Lecture Notes 5: Human Capital, Economic Development and Growth

- Quality of labor vary: health, education, ability, termed "human capital"
- More able earn higher wages,
- Can quality differences explain differences among countries in income?
- Human capital: *productive, produce*d, earns a return through higher wage, depreciates.

1. Human Capital in the Form of Health

- As countries develop, their people get bigger.
- Height of men in Great Britain rose by 9.1 centimeters in 1775-1975.
- In 1855, 66% of Dutch men were shorter than 168 cm, today only 2%.
- Changes due to changes in the environment, genetics has changed very little.
- Such changes also in DEVC but started later and more rapidly.
- Height of South Korean men rose 5 centimeters in 1962-95.

Explanation: better nutrition.

- UK calorie intake: 2,944 in 1780 to 3,701 in 1980.
- South Korea calorie intake: 2,214 in 1962 to 3,183 in 1995.

- Height good indicator of malnutrition, experienced in utero and during first years of life.
- Shortness is biological adaptation to low food supply, short people require fewer calories.
- But people stunted by malnutrition are also less healthy.
- Malnutrition that causes shortness also lowers abilities as a worker.

In DC shortness reflect genetic predisposition.

In DEVC much of the variation in height *is* due to variation in nutrition.

In Brazil, 1% difference in height leads to 7.7% difference in wages.
In US 1% difference in height leads to 1% difference in wages.

Better health in a country will raise its level of income.
Robert Fogel: in UK 1780-1980, improved nutrition raised output by:
1. Increasing labor force participation: in 1780 20% did not work due to malnutrition, by 1980, this sort of malnutrition was eliminated, and led to increased output per adult by a factor of 1.25.

2. Increasing work effort among working adults: increased caloric intake allowed a 56% increase in the amount of labor.

1.25 X 1.56 = 1.95 . Over 200 years this was an increase of 0.33% per year.

Actual growth of output in the UK was 1.15% per year, the improvement in nutrition produced one-third of growth in income.

1.1 Modeling Interactions of Health and Income

Better nutrition is also a *result* of higher income.

Among OECD, 2.2 doctors per thousand people; in DEVC 0.8, in sub-Saharan Africa 0.3.

Health and income are endogenous variables.

Figure 4, Figure 5: An exogenous improvement in technology. The "multiplier" effect.

Exogenous health improvements (new vaccines or medicines).

Example: in the American South before World War I, the hookworm parasite, which causes anemia, exhaustion, and stunted physical and mental growth, played a significant role in holding back economic development. Called the "germ of laziness", hookworm infected 42% of the Southern population in 1910, workers earn only half as much as healthy workers.

Public health efforts => prevalence of disease greatly diminished by 1930s.

The control of Malaria in many parts of the world, greatly aided by invention of pesticide DDT during WWII, had a similarly dramatic effect on productivity.

A Model of Nutrition, Health, and Income

A formal model of the relationship between health and earnings.

L = labor input per worker (hours of labor input, adjusting for the quality of the input)

h = health

E = earnings per worker

Assume labor is only input and earnings linearly related to labor input:

$(1)\ E = WL$

W = the wage per unit of labor input.

Determinants of health:

$(2)\ h = XE^{\alpha}$

α - *elasticity* of health with respect to earnings.

X - other factors which affect health (medical technology)

A relation between workers' health and their labor input:

$(3)\ L = h^{\beta}$

β is the elasticity of labor input with respect to health.

Three endogenous variables: health, labor input, and earnings.

Solving the three equations, we can find earnings as a function of the parameters of the model:

$$(4)\quad E = W^{\frac{1}{(1-\alpha\beta)}} X^{\frac{\beta}{(1-\alpha\beta)}}$$

Examine the effect of different changes that the economy might experience. A change in w, improvements in health

$$(5)\quad \frac{dE/dW}{E/W} = \frac{\left[\frac{1}{1-\alpha\beta}\right] W^{\frac{\alpha\beta}{1-\alpha\beta}} X^{\frac{\beta}{1-\alpha\beta}}}{\left(W^{\frac{1}{1-\alpha\beta}} X^{\frac{\beta}{1-\alpha\beta}}\right)/W} = \frac{1}{1-\alpha\beta}$$

Recall that the parameter X represents factors other than earnings which affect health.

As above, we can solve for the elasticity of health with respect to these factors:

$$(6)\quad h = X^{\frac{1}{(1-\alpha\beta)}} W^{\frac{\alpha}{(1-\alpha\beta)}}$$

$$(7)\quad \frac{dh/dX}{h/X} = \frac{1}{1-\alpha\beta}$$

A feedback mechanism: health improvements have a direct effect but also an indirect effect: healthier workers supply more labor input and earn higher wages; higher earnings feed back to even better health.

2. Human Capital in the Form of Education.

In DC intellectual ability more important than physical ability in determining w.

Education become most important form of investment in human capital.

2.1 Changes in the Level of Education

Table 1.

Large differences in the level of education among countries.

A large increase in years of schooling.

		Average Years of Schooling	Percentage of the Adult Population With:			
			No Schooling	Completed Primary	Completed Secondary	Completed Higher
Developed Countries	1960	2.05	64.1	17.1	2.5	0.4
	2000	5.13	34.4	43.0	14.8	3.0
Advanced Countries	1960	7.06	6.1	72.9	20.2	3.0
	2000	9.76	3.7	84.6	44.7	13.0
United States	1960	8.49	2.0	78.4	31.0	7.0
	2000	12.05	0.8	94.9	68.1	24.5

Investment in human capital is costly:

In 1999, US public spending on education= $469 b, private spending= $148 billion.

6.6 percent of GDP. Not included: opportunity cost of students time.

2.2 Education and Wages

Human capital in the form of education have economic value.

HC is always attached to its owner. Cannot separate part of a person's education from rest of body and see how much it rents for.

Economists infer the returns to HC from data on people's wages.

Higher levels of education earn higher wages: evidence that HC is valued by the market.

Return to education: increased wages for more schooling.

Figure 7: assumes returns to education is 13.4% per year for grades 1-4, 10.1% per year for grades 5-8, and 6.8% beyond eight years.

The College Premium in the United States

Return to education is generally higher in poor than in rich countries,

Reflecting the fact that skilled workers are more scarce in poor countries.

Figure 8: a significant rise % labor force of educated workers.

College educated workers far less scarce over this period.

A resulting decline in the return to a college education over this period?

Figure 9: ratio of wages of college education to high-school degree:

The **college premium**: fell in 1970s as result of growing supply,

Then rose in the 1980s and 1990s, due to an increase in demand for educated workers.

Two prominent explanations:

1. Opening up of economies to international trade, made educated American workers more scarce in the US.

2. Technological change has been “skill-biased,” made educated more productive.

2.3 Human Capital's Share of Wages

How much of payment to labor represents payment to the HC and to "raw labor?

Table 2: Breakdown of the Population by Schooling and Wages

Highest Level of Education	Years of Schooling	Wage Relative to No Schooling	Percentage of the Population	
			Developing Countries	Advanced Countries
No Schooling	0	1	34.4	3.7
Incomplete Primary	4	1.65	22.6	11.7
Complete Primary	8	2.43	11.9	13.4
Incomplete Secondary	10	2.77	16.3	26.5
Complete Secondary	12	3.16	8.3	16.6
Incomplete Higher	14	3.61	3.5	15.1
Complete Higher	16	4.11	3.0	13.0

Figures 10-11

Payment to HC in DC 65%, in DEVC 49%.

3. Variation in Income Across Countries Explained by Education?

Differences in schooling explain differences in income per capita?

Figure 12: Strong positive correlation but is it causal? Since countries that are richer can afford to spend more on education, and so even if education had no effect whatsoever on income we would expect to see a positive relation like the one depicted in the figure.

HC in the Solow model:

$$(1)\quad y = AK^{\alpha}\left(hL\right)^{1-\alpha}$$

$$(2)\quad y = h^{1-\alpha}AK^{\alpha}L^{1-\alpha}$$

$$(3)\quad y^{ss} = A^{\frac{1}{1-\alpha}}\left[\frac{\gamma}{\delta+n}\right]^{\frac{\alpha}{1-\alpha}}$$

$$(4)\quad y^{ss} = \left(h^{1-\alpha}A\right)^{\frac{1}{1-\alpha}}\left[\frac{\gamma}{\delta+n}\right]^{\frac{\alpha}{1-\alpha}} = h\left[A^{\frac{1}{1-\alpha}}\left(\frac{\gamma}{\delta+n}\right)^{\frac{\alpha}{1-\alpha}}\right]$$

$$(5)\quad \frac{y_i^{ss}}{y_j^{ss}} = \frac{h_i\left[A^{\frac{1}{1-\alpha}}\left[\frac{\gamma}{\delta+n}\right]^{\frac{\alpha}{1-\alpha}}\right]}{h_j\left[A^{\frac{1}{1-\alpha}}\left[\frac{\gamma}{\delta+n}\right]^{\frac{\alpha}{1-\alpha}}\right]} = \frac{h_i}{h_j}$$

$$(6)\quad h_j = 1.134^2 \cdot h_0 = 1.29 \cdot h_0$$

$$(7)\quad h_i = 1.134^4 \cdot 1.101^4 \cdot 1.068^4 \cdot h_0 = 3.16 \cdot h_0$$

$$(8)\quad \frac{y_i^{ss}}{y_j^{ss}} = \frac{h_i}{h_j} = \frac{3.16 \cdot h_0}{1.29 \cdot h_0} = 2.47$$

School Quality

Does quality of schooling vary between countries?

Measure schooling quality by inputs into education – teachers, class size and textbooks - or by output from education – what students know?

Richer countries can supply more inputs: in 1997, student/teacher ratio DEVC was 16.7; in DC 29.7; in Africa 34.2.

Teachers training: Mozambique, 70% teachers only 7 years of schooling.

Textbooks are so scarce, widespread health problems among students.

Figure 14: Students in rich countries do better. USA? China?

Difference in quality ➔ years schooling understate true difference in HC.

A Quality-Quantity Model of Fertility and Education

The simultaneous determination of fertility and educational investment.

HH has one unit of time: how is it divided between children and other C?

Quality and quantity are valued, both have a price.

A fixed cost to raising each child, a cost for adding "quality" (education).

τ^q -price of producing a child with no education

τ^e -price of providing one unit of education to one child.

$\left(\tau^q + educ\tau^e\right)$ - price of raising a child with education .

The budget constraint:

$$(1)\quad n\left(\tau^q + educ\tau^e\right) = 1$$

where *n* is the number of children.

Parents care about the total income of their children. We assume that their utility is a function of potential income of their children, namely the number of children they have times the wages that each child earns.

$$U = n\left(educ^{\rho}\right)$$

The wage depends in turn on the quality of the child.
Education is a synonym for quality in this model:

$$(2)\ wage = educ^{\rho}$$

ρ is the return to education , $\rho < 1$.

Substituting this wage equation into the utility function, maximized subject to BC:

$$(3)\ U = n\left(educ^{\rho}\right)$$

Substitute the budget constraint

$$(4)\ n = \frac{1}{\left(\tau^{q} + educ\tau^{e}\right)}$$

directly into the utility function,

$$(5)\ U = \frac{educ^{\rho}}{\left(\tau^{q} + educ\tau^{e}\right)}$$

To find the optimal level of education, differentiate utility with respect to education and set the derivative equal to zero:

$$(6)\quad \frac{\partial U}{\partial educ} = \frac{\rho educ^{\rho-1}\left(\tau^q + educ\tau^e\right) - educ^{\rho}\tau^e}{\left(\tau^q + educ\tau^e\right)^2}$$

which can be re-arranged to give:

$$(7)\quad educ = \frac{\rho\tau^q}{1-\rho\tau^e}$$

Intuitively, if there is no return to education (i.e. $\rho = 0$), then parents will not provide any education to their children.

The higher is ρ, the more education parents will provide. But the quantity of education per child also depends on prices: if the price of producing a child (τ^q) is high relative to the price of educating one (τ^e), then this will also bias parents toward giving each child more education.

Since households have a limited time budget to devote to both child quality and child quantity, an increase in the amount of education given to each child will lead to a reduction in the quantity of childrent. Note that if ρ = 1, then the formulas for both education and the number of children lead to nonsensical (negative) results.

The budget constraint can be solved for the number of children explicitly:

$$(8)\quad n = \frac{1-\rho}{t^q}$$

Once again, we can see that an increase in the return to education (ρ) or in the price of producing a child (τ^q) will lead to a reduction in fertility.

If ρ=0 then the optimal number of children is equal to $\frac{1}{t^q}$

Externalities

An **externality** is an incidental effect of some economic activity for which no compensation is provided.

In education: more education raises own HC and other HC.

EX: educated farmers adopt new technologies, copied by less educated farmers.

A study in Ethiopia found that own benefit of education smaller than half total externality benefit.

In Developed Countries externalities are less significant.

Externalities from HC: explanation of public education or mandatory schooling:

People do not take into account the full social benefit of education.

Amount will be lower than what would be socially optimal.

Future improvement in Human capital

Future improvement in health unlikely to be at past rate: improvements in sanitation, widespread vaccination, introduction of antibiotics – are unlikely to be matched in the future.

HC accumulation will slow down in the future in DC. 1960-80 by 1.8 years, 1980-00 by 0.9 years.

HC, has been one of the major sources of economic growth over the last century, will contribute less to growth over the next century.