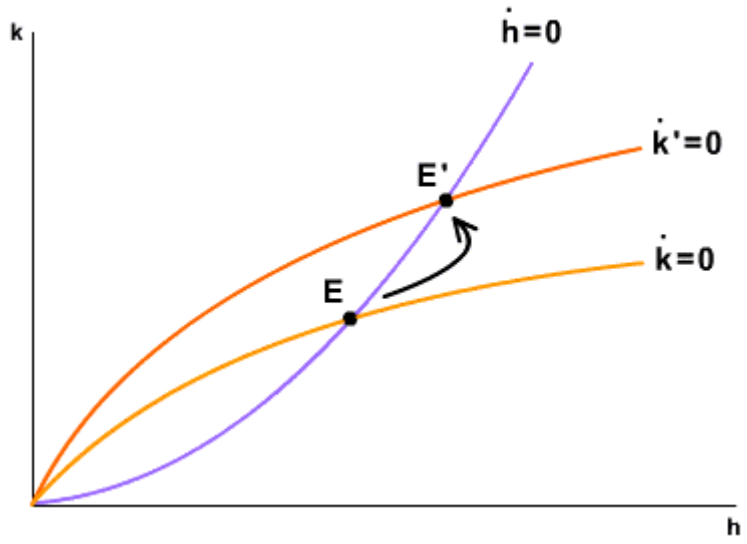
- Whatever the economy's initial position, it converges to point E which is globally stable. Once it reaches point E, it remains there and thus it is on a balanced growth path.

- On the balanced growth path, k, h and y are constant and they are growing at rate g. Total physical capital, human capital, and output are growing at rate n + g.

- As in the Solow model, the long-run growth rate of output per worker is determined by the exogenous rate of technological progress.

- Now, assume that initially the economy is on a balanced growth path, and that s_K increases.

- **(7)** and **(9)** imply that the increase in saving only affect the $\dot{k}(t) = 0$ locus but not the $\dot{h}(t) = 0$ locus.



- An increase in s_K shifts up $\dot{k}(t) = 0$. Initially, **h** is constant and **k** is rising. This moves the economy above the $\dot{h}(t) = 0$ locus, and so **h** also begins to rise.

- Both **k** and **h** increase, and hence the economy reaches a new balanced growth path at point E'.

- During the transition between the two balanced growth paths, output per worker is rising since **A**, **k**, and **h** are rising. Output worker is growing at a rate greater then **g**. when the economy reaches the new balanced growth path, **k** and **h** are again constant, and so the growth rate of output per worker returns to **g**.