Econ 110A: Lecture 14

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Human Capital from a growth theory perspective: the Lucas Model

An introduction to the Economics of Human Capital

Robert (Bob) Lucas
1937-2023

Nobel Prize in Economics, 1995

Lucas showed that human capital accumulation can sustain growth in the long-run, through a mechanism similar to the one we studied in the Romer model

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On the mechanics of economic development ☆

Robert E. Lucas Jr.

https://doi.org/10.1016/0304-3932(88)90168-7

Abstract

This paper considers the prospects for constructing a neoclassical theory of growth and international trade that is consistent with some of the main features of economic development. Three models are considered and compared to evidence: a model emphasizing physical capital accumulation and technological change, a model emphasizing human capital accumulation through schooling, and a model emphasizing specialized human capital accumulation through learning-by-doing.

The Lucas Model

- "Effective" labor: $(1 - \bar{e})h_t\bar{L}$, where:
  - h_t: average level of human capital in society
  - $\bar{e}$: share of time (out of 1) spend accumulating human capital

- Output: $Y_t = AK^{\alpha}\left([1 - \bar{e}]h_t\bar{L}\right)^{1-\alpha}$

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- Human capital accumulation: $\Delta h_{t+1} = (h_t)^{\gamma}\bar{h}\bar{e}$
  - if we take $\gamma < 1$ there is diminishing returns to the accumulation of human capital
  - we will assume $\gamma = 1$, such that there are **no decreasing returns**

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- Human capital growth:

$$\frac{\Delta h_{t+1}}{h_t} \equiv g_h = \bar{h}\bar{e}, \qquad h_t = h_0(1+g_h)^t$$

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So long-run growth can be sustained!

The Lucas Model

- Wages grow in the long run:

$$w = MPL = (1 - \alpha) = A \left(\frac{K}{L} \right)^{\alpha} \left([1 - \bar{e}] h_0 (1 + g_h)^t \right)^{1-\alpha}$$

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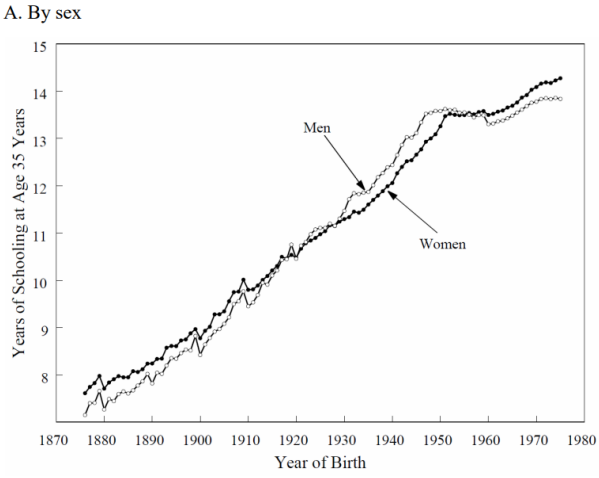
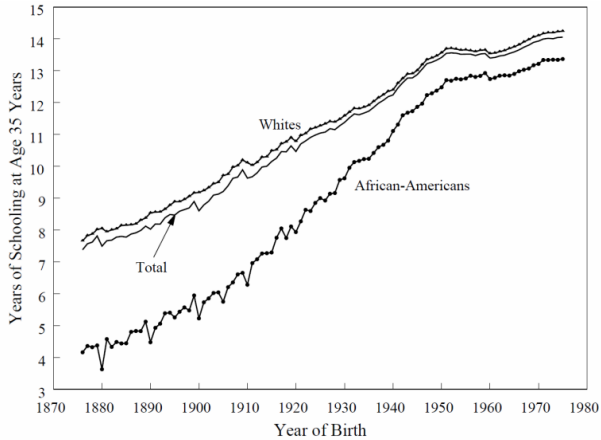
- Intuition:
  - human capital works as improving the **efficiency of labor**
  - while labor itself still has diminishing returns, human capital (under these assumptions) does not
  - as you can see, it basically operates as a growing productivity term!

Measuring Human Capital: Years of Schooling



From Goldin (2019) “Human Capital” Handbook of Cliometrics (Claude Diebolt and Michael Haupert, editors)

Measuring Human Capital: Years of Schooling



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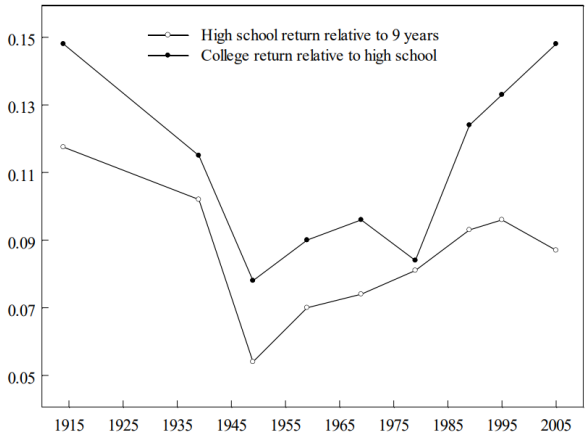
Measuring Human Capital: Returns to Schooling



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How Much is Your Human Capital Worth?

- Average wage of HS graduates $\$40,000$.
- Average wage of college graduates $\$70,000$.
- College Premium $= \$30,000$.

$$\text{present discounted value} = \$30,000 \times \frac{1-\left(\frac{1}{1+3\%}\right)^{46}}{1-\left(\frac{1}{1+3\%}\right)} = \$765,561$$

Human Capital and Development Accounting

Human Capital and Development Accounting: New Evidence from Wage Gains at Migration*

Lutz Hendricks† Todd Schoellman‡

August 2017

Abstract

We use new data on the pre- and post-migration wages of U.S. immigrants to measure the importance of human capital for development accounting. Wages increase at migration, but by less than half of the gap in GDP per worker. This finding implies that human capital accounts for a large share of cross-country income differences. Wage gains decline with education, consistent with imperfect substitution between skill types. We bound the human capital share in development accounting to between one-half and two-thirds; additional assumptions lead to an estimate of 60 percent. We also provide results on the importance of assimilation and skill transfer.

JEL Classification: O11, J31

Framework

- At a given country c, output is:

$$Y_c = K_c^{\alpha}(A_c h_c L_c)^{1-\alpha}$$

where h_c is worker human capital in c.

- Output per worker:

$$\begin{aligned}
Y_c &= \left(\frac{K_c}{Y_c}\right)^{\alpha} \cdot Y_c^{\alpha}(A_c h_c L_c)^{1-\alpha} \\
\iff Y_c^{1-\alpha} &= \left(\frac{K_c}{Y_c}\right)^{\alpha} (A_c h_c L_c)^{1-\alpha} \\
\iff Y_c &= \left(\frac{K_c}{Y_c}\right)^{\frac{\alpha}{1-\alpha}} \cdot A_c h_c L_c \\
\iff y_c \equiv \frac{Y_c}{L_c} &= \left(\frac{K_c}{Y_c}\right)^{\frac{\alpha}{1-\alpha}} \cdot A_c \cdot h_c
\end{aligned}$$

Framework

- Define $\left(\frac{K_c}{Y_c}\right)^{\frac{\alpha}{1-\alpha}} \cdot A_c \equiv Z_c$ as the country component.

- Then income per capita can be decomposed between a country component and a human capital component:

$$y_c = \underbrace{Z_c}_{\text{country share}} \times \underbrace{h_c}_{\text{human capital share}}$$

Development accounting

- Furthermore, in principle, we could decompose differences in income between rich and poor countries in a development accounting framework:

$$\underbrace{\frac{y_{rich}}{y_{poor}}}_{64} = \underbrace{\frac{Z_{rich}}{Z_{poor}}}_{\text{country contribution}=?} \times \underbrace{\frac{\bar{h}_{rich}}{\bar{h}_{poor}}}_{\text{avg. human capital contribution}=?}$$

- Problem: we do not observe some components of Z_c, such as A_c.

Development accounting: solution

- Hendricks and Shoellman find the following solution:
- when worker *i* migrates from India to the U.S., their human capital stays $\approx$ the same, but the country contribution changes
- If you observe the changes in their wages, you can infer the country contribution!

$$\frac{w_{i,US}}{w_{i,India}} = \frac{(1-\alpha)}{(1-\alpha)} \times \underbrace{\frac{Z_{US}}{Z_{India}}}_{\text{country contribution}} \times \frac{h_i}{h_i} = \underbrace{\frac{Z_{US}}{Z_{India}}}_{\text{country contribution}}$$

Table 3: Human Capital Share in Development Accounting by Subgroups

Robustness Check	Human Capital Share	95% Confidence Interval	N
Panel A: Baseline			
Baseline	0.60	(0.55, 0.64)	907
Panel B: Decomposition by Country			
Ethiopia	0.77	(0.67, 0.86)	41
India	0.63	(0.58, 0.69)	167
Philippines	0.47	(0.39, 0.55)	111
China	0.70	(0.57, 0.83)	63
Panel C: Decomposition by Visa Status			
Employment visa	0.52	(0.46, 0.59)	196
Family visa	0.64	(0.53, 0.74)	148
Diversity visa	0.58	(0.49, 0.67)	186
Other visa	0.58	(0.47, 0.68)	121

Table note: Each column shows the implied human capital share in development accounting (one minus the wage gain at migration relative to the GDP per worker gap); the 95 percent confidence interval for that statistic; and the number of immigrants in the corresponding sample. Each row gives the result from constructing these statistics for a different sample or using different measures of pre-migration wages, post-migration wages, or the GDP per worker gap.

Table 2: Implied Human Capital Share in Development Accounting

GDP p.w.		Hourly Wage		Gain	Human Capital Share		N
Category	Mean Gap	Pre-Mig	Post-Mig		Estimate	95% C.I.	
$< 1/16$	33.4	\$2.88	\$8.43	2.9	0.69	(0.62, 0.76)	181
$1/16 - 1/8$	12.0	\$4.43	\$12.04	2.7	0.60	(0.55, 0.64)	424
$1/8 - 1/4$	5.6	\$4.43	\$9.73	2.2	0.55	(0.46, 0,65)	302
$1/4 - 1/2$	3.0	\$5.03	\$9.28	1.8	0.46	(0.29, 0.64)	175
$> 1/2$	1.3	\$12.57	\$16.15	1.3	0.83	(-0.06, 1.71)	301

Table note: Each row gives results for immigrants from one of five GDP p.w. groups. Columns give the categories and the mean gap in PPP GDP p.w. relative to U.S.; mean hourly pre- and post-migration wages, reported in 2003 U.S. dollars; wage gain at migration; implied human capital share and the 95 percent confidence interval; and the number of immigrants in the corresponding category.

Table 8: Robustness: Human Capital Share in Development Accounting by Education

Robustness Check	Human Capital Share	95% Confidence Interval	N
Less than High School Graduate	0.50	(0.39, 0.61)	138
High School Graduate	0.58	(0.48, 0.68)	183
Some College, No Degree	0.50	(0.35, 0.64)	82
College Degree or More	0.66	(0.61, 0.71)	504

Table note: Each column shows the implied human capital share in development accounting (one minus the wage gain at migration relative to the GDP per worker gap); the 95 percent confidence interval for that statistic; and the number of immigrants in the corresponding sample. Each row gives the result from constructing these statistics for the baseline sample or for subsamples with the different levels of education.