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# Chapter 7: Part 2

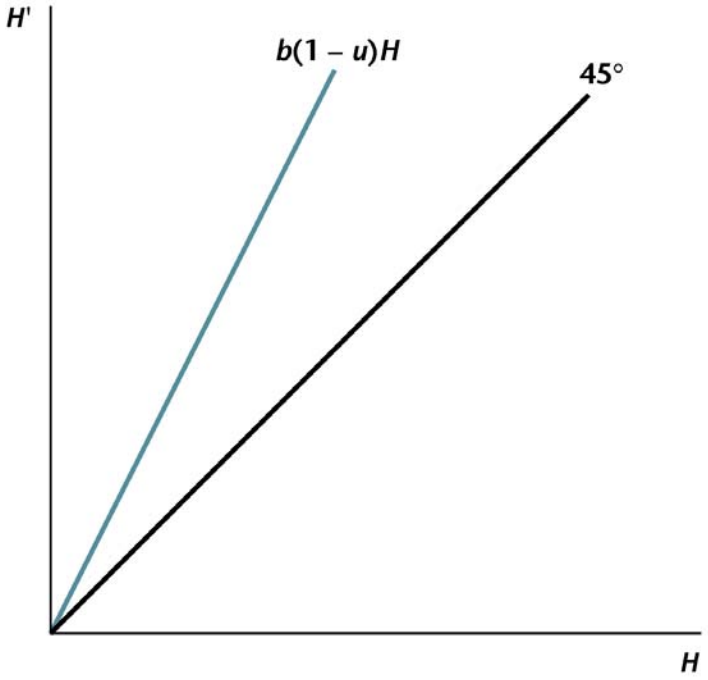
## 5. Definition of Competitive Equilibrium

- Competitive equilibrium is very easy to derive because:
    a. There is only one market where the consumption goods are traded for efficiency units of labor wage.
    b. The labor always clears at the equilibrium real wage: $w = z$
- Labor market clearing condition: $\mu H^s = \mu H^d$

  This means that: $H^s = H^d = H$ ---- (5)
- Subbing (5) into (1): $C = z\mu H$ ---- (6)
- Subbing (5) into (2): $H' = b(1-\mu)H$ ----(7)

  Hence in equilibrium, the growth rate of human capital is denoted as: $\frac{H'}{H} - 1 = b(1-\mu) - 1$---- (8)

**Figure 7.6 Human Capital Accumulations in the Endogenous Growth Model**



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- The graph plots equation (7). We see the following:
  - If $b(1-\mu) \succ 1$, then $H' \succ H$ .
  - If the above condition is satisfied, then there is no convergence of human capital in the long run. Hence growth can be unbounded. This is reflected in the graph
- Unbounded Growth can in this model can be achieved in two ways
- If $b$ increases, then $b(1-\mu) \succ 1$. This means that **an increase in the efficiency of the human capital technology can lead to unbounded growth.**
- If $\mu$ goes down, then also $b(1-\mu) \succ 1$ and we have unbounded growth. Thus **an increase in time allocated to accumulating human capital ($(1-\mu)$) may also lead to unbounded growth.**
- If equation (6) holds in equilibrium for $C$, it also holds for $C'$. So, we can have: $C' = z\mu H'$ ----(9)

Using (6) and (9) together and make use of (8), we get:

$$\frac{C'}{C} = \frac{H'}{H} = \frac{C'}{C} - 1 = \frac{H'}{H} - 1 = b(1-\mu) - 1 \text{-------} \quad (10)$$

So, **the growth rate of consumption is equal to the growth rate of human capital accumulation.**

- Since in equilibrium, the income expenditure identity holds, $C = Y$, we see:

$$\frac{Y'}{Y} = \frac{H'}{H} = \frac{Y'}{Y} - 1 = \frac{H'}{H} - 1 = b(1-\mu) - 1$$

Thus, **the growth rate of output is equal to the growth rate of human capital accumulation.**

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## Very Very Very Important Critical Issue

- This model predicts that countries with more efficient education system can experience higher human capital accumulation and therefore, higher economic growth. This is consistent with the growth experience from India and Korea.
- In this model, growth is completely **endogenous.** There is no population growth, no Technological innovation (change in z). So technology remains unchanged over time and yet, we have economic growth.
- The growth process is controlled by **endogenous factors** such as $b, \mu$.
- The main reason behind unbounded growth in Lucas Model is because Human capital does not exhibit **DRS**. So, although production technology has **CRS**, output increase in the same proportion with human capital and we have economic growth

# C. GOVERNMENT POLICY AND ENDOGENOUS GROWTH MODEL: POLICY EXPERIEMNTS

## 1. Basic idea

- Government policy can directly effect economic growth. Examples are making public education more effective, introducing an efficient mixture of public and private education.
- Government policy can indirectly effect growth by effecting $b, \mu$. We see:
  - Government could provide tax evasion or subsidy on education. Subsidy on education makes it more desirable to accumulate. This would increase $(1-\mu)$ and promote economic growth.
  - Government could create more jobs with different skill requirements or education requirements. This also makes education more attractive to acquire. But this will also make human capital accumulation more productive.

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Thus $b$ would go up and promote economic growth.

## 2. Policy Experiment: Validity of Government intervention

- We will consider an experiment where government changes one of the efficiency parameter. Then we will analyze the consequences and make comments about the validity of government intervention.
- Suppose government can directly or indirectly increase $(1-\mu)$. This will have two effects:
  - As a **direct** effect, growth rate of consumption will go up according to equation (10):
    $$\frac{C'}{C} = \frac{H'}{H} = \frac{C'}{C} - 1 = \frac{H'}{H} - 1 = b(1-\mu) - 1$$
  - The aggregate level of **initial** consumption will go down according to equation (6):
    $$C = z\mu H$$
  - But although initial consumption goes down, consumption experiences a larger growth rate in future consumption:
    $$\left(\frac{C'}{C\downarrow}\right)\uparrow\uparrow = \frac{H'}{H} = \frac{C'}{C} - 1 = \frac{H'}{H} - 1 = b(1-\mu)\uparrow - 1$$

    **Therefore, when $\mu$ goes up, there is a tradeoff between lower level of initial consumption vs higher level of consumption in future.**

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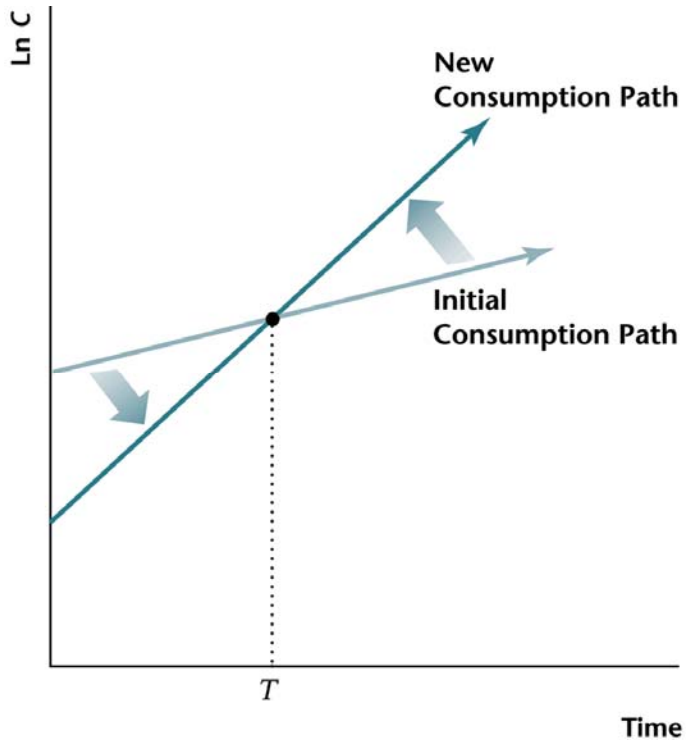
## Figure 7.7 Effect of a Decrease in u on the Consumption Path in the Endogenous Growth Model




- In the graph above, because of an increase in $\mu$, consumption path takes a downward shift. But as growth rate of consumption goes up, the new consumption path has a steeper slope indicating higher future consumption level.
- Whether the consumer will like the new or the old consumption path will depend on consumer preference. If he is a patient consumer, he would probably like the new path. Thus **justification of government intervention is questionable.**

## Critical Question

**Q: What happens when the government increases $b$?**

Answer: Do it at home

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# D. IMPLICATIONS OF ENDOGENOUS GROWTH MODEL

- The endogenous growth model can explain the disparity among poor countries. (Why do some poor countries grow faster than other poor countries?)
- If two poor countries have different level of initial human capital stock but same of everything (even access to the same technology), their economic growth would still be different because they will experience different level of human capita accumulation.
- If a poor and a rich country have different level of initial human capital they would experience different level of economic growth. Thus **there would not be any convergence of economic growth across the world in the long run. This contradicts with Solow prediction and is more intuitive. This also explains data**(stylized facts of economic growth)
- But the model predicts that even two rich countries with different initial human capital might also not converge in terms of growth. This prediction also **contradicts** Solow Growth model but also is **inconsistent** with data.

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## Critical Issue

- One possible explanation of how growth rate in rich countries can converge is by introducing **Human Capital Externality**. According to Lucas, Human capital externality refers to a situation where the presence of higher level of human capital in one country can also make the human capital in other country more productive. Examples of Human Capital Externality would the increase in Human capital in the presence of **cities.**
- But sometimes Human Capital Externality may **backfire**. If poor developing countries come in touch with richer countries, there is "**brain drain**" in the sense that human capital flights from poorer to richer countries. Thus the difference in the growth rate between rich and poor countries may persist even in the presence of Human Capital Externality

## Growth and Education: Glomm & Ravikumar(1992)

- Education plays a pivotal role in promoting economic growth. Jones (1998) finds a positive correlation between educational attainment and growth rate of GDP.
- It is therefore absolutely crucial to have an efficient education system. There are debates to how can one make education more productive.
- Glomm and Ravikumar(1992) develops an endogenous model of economic growth where they have both public and private education as a propeller for human capital accumulation. They show that with an efficient public education system and with an efficient mechanism to finance public education, public education reduces inequality in terms of growth. But with private education system, long run growth is higher