

13. Education

Econ 373: US Economic History

Taylor Jaworski

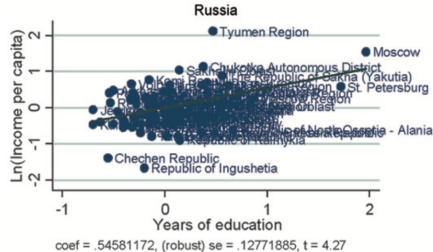
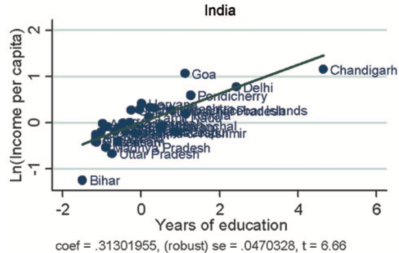
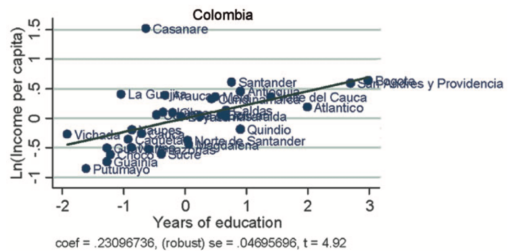
Fall 2023

Education and Human Capital

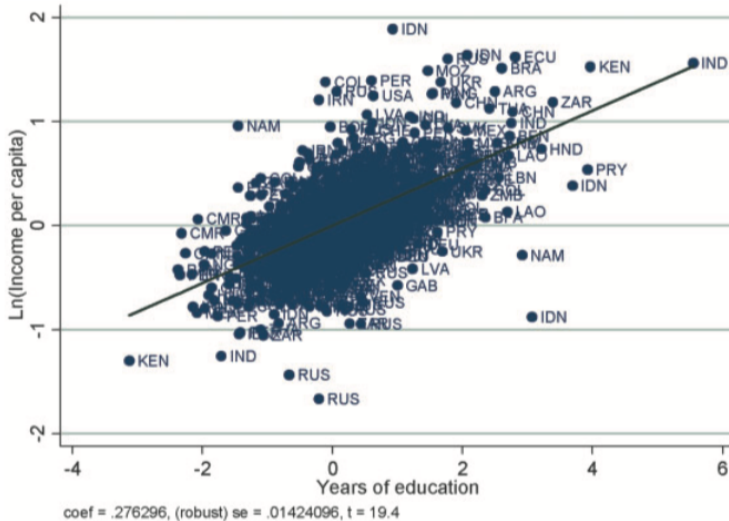
- **This lecture** is about the economics and history of the changing role of education and skills in the American labor market over the twentieth century
- Education, skills, or **human capital** are important determinants of individual labor market outcomes and widely understood to be fundamental to economic growth
- And the evolution of the wage structure reflects the relative growth in the **demand** for and **supply** of skills, which depend on historical economic and social conditions
- Both forces interact to create a **race between education and technology** that continues to shape economic growth and inequality in the United States

The Impact of Human Capital around the World and in the United States

Education is positively correlated with income p.c. **within countries**



Education is positively correlated with income p.c. **across countries**

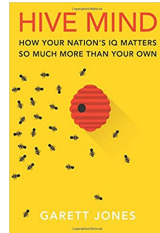


The impact of education (and skills) **around the world**

- One group of economists—Gennaioli, La Porta, Lopez-de-Silanes, and Shleifer (2013)—find that the impact of education on income per capita is large
- In particular, the **private return** for an individual are positive and modest, while **social return** for society are positive and quite large: 6–8 percent versus > 25 percent
- In part, this is because the supply of skills leads to the new ideas, greater knowledge exchange, and higher productivity for firm, cities, regions, and countries
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- In the popular press, this is reflected in the work of **Garett Jones** →



The **returns to education** in US history

- As economists we still want to understand the incentive to **invest in human capital** and how this has changed over time—we will turn focus to the United States
- To do this, we can use ordinary least squares to estimate the **returns to education**

$$\log W_i = \beta_0 + \beta_1 \text{education}_i + \varepsilon_i$$

where i indexes individuals, W_i is the hourly, weekly, or annual wage of individual i , and education_i is the highest number of completed years of schooling by i

- The coefficient of interest, β_1 , measures the percent increase of an average individual's wage from one additional year of schooling

The **returns to education** in US history

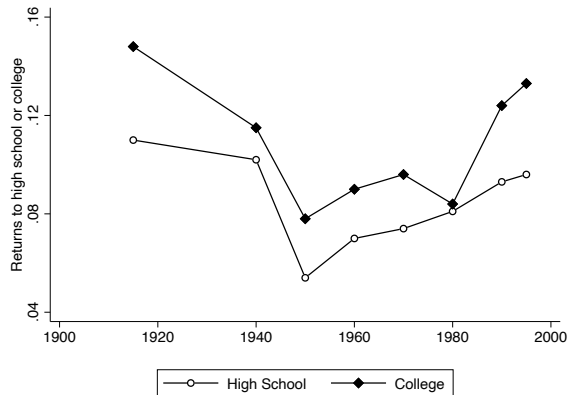
- Economists will also often use the same ordinary least squares to estimate the returns from achieving a particular degree status (e.g., high school or college graduate) using

$$\log W_i = \beta_0 + \beta_1 \text{high school}_i + \varepsilon_i \quad \text{or} \quad \log W_i = \beta_0 + \beta_1 \text{college}_i + \varepsilon_i$$

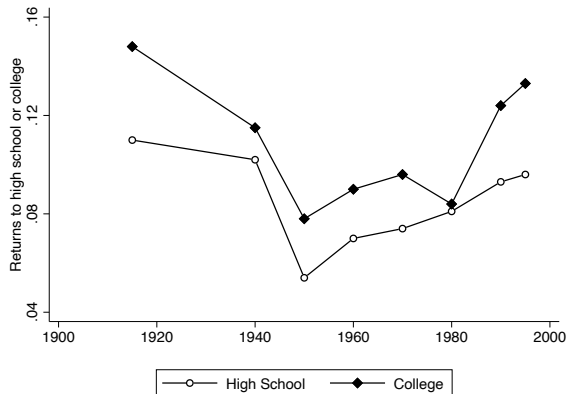
where high school_i or college_i are equal to 1 if the degree was completed and 0 otherwise

- Then (a transformation of) the coefficient, $\exp(\beta_1) - 1$, measures the percent difference of an average individual's wage from completing a given degree or not
- To estimate β_1 we need data on earnings and education for US individuals over time, which we can get from the US census back to 1940 and for an Iowa census in 1915

The **returns to education** in US history



The **returns to education** in US history



- Returns to schooling exhibit a **U-shaped pattern** over twentieth century
- This pattern illustrates the **interaction** between technology and skills

The **contribution of education to growth** in US history

- Turning to the whole US economy, we can ask how much education contributed to economic growth over the twentieth century using a simple economic framework
- Let's use the Cobb-Douglas production function where the exponents sum to one:

$$Y = A \times K^{1-\alpha} \times L^{\alpha}$$

which we can rewrite in the *intensive* (per worker) form:

$$Y/L = A \times K^{1-\alpha} \times L^{\alpha-1} \implies y = A \times k^{1-\alpha}$$

and then in the *rate of change* form:

$$\dot{y} = \dot{A} + (1 - \alpha) \times \dot{k}$$

The **contribution of education to growth** in US history

- This formulation treats the labor input too simplistically, instead we want to capture the role of education through labor as the combination of hours (L) and efficiency units (E):

$$Y = A \times K^{1-\alpha} \times (L \cdot E)^\alpha$$

which we can rewrite in the *rate of change* form:

$$\dot{y} = \dot{A} + (1 - \alpha) \times \dot{k} + \alpha \times \dot{E}$$

- Ultimately, we are interested in measuring $(\alpha \times \dot{E})/\dot{y}$ over time
- To do this, we need to measure \dot{y} , \dot{E} , and α from US data over the twentieth century

The **contribution of education to growth** in US history

	(1)	(2)	(3)	(4)
	Average annual percentage point change in:		Fraction “explained” by educational change	Change in mean years of workforce education
Period	y^*	E^*	$\alpha \cdot E^* / y^*$	
1915–40	2.45	0.50	0.143	1.38
1940–60	2.92	0.49	0.118	1.52
1960–80	2.41	0.59	0.171	1.93
1980–2005	2.18	0.37	0.119	1.08
1915–2005	2.47	0.48	0.136	5.91

Time periods



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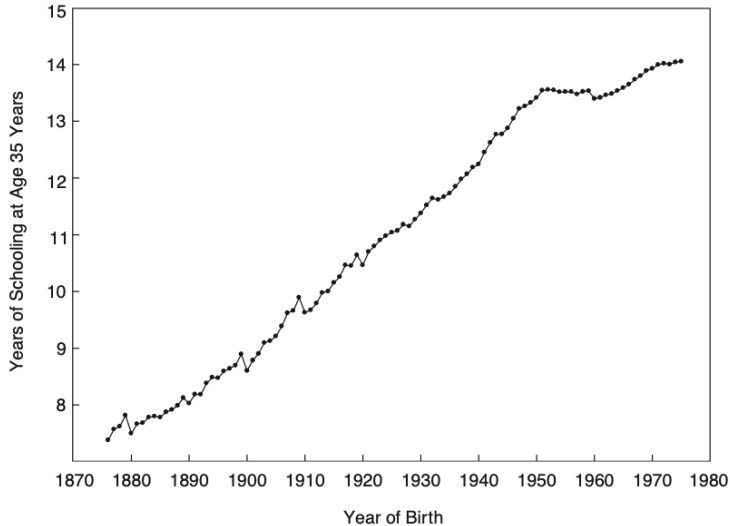
- The average worker had 5.91 more years of schooling in 2005 than in 1915 and this explains 13.6 percent of the change in output per worker over that period
- This is why [Claudia Goldin](#) and [Larry Katz](#) call the 20thC the “human capital century”

The Human Capital Century

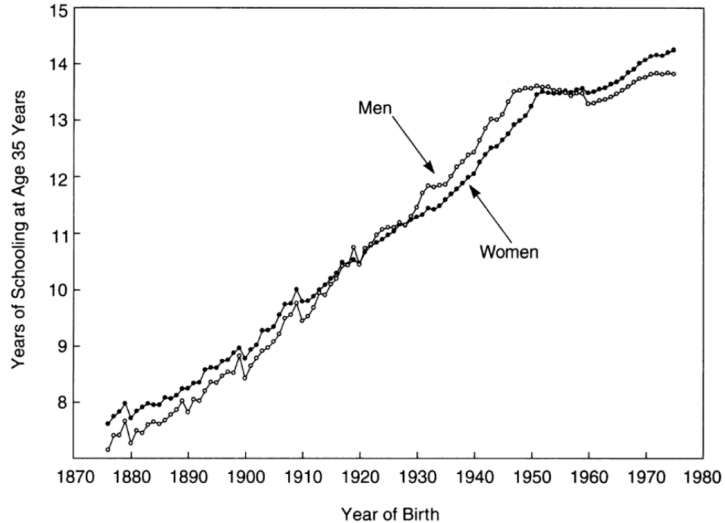
Human capital in the twentieth century

- The nineteenth century in the United States was a period of industrialization that is often associated with capital investment
- At the start of the twentieth century, Americans began to make the transition toward an emphasis on human capital, education, and skills as a source of the wealth of nations
- After 1900, access to schooling in the United States increased and was less attached to personal station or residence—with the big exception(!) of access by race
- Even rich European nations would lag behind the United States by five decades or more

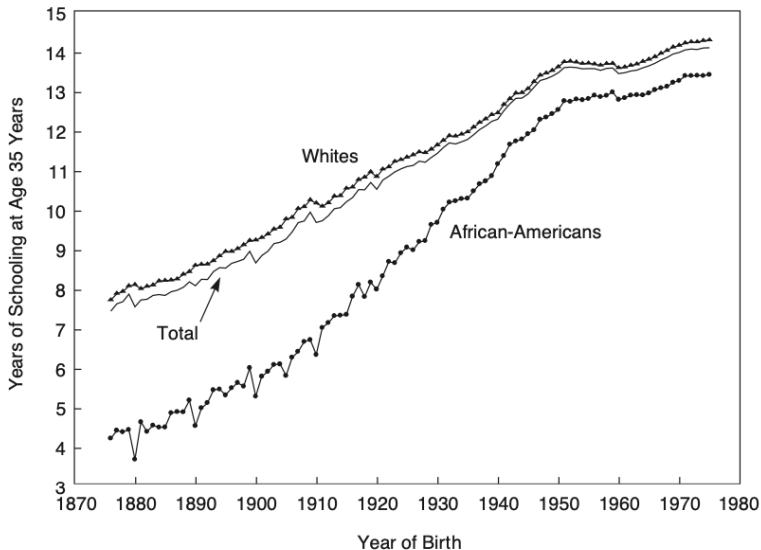
What does the human capital century look like **by cohort**?



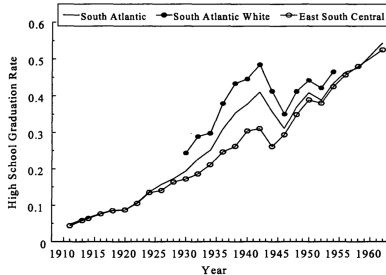
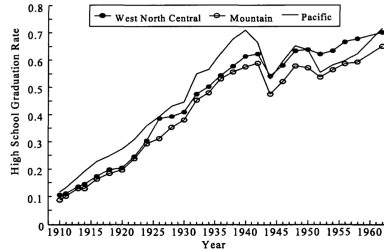
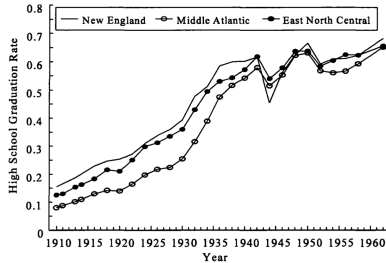
What does the human capital century look like **by gender**?



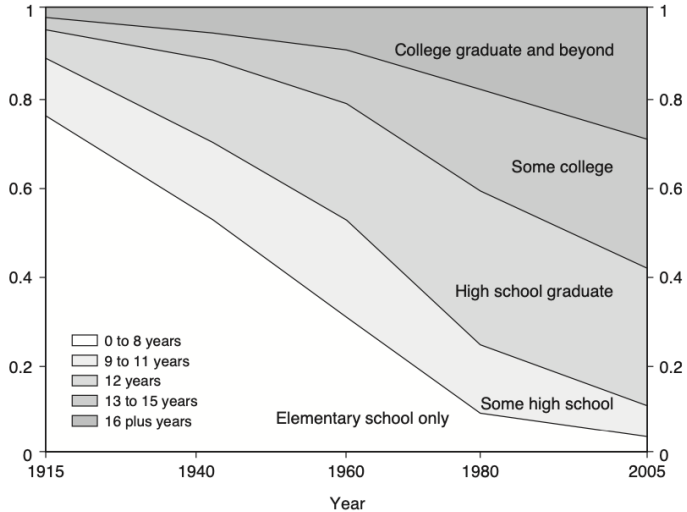
What does the human capital century look like **by race**?



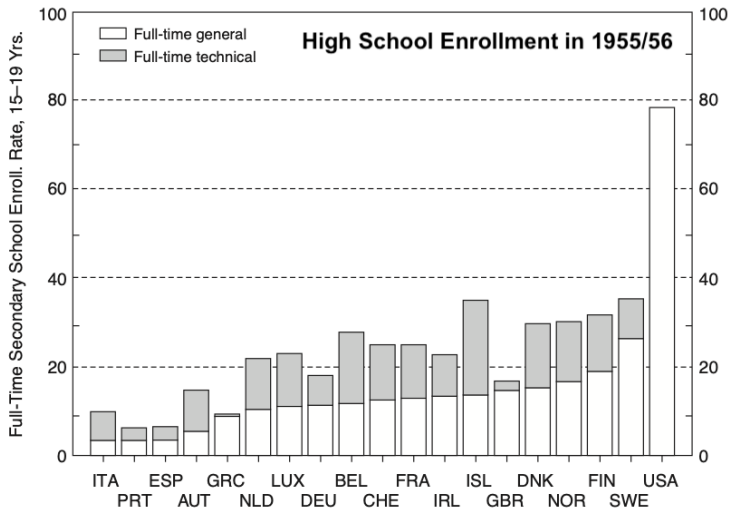
What does the human capital century look like **by region**?



What does the human capital century look like **in the workforce**?



What does the human capital century look like **compared to Europe?**



The **high school movement**

- So by the middle of the twentieth century the United States outpaced every country in the world in terms of high school enrollment, although progress was uneven
- What were the economic forces behind the high school movement? e.g.,
 - taxable wealth of residents
 - distribution of income
 - racial and ethnic homogeneity
 - opportunity cost of youth employment
 - structural change out of agriculture
 - many, fiscally independent school districts

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We can understand the contribution of some of these factors in terms of **supply** and **demand** and using simple regression analysis

The **high school movement**

- How do we model the market of high school graduation?
 - Demand → preferences over schooling
 - Supply → cost of provision of schooling
- Empirically, we can model enrollment in public and private high schools at the state-year level (Y_{it}) as a function of several variables (X_{it}):

$$Y_{it} = \beta_0 + \beta_1 X_{1,it} + \cdots + \beta_J X_{J,it} + \varepsilon_{it}$$

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$$Y_{it} = \beta_0 + \underbrace{\beta_1 X_{1,it} + \cdots + \beta_J X_{J,it}}_{\text{wealth, wage, religion, region}} + \varepsilon_{it}$$

The high school movement

$$Y_{i,1910} = \beta_0 + \beta_1 X_{1,i,1910/12} + \cdots + \beta_J X_{J,i,1910/12} + \varepsilon_{i,1910}$$

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
		Levels		Differences			Means (s.d.)	
	1910	1928	1928	1928-1910	1938-1928	1938-1928	1910	1928
Log per capita taxable wealth, 1912 or 1922, $\times 10^{-1}$	0.236 (0.0901)	0.852 (0.368)		0.857 (0.260)	1.25 (0.345)		7.471 (0.451)	7.926 (0.386)
% ≥ 65 years, 1910 or 1930	2.13 (0.260)	1.423 (0.788)	1.846 (0.774)	-1.749 (0.737)	-0.527 (0.866)		0.0414 (0.0143)	0.0547 (0.0142)
% of labor force in manufacturing, 1910 or 1930	-0.0673 (0.0335)	-0.144 (0.0972)	0.989 (0.481)	-0.0495 (0.0947)	0.126 (0.0934)	0.203 (0.0723)	0.248 (0.124)	0.255 (0.103)
% Catholic, 1910 or 1926	-0.0913 (0.0305)	-0.377 (0.0867)	-0.274 (0.0849)	-0.265 (0.0900)	0.0595 (0.0841)		0.150 (0.121)	0.151 (0.123)
South	-0.0449 (0.00932)	-0.0935 (0.0272)	-0.131 (0.0294)	-0.0735 (0.0267)	0.0375 (0.0306)			
New England	0.0444 (0.0121)	0.100 (0.0310)		0.0811 (0.0333)				
Middle Atlantic			-0.0635 (0.0338)		0.0620 (0.0188)			
Males in public colleges /17-year-olds, 1910				1.09 (0.384)				0.0316 (0.243)
Wage in manufacturing, 1929, $\times 10^{-1}$			0.0241 (0.00974)					1.191 (254)
Wage \times % in manufacturing, $\times 10^{-1}$			-0.0827 (0.0375)					
Auto registrations per capita, 1930, $\times 10^{-2}$		0.0568 (0.0230)	0.0449 (0.0218)					0.224 (0.648)
Log agricultural income per agricultural worker, 1920						0.0985 (0.0174)		

The high school movement

$$Y_{i,1928} = \beta_0 + \beta_1 X_{1,i,1922/26/30} + \cdots + \beta_J X_{J,i,1922/26/30} + \varepsilon_{i,1928}$$

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The **high school movement**

- Results for correlation with HS graduation in 1910 and 1928:
 - More wealth ↑
 - An older population ↑
 - A larger manufacturing base ↓
 - More Catholics ↓
 - South ↓, New England ↑ relative to excluded regions

The high school movement

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 - More Catholics ↓
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- Results for correlation with change in HS graduation from 1910 to 1928:
 - More wealth leads to faster growth
 - An older population, larger manufacturing base, more Catholics leads to slower growth
 - The South grows slower, New England grows faster relative to excluded regions

The **high school movement**

- The high school movement was a **grassroots campaign**, not the result of legal compulsion
- Places that were **richer** and had a **more homogeneous population** led the way
- Boys and girls participated **equally**, whites and blacks **did not**
- Graduation rates were higher **in small towns** and in places that were **more agricultural**
- During the expansion, **quality** remained high and the **curriculum changed**
- Importantly, the high school movement adapted to and accommodated **structural change**, and helped to smooth the transition to the modern economy

Education and labor markets at **mid-century**

- By 1940, the median youth in most US regions was a high school graduate
- This reflected America's distinctive approach to secondary school:
 1. decentralization of control
 2. local funding (through property taxes)
 3. open-access schooling
 4. separation of church and state
 5. gender neutrality
 6. open and forgiving
- One implication of these virtues can be seen in the experience **women**, one exception can be see in the experience of **African-Americans**

Education and labor markets at **mid-century**

- For women, a few key issues are to understand:
 - the slope of labor demand curve
 - the degree of substitution between male and female labor
 - the extent to which women were substitutes for more or less skilled men
- The economists [Acemoglu, Autor, and Lyle \(2004\)](#) find:
 - a 10% increase in relative female labor supply lowers female wages 7-8%
→ female labor demand elasticity of 1.2 to 1.5
 - a 10% increase in relative female labor supply lowers male wages 3-5%
→ elasticity of substitution between male and female labor of ≈ 3
 - women were closer substitutes for men in the middle of the skill distribution
- So women were poised to (and did!) make labor market gains over the next half century

Education and labor markets at **mid-century**

- For African-Americans, an important debate among economists is whether [human capital](#) or [structural labor market](#) factors explain wage differences relative to whites
- The economists [Carruthers and Wanamaker \(2017\)](#) use a decomposition to understand the reasons behind the black-white wage gap
- A key aspect of this study is measure differences in [school quality](#) between blacks and whites—one year of schooling was not the same amount of human capital by race
- Indeed, schools that were actually “[separate but equal](#)” in the Jim Crow era would have reduced wage inequality by 29%-48%
- So African-Americans were poised to (and did!) benefit tremendously from Civil Rights era reforms of schooling—as documented by the economist [Wright \(2013\)](#)

The Race between Education and Technology

The **race** between education and technology

- In the late **eighteenth century** the United States was the “best poor man’s country”
- Land was abundant and farming provided for a high standard of living in relative global terms, wealth and income were quite equally distributed
- In the late **nineteenth century** (circa 1890) the standard of living had climbed higher, but wealth and income were less equally distributed
- In part due to the process of industrialization, the returns to skill were increased and by the beginning of the **twentieth century** were at a peak

The **race** between education and technology

- Starting in the 1910s and 1920s occupations that that previously required education and substantial training began **deskilling**
 - e.g., clerical occupations began to substitute office machinery for skills
- At the same, the “**closing of the border**” and **reduction in immigration** increased the wages of less skilled workers
- And, as an outcome of the early advances of the high school movement, the **supply of skills increased** and **depressed the wages** of white collar workers
- Between the 1910s and 1950s inequality decreased and **wage distribution compressed**

The **race** between education and technology

- Moving forward to the last quarter of the 20thC, the United States had just experienced a period of **rapid economic growth** and was in the midst of **historically low inequality**
 - but from the late 1970s to the 2010s wage inequality increased
- From here we want a unified explanation for the changing returns to skills—we will use a **supply-demand-institutions framework** summarized by the following equations:

$$Q_t = A_t[\lambda_t S_t^\rho + (1 - \lambda_t)U_t^\rho]^{\frac{1}{\rho}} \quad \text{and} \quad U_t = [\theta_t H_t^\eta + (1 - \theta_t)O_t^\eta]^{\frac{1}{\eta}}$$

where Q is output, A is productivity, S is college labor, H is high school labor, and O is high school dropout labor, and λ and θ are technology shifters

- The **elasticities of substitution** between different types of labor are given by:

$$\sigma_{SU} = 1/(1 - \rho) \quad \text{and} \quad \sigma_{HO} = 1/(1 - \eta)$$

The **race** between education and technology

- We can write college wages relative to high school wages as

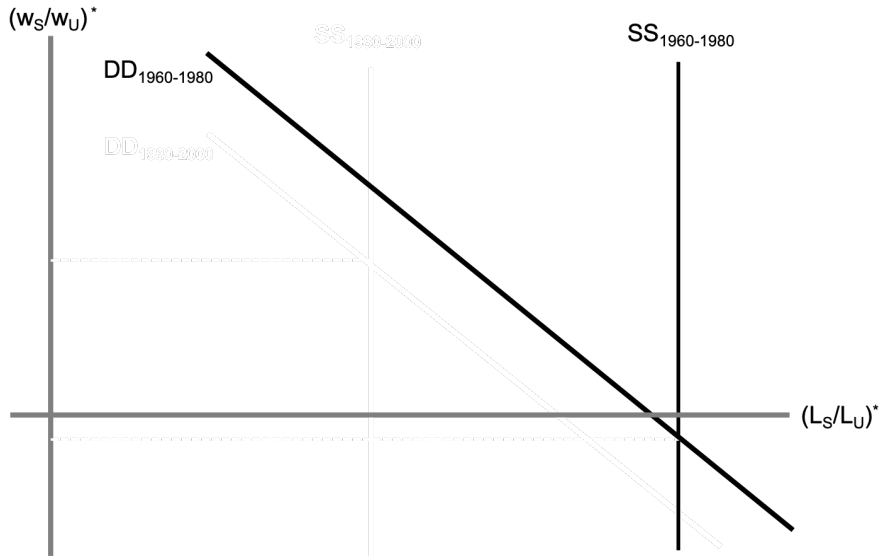
$$\log \left(\frac{w_{St}}{w_{Ut}} \right) = \log \left(\frac{\lambda_t}{1 - \lambda_t} \right) - \frac{1}{\sigma_{SU}} \log \left(\frac{S_t}{U_t} \right)$$

And high school wages relative to high school dropout wages as

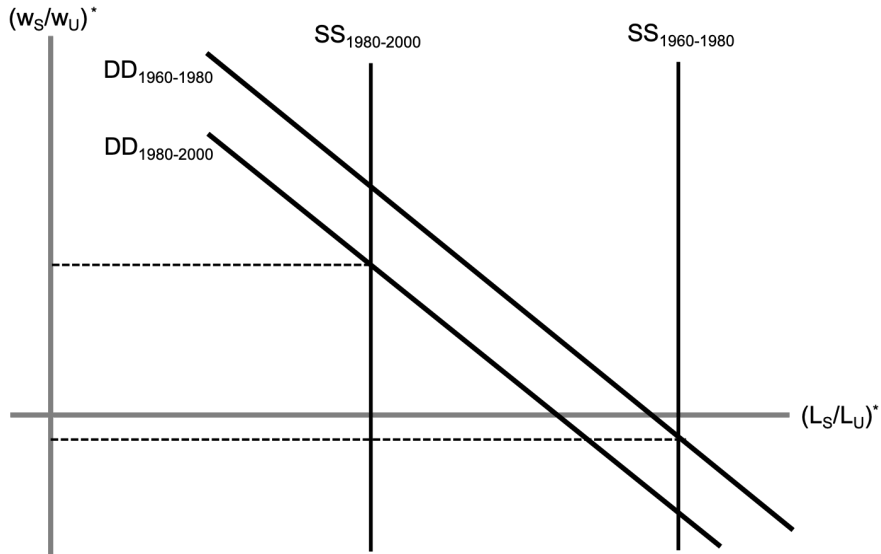
$$\log \left(\frac{w_{Ht}}{w_{Ot}} \right) = \log \left(\frac{\theta_t}{1 - \theta_t} \right) - \frac{1}{\sigma_{HO}} \log \left(\frac{H_t}{O_t} \right)$$

- So **relative wages are determined** by technology shifters (λ and θ), the relative supply of different labor groups to each other, and the relevant elasticity of substitution
- We can use this framework to **analyze changes in the wage structure** over time

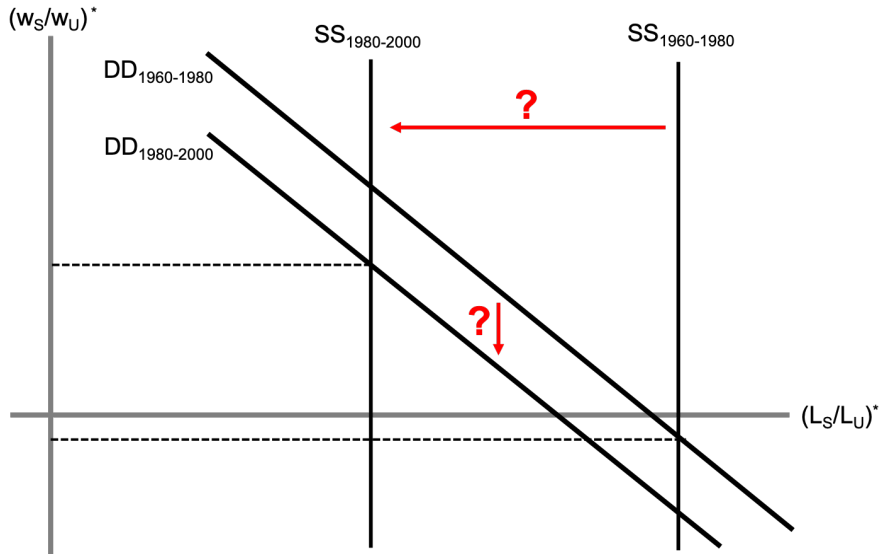
The **supply, demand, and institutions** framework



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The **college** wage premium

	Relative Wage	Relative Supply	Relative Demand ($\sigma_{SU} = 1.4$)	Relative Demand ($\sigma_{SU} = 1.64$)	Relative Demand ($\sigma_{SU} = 1.84$)
1915-40	-0.56	3.19	2.41	2.27	2.16
1940-50	-1.86	2.35	-0.25	-0.69	-1.06
1950-60	0.83	2.91	4.08	4.28	4.45
1960-70	0.69	2.55	3.52	3.69	3.83
1970-80	-0.74	4.99	3.95	3.77	3.62
1980-90	1.51	2.53	4.65	5.01	5.32
1990-2000	0.58	2.03	2.84	2.98	3.09
1990-2005	0.50	1.65	2.34	2.46	2.56
1940-60	-0.51	2.63	1.92	1.79	1.69
1960-80	-0.02	3.77	3.74	3.73	3.73
1980-2005	0.90	2.00	3.27	3.48	3.66
1915-2005	-0.02	2.87	2.83	2.83	2.82

The **college** wage premium

	Relative Wage	Relative Supply	Relative Demand ($\sigma_{SU} = 1.4$)	Relative Demand ($\sigma_{SU} = 1.64$)	Relative Demand ($\sigma_{SU} = 1.84$)
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1940-50	-1.86	2.35	-0.25	-0.69	-1.06
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1960-70	0.69	2.55	3.52	3.69	3.83
1970-80	-0.74	4.99	3.95	3.77	3.62
1980-90	1.51	2.53	4.65	5.01	5.32
1990-2000	0.58	2.03	2.84	2.98	3.09
1990-2005	0.50	1.65	2.34	2.46	2.56
1940-60	-0.51	2.63	1.92	1.79	1.69
1960-80	-0.02	3.77	3.74	3.73	3.73
1980-2005	0.90	2.00	3.27	3.48	3.66
1915-2005	-0.02	2.87	2.83	2.83	2.82

The **high school** wage premium

	Relative Wage	Relative Supply	Relative Demand ($\sigma_{HO} = 2$)	Relative Demand ($\sigma_{HO} = 3$)	Relative Demand ($\sigma_{HO} = 5$)
1915-40	-0.38	5.54	4.79	4.41	3.66
1940-50	-1.32	4.38	1.74	0.42	-2.22
1950-60	0.15	2.72	3.02	3.17	3.47
1960-70	0.01	5.31	5.33	5.34	5.36
1970-80	-0.01	5.65	5.63	5.62	5.60
1980-90	0.44	4.04	4.92	5.36	6.24
1990-2000	0.25	1.87	2.37	2.62	3.12
1990-2005	0.11	1.52	1.75	1.86	2.09
1940-60	-0.59	3.55	2.38	1.79	0.62
1960-80	0.00	5.48	5.48	5.48	5.48
1980-2005	0.24	2.53	3.02	3.26	3.75
1915-2005	-0.17	4.25	3.91	3.75	3.41

Who **won** the race?

- Over the second half of the twentieth century growth in the relative demand for skilled workers **outpaced** growth in the relative supply of skilled workers
- And the human capital century ended with **more inequality** expressed in the premium for college (relative to high school) and high school (relative) high school dropout labor
- This **contrasts sharply** with the pattern earlier in the first half of twentieth century in which the relative supply of skills expanded (responding to the relative skill premium)
- So in this explain inequality arises from a **breakdown in access** to education opportunities and **inflexibility** of educational institutions' response to increasing technological change