Lecture 5: The Race Between Education and Technology

Natalie Bau and Hammad Shaikh

What We Know So Far

① Income ratio: $\frac{\text{Top 5\%}}{\text{Bottom 5\%}}$, ② Gini Coeff.

- Periods of high inequality were also periods of high education wage premiums

- Inequality and wage premiums fell during periods when the supply of high school educated individuals greatly expanded

- Hypothesis: the rise and fall of inequality are driven by a race between demand for educated workers and growth in the supply of educated workers

Model for Output and Relative Skilled Labour

1 Q = Output, A = TFP, S = skilled labour, U = unskilled labour, λ = share of S, $\sigma_{SU} = \frac{1}{1-\rho}$

Goldin and Katz define a CES aggregate production function:

$$Q_t = A_t(\lambda_t S_t^{\rho} + (1-\lambda_t)U_t^{\rho})^{\frac{1}{\rho}} \quad (1)$$

and

$$U_t = (\theta_t H_t^{\eta} + (1-\theta_t)O_t^{\eta})^{\frac{1}{\eta}} \quad (2)$$

Define all variables and parameters above

$\rho \to 1 \Rightarrow S, U$ perf. subst.
$\rho \to 0 \Rightarrow$ CD
$\rho \to \infty \Rightarrow$ perf. comp

H = HS grad, O = HS drop, θ = share of H, $\sigma_{HO} = \frac{1}{1-\eta}$

Equilibrium Equations

① $\min_{S_t, U_t} W_{S_t} S_t + W_{U_t} U_t$

s.t. $Q_t(S_t, U_t) = \bar{Q} \Rightarrow \mathcal{L} = W_{S_t} S_t + W_{U_t} U_t - \lambda(Q_t - \bar{Q})$

$\Rightarrow \frac{d\mathcal{L}}{dS_t} = 0, \frac{d\mathcal{L}}{dU_t} = 0 \Rightarrow$ ①. Similar for ②.

Goldin and Katz use equilibrium conditions to derive

$$log(\frac{W_{S_t}}{W_{U_t}}) = log(\frac{\lambda_t}{1-\lambda_t}) - \frac{1}{\sigma_{SU}} log(\frac{S_t}{U_t}) \quad ①$$

and

$$log(\frac{W_{H_t}}{W_{O_t}}) = log(\frac{\theta_t}{1-\theta_t}) - \frac{1}{\sigma_{HO}} log(\frac{H_t}{O_t}), \quad ②$$

where $\sigma_{SU} = \frac{1}{1-\rho}$ and $\sigma_{HO} = \frac{1}{1-\eta}$. How to derive?

Estimate $\hat{\sigma}_{SU}, \hat{\sigma}_{HO}$ using reg. eqn above

College Wage Premium and Relative Skilled Labour

↑ relative supply of college grads by 10% is associated 5.5% ↓ college wage premium

$Y = \ln\left(\frac{w_{st}}{w_{ut}}\right)$

Table 8.2. Determinants of the College Wage Premium: 1915 to 2005

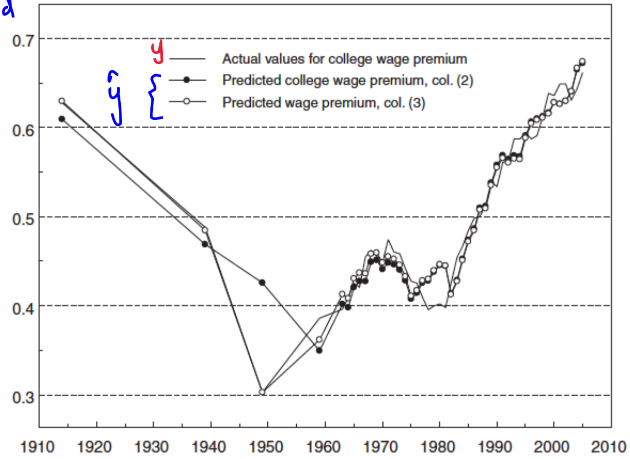
	(1)	(2)	(3)	(4)	(5)
(College/high school) supply	−0.544	−0.595	−0.610	−0.579	−0.618
	(0.079)	(0.093)	(0.065)	(0.099)	(0.079)
(College/high school) supply × post-1949					0.0078
					(0.0420)
Time	0.00378	0.00970	0.00991	0.00973	0.0103
	(0.00200)	(0.00243)	(0.00171)	(0.00545)	(0.0028)
Time × post-1949	0.0188				
	(0.0013)				
Time × post-1959		0.0156	0.0154		0.0150
		(0.0012)	(0.0009)		(0.0022)
Time × post-1992	−0.00465	−0.00807	−0.00739		−0.00742
	(0.00227)	(0.00279)	(0.00196)		(0.00199)
1949 Dummy			−0.137		−0.143
			(0.021)		(0.036)
$\text{Time}^2 \times 10$				−0.00342	
				(0.00203)	
$\text{Time}^3 \times 1000$				0.105	
				(0.034)	
$\text{Time}^4 \times 10{,}000$				0.00664	
				(0.00186)	
Constant	−0.493	−0.645	−0.656	−0.587	−0.674
	(0.168)	(0.197)	(0.138)	(0.210)	(0.079)
R^2	0.934	0.917	0.960	0.928	0.960
Number of observations	47	47	47	47	47

$\sigma_{SU} = \frac{1}{0.55} = 1.8$

Predicted Wage Premium and Actual Premium

Model does a good job predicting the college wage premium

$\hat{y}$ = Predicted college wage premium



Discussion of Model Fit

- WWII policies and union power may explain the greater than predicted decline in the college wage premium in the 1940s

  GI bill in 1944 ↑ supply of college grads

  $\Rightarrow \downarrow \frac{w_s}{w_u}$

- The greater-than-predicted premium may be explained by the erosion of union power in the 1970s

  ↓ unions ⇒ ↑ ineq.

High School Wage Premium and Relative HS Graduates

$Y = \ln\left(\frac{W_{HE}}{W_{DE}}\right)$

Table 8.4. Determinants of the High School Wage Premium: 1915 to 2005

	(1)	(2)	(3)	(4)	(5)
(High school/ dropout) supply	−0.180	−0.193	−0.193	−0.512	−0.352
	(0.059)	(0.039)	(0.039)	(0.071)	(0.137)
(High school/dropout) supply×post-1949				0.322	
				(0.054)	
(High school/dropout) supply×time					0.00496
					(0.00218)
Time	−0.00084	0.00239	0.00235	0.0171	0.0308
	(0.00278)	(0.00179)	(0.00176)	(0.0037)	(0.0100)
Time×post-1949	0.0132			−0.0032	
	(0.0011)			(0.0029)	
Time×post-1959		0.0117	0.0116		
		(0.0006)	(0.0006)		
Time×post-1992	−0.00753	−0.0109	−0.0107	−0.0106	
	(0.00386)	(0.0026)	(0.0026)	(0.0029)	
1949 Dummy			−0.0278		
			(0.0192)		
$\text{Time}^2 \times 10$					−0.0084
					(0.0012)
$\text{Time}^3 \times 1000$					0.113
					(0.025)
$\text{Time}^4 \times 10{,}000$					−0.0055
					(0.0015)
Constant	0.088	0.049	0.053	−0.579	−0.282
	(0.118)	(0.078)	(0.077)	(0.142)	(0.271)
R^2	0.897	0.953	0.956	0.944	0.971
Number of observations	47	47	47	47	47

$\sigma_{HD} = \frac{1}{0.18}$

$\approx$

5.5

Determinants of Inequality

- Model suggests that $\overbrace{\text{relative supply of skilled labor}}^{\frac{L_s}{L_u}}$ explains a portion of the wage premiums and therefore, inequality

- But is the supply of skilled workers driven only by the high school and college movements?

- Alternative explanations:
  - Immigration of low-skilled immigrants decreasing the relative supply of skilled labor
  - Growth in cohort size naturally leads to larger cohorts and since each cohort is more educated

Immigration and Cohort Size

$\frac{W_S}{W_U} \leftarrow \frac{L_S}{L_U}$ → Educ. attain.

→ Imigration

- Goldin and Katz can estimate how much immigration changed the relative supply of skilled workers in each period

- Their regression estimates tell them how much this would have changed the college and high school wage premium

- Immigration had little effect in the early period (1915-1940). From 1980-2005, explains 5 percent of the growth in the college premium and 43 percent of the high school premium

- Similar argument for cohort-size. Education rates are increasing during periods where the wage premiums are changing rapidly faster than cohort-size is changing

Cohort Size explains 10% $\frac{L_S}{L_U}$ changes