14.662 Spring 2026
Lecture 1 – The Canonical Model of Skill Differentials

David Autor
MIT and NBER

February 2, 2026 (rev 2026/02/02)

Agenda

1. **Topics from now to Lorenzo**
2. **Course Expectations/Requirements**
3. **Context: Education and earnings inequality**
   - Earnings inequality
   - Broader / different metrics of inequality
   - Productivity, mean and median earnings, labor share
   - Supply of skills
   - Education and inequality
   - Demographics and genentocracy
4. **The canonical model**
   - Building blocks
   - Technological change and the skill premium
   - Tinbergen and the education race
   - Education race with data: Katz-Murphy '92
   - Capital-skill complementarity
5. **International comparisons of wage inequality: Supply, demand and institutions**

Topics from now to Lorenzo

1. 2/02/26 (Mon): Skill differentials: The canonical Tinbergen-Katz-Murphy model
2. 2/04/26 (Weds): Educational production and wage structure
3. 2/09/26 (Mon): Comparative advantage and self-selection: the Roy model
4. 2/11/26 (Weds): Comparative advantage and self-selection: Misallocation
5. 2/17/26 (**Tues**): Dimensions of skill at the *person* level
6. 2/18/26 (Weds): Skills, tasks, and technologies
7. 2/23/26 (Mon): Skills, tasks, and technologies
8. 2/25/26 (Weds): Assignment models: Superstars, and mediocrities
9. 3/02/26 (Mon): Some economics of artificial intelligence
10. 3/04/26 (Weds): Trade and labor markets
11. 3/09/26 (Mon): Trade and labor markets
12. 3/11/26 (Weds): Local labor markets in general equilibrium
13. 3/16/26 (Weds): Buffer
14. 3/18/26 (Weds): *First Lagos lecture*

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Course expectations: Everyone

Labor minors and majors

1. Attend every class, and prepare/expect to be called by name
2. Comment on weekly assigned paper
   - You *could* read paper using perusall.com — *would* you?
   - Send written **1 page** comment to Nagisa by **Saturday @ 6pm** prior to Monday's class
   - Shared with peers (unless otherwise specified)
   - Use Gradescope for p-set (and other) submissions
3. Four p-sets, due (see psetpartners.mit.edu)
   - **February 27**
   - **March 20**
   - **April 17**
   - **May 8**
4. Final exam (3 hours)
5. Do attend *Applied Micro Seminar* (Mon @ 4pm) and *Labor Lunch* (Tue @ noon) every week

Weekly written comments: Everyone

Minors and majors: Write a **1 page** comment on assigned article each week.

1. What is the research question?
2. What are the strengths and weaknesses of the approach to answering that question?
3. How does this work advance knowledge on the question, i.e, what's the contribution?
4. What would be one or two valuable, specific, next steps to advance the question?

Please...

- *Write a* **memo**, *not a question and response list to above*
- *Do not exceed 1 page*. We will be reading *a lot* of comments

Additional assignment: Majors

Labor majors additional assignments

- Two **5 to 7 page** research proposals (not including tabs, figs, and references)
  - Due: (1) March 13 (before spring break) and (2) April 24 (prior to end-of-semester crunch)
  - Please don't submit 30 page proposals. We can't read 'em all. And there's a discipline to writing a short memo
  - In-person meetings w/ Lorenzo, David, and Nagisa: (1) March 19 and (2) April 28
- You may partner with *one* other 14.662 classmate if desired
  - You must either turn-in **separate write-ups** *or* **one more ambitious, highly-polished write-up**
  - We recommend *against* pairing with the same partner for both proposals

Research proposals: Majors

1. Pose research question and explain importance
2. Summarize the state of knowledge on question
3. Explain idea for advancing knowledge on question
4. Present research design with specificity and clarity
   - Empirical design, experimental design, simple model, etc.
5. Discuss implementation strategy
   - Data requirements, experimental setting, etc.
   - Next steps and roadblocks

Grading rubric

All elements of class count substantially

	Minors	Majors
In-class participation	15	10
Written comments	15	10
Four p-sets	35	30
Two research proposals	.	20
Final Exam	35	30
	100%	100%

14.662 class pizza party/social

Evening of Wednesday, March 11 in E52-432 (week before week before Spring break)

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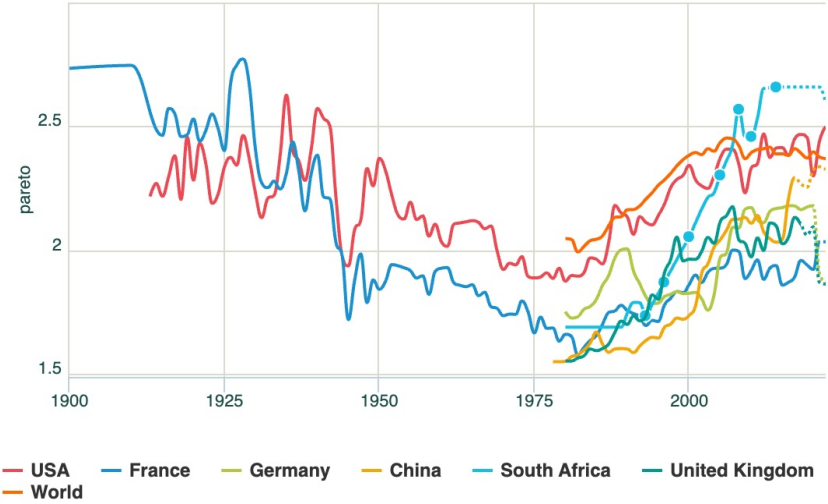
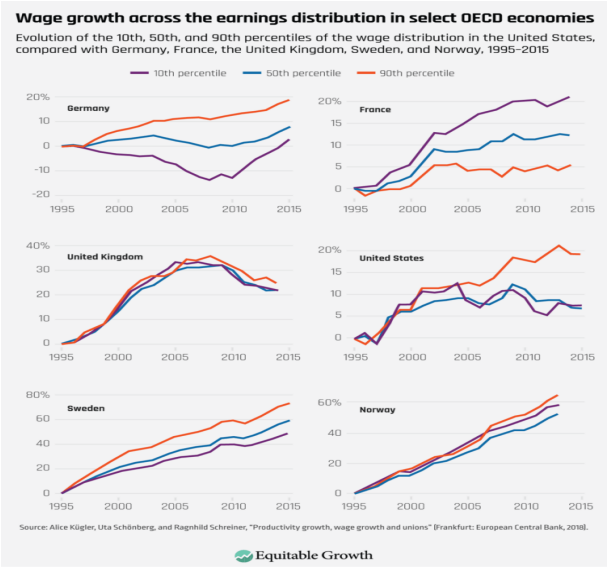
Inequality trends worldwide, 1900–2022

Beta coefficient at the 90th percentile (corresponds to the inverted Pareto-Lorenz coefficient)



World Inequality Database, 2024. https://wid.world

Uneven wage growth in six OECD countries, 1995–2015



Schoefer 2021

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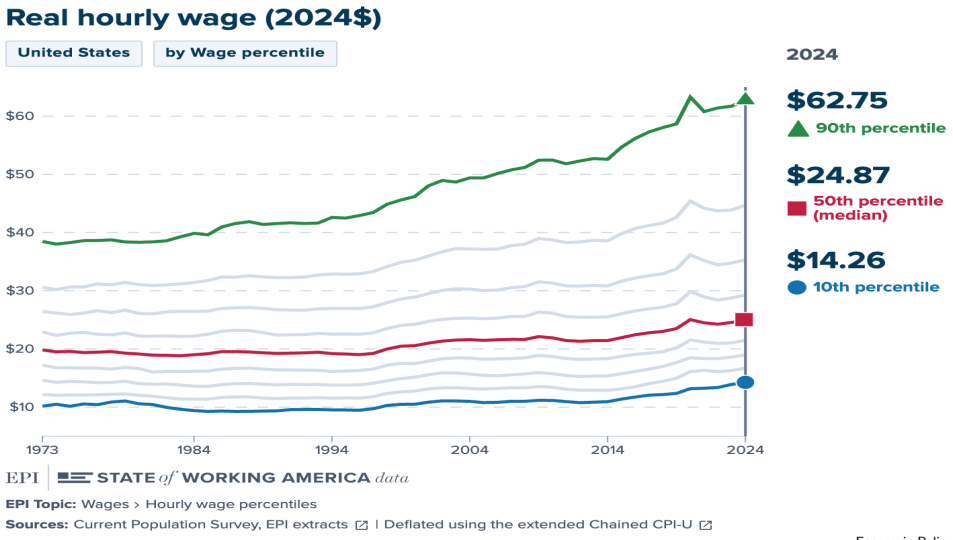
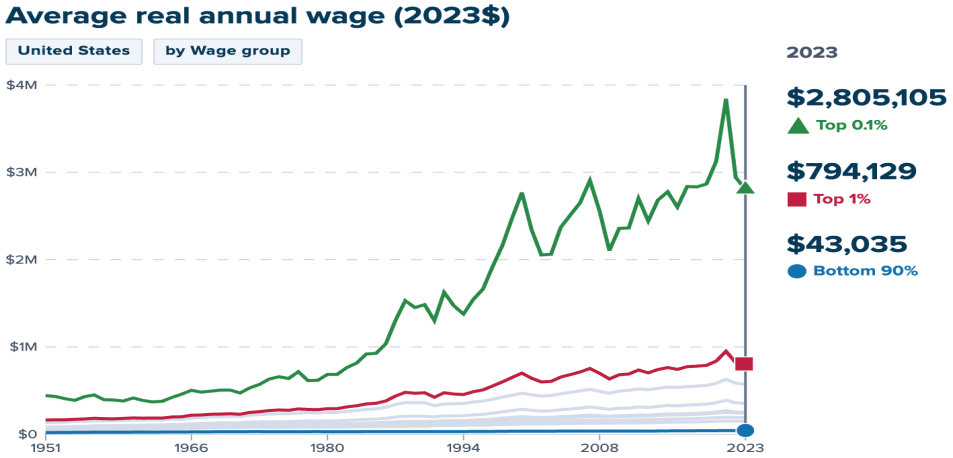
Real US hourly wages by percentile, 1973-2024



Economic Policy Institute, 2025

Top annual earnings percentiles, 1951-2023



Economic Policy Institute, 2025

Large % of rising US inequality is between firms — except within megafirms

FIGURE II

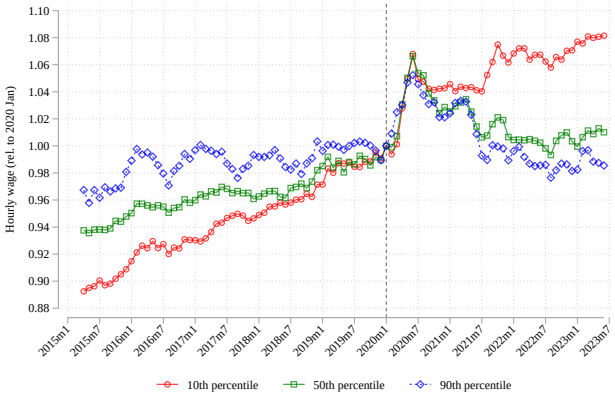
Decomposition of the Variance of Log Annual Earnings within and between Firms: All, Smaller, and Mega Firms

See variance decomposition in equation (2). Only firms and individuals in firms with at least 20 employees are included. Only employed individuals aged 20 to 60 are included in all statistics, where "employed" is defined as earning the equivalent of minimum wage for 40 hours per week in 13 weeks. Individuals and firms in public administration or educational services are not included. Firm variance is calculated using mean log earnings and weighted by number of employees. Within-firm variance is calculated based on the difference between individual log earnings and firm mean log earnings.

Song,Price, Guvenen, Bloom, von Wachter 2019

Reversal of US inequality trends post-pandemic since 2020

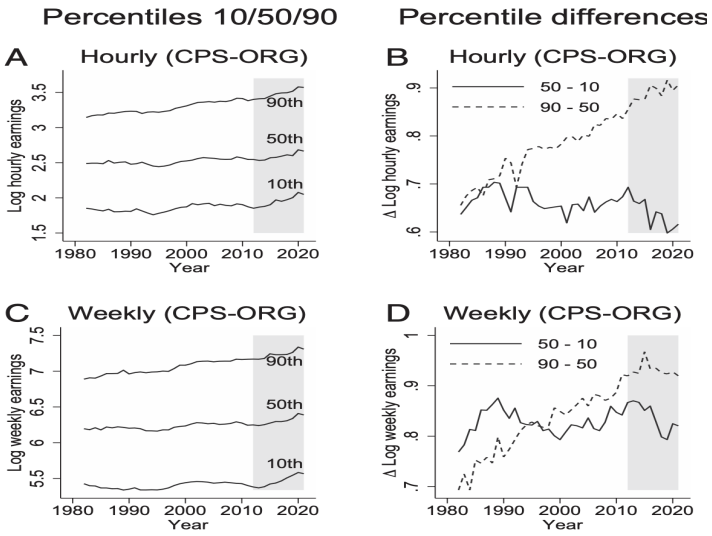
Figure 8: Real Hourly Wages by Quantile, Relative to January 2020



Note: CPS monthly data. Adjusted to maintain demographic composition in January–March 2020 using inverse probability weighting based on age, education, race/ethnicity, gender, country of birth, and region. Wages are real (2023_{q2} USD). We construct wage quantiles by month. Wage percentiles smoothed with lowess and 3-month moving average.

Autor, Dube, McGrew 2023

Reversal of US inequality trends, starting in mid-2010s



Aeppli and Wilmers 2022

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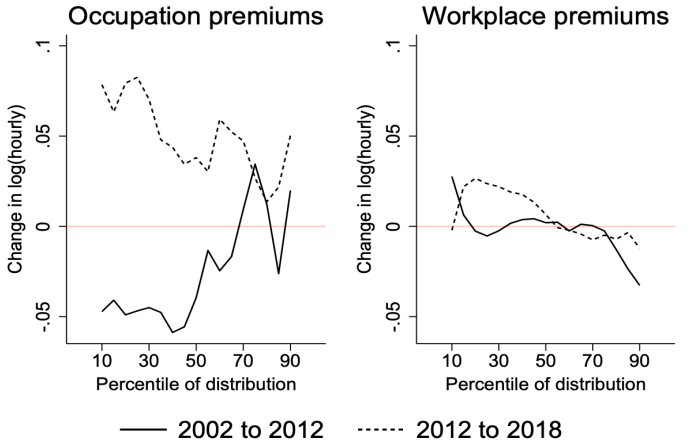

Fig. 3. Differenced quantiles of occupation and workplace premiums between 2002 and 2012 and between 2012 and 2018. The 5th and 95th percentiles are excluded. Data are from the OEWS.

Aeppli and Wilmers 2022

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Estimated percentiles of lifetime income by entry cohort, 1956-1983

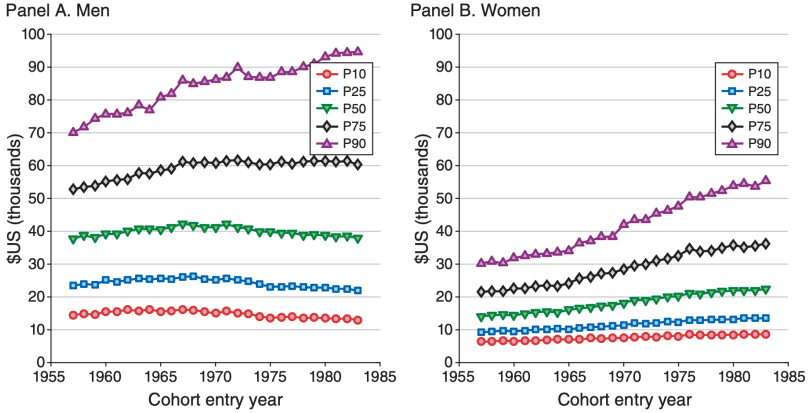


FIGURE 3. SELECT PERCENTILES OF LIFETIME EARNINGS BY COHORT AND GENDER

Notes: An observation represents a select quantile of the lifetime earnings distribution of a cohort that entered the labor market in a given year for the baseline sample (see Section IC). Panel A displays the distribution for men and panel B, for women. Values are displayed in thousands of 2013 US dollars and deflated using the PCE.

Guvenan, Kaplan, Song, Wiedner 2022

Consumption inequality versus income inequality in the US, 1980-2016

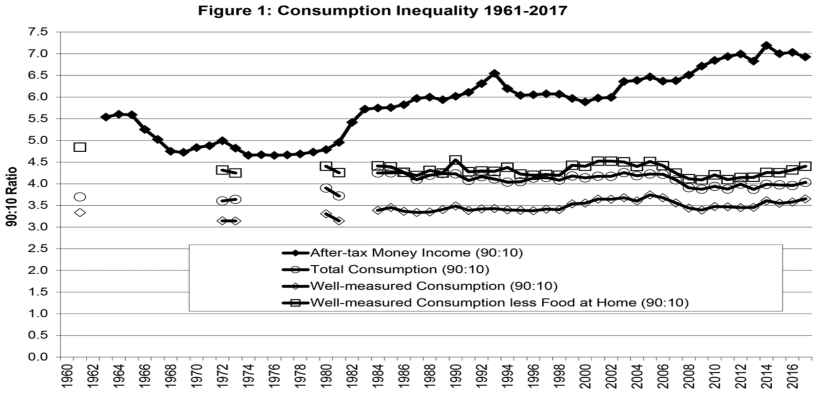


FIG. 1.—Consumption inequality 1961–2017: after-tax money income (90:10), total consumption (90:10), well-measured consumption (90:10), and well-measured consumption less food at home (90:10). Consumption data are from the Consumer Expenditure Interview Survey, and income data are from the Current Population Survey. Well-measured consumption includes spending on food at home, rent (for renters), rental equivalent (for homeowners or those in government or subsidized housing), utilities, service flows from owned vehicles, and spending on gasoline and motor oil. See text for more details.

Meyer and Sullivan 2023

Why non-wage compensation matters for interpreting skill premia

Measured wage differentials may understate or overstate welfare inequality

1. **Workplace amenities** (flexibility, safety, autonomy) are a larger share of total compensation for low-wage workers
2. **Employer-provided health insurance** is roughly flat in dollar terms across the wage distribution—a larger share of compensation for low earners
3. **Implication:** The 'true' skill premium in total compensation may differ substantially from wage-based measures
4. **Policy relevance:** How we finance benefits (employer-provided vs. tax-financed) affects measured wage inequality

Value of workplace amenities as a % of earnings by wage percentile, 2019
Does not include fringe benefits (e.g., healthcare)

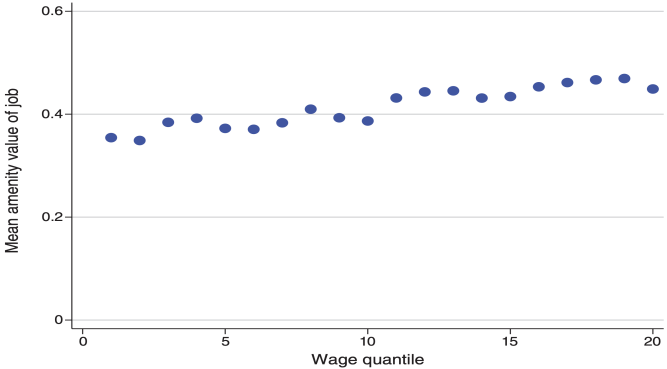


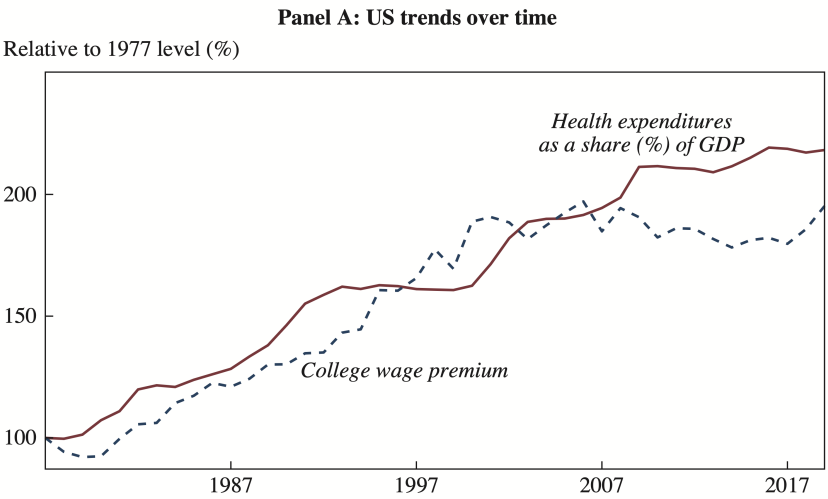
FIGURE 4. MEAN AMENITY VALUE BY WAGE QUANTILE

Notes: The figure plots the mean amenity value of workers' jobs against their position in the wage distribution, aggregating into 20 groups, each representing 5 percent of the sample, using valuations from the logit specification estimated on the full sample (column 5 of Table 2).

Maestas, Mullen, Powell, von Wachter, Wegner 2023

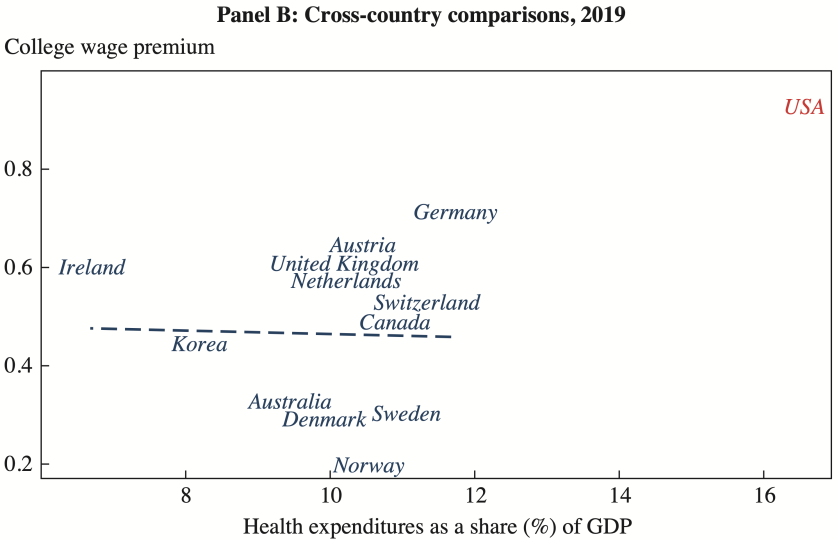
Healthcare costs loom large relative to earnings

Figure 1. College Wage Premiums and Health Expenditures



Finkelstein, McQuillan, Zidar, Zwick 2023

The US is a healthcare and college premium outlier among rich countries



Finkelstein, McQuillan, Zidar, Zwick 2023

Moving from employer-financing to payroll tax-financing of health premiums would likely reduce earnings inequality

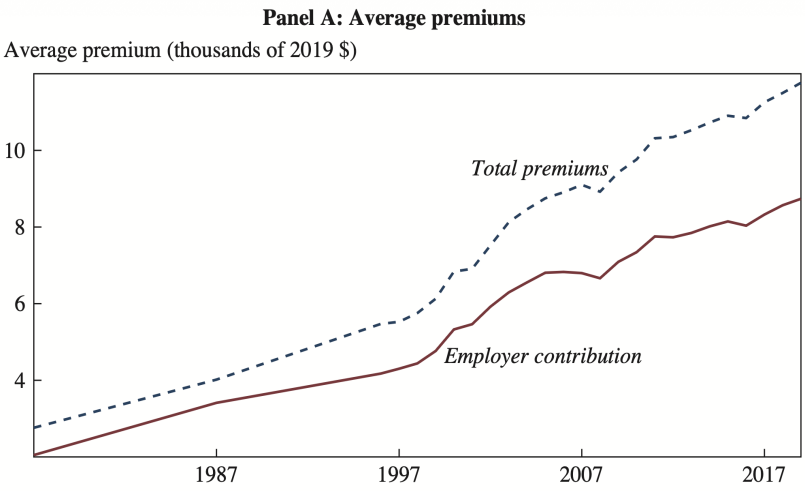
Table 3. 2019 Labor Market Effects of Counterfactual Payroll Tax Financing

	(1) Baseline	*(2) Full coverage*
Fixed per worker cost, τ	\$7,758	\$11,764
Payroll tax rate, t	11.06%	16.80%
Wages		
Change in college wage, $\Delta(w_C)$	−\$2,181	−\$3,158
Change in noncollege wage, $\Delta(w_N)$	\$1,660	\$2,383
Change in college wage premium (%)	−11.26	−16.00
Employment		
Change in college employment rate, $\Delta(P_C)$	−0.69 pp	−1.00 pp
Change in noncollege employment rate, $\Delta(P_N)$	0.52 pp	0.75 pp
Change in total employment, $\Delta(L)$	86,833	119,495
Change in college employment, $\Delta(L_C)$	−408,588	−591,747 pp
Change in noncollege employment, $\Delta(L_N)$	495,420	711,242
Change in college share of wage bill, $\Delta\left(\frac{w_C L_C}{w_N L_N + w_C L_C}\right)$	−1.77 pp	−2.55 pp

Finkelstein, McQuillan, Zidar, Zwick 2023

Rising healthcare expenditures accrue to employer contributions

Figure 6. Premiums for Employer-Provided Health Insurance



Finkelstein, McQuillan, Zidar, Zwick 2023

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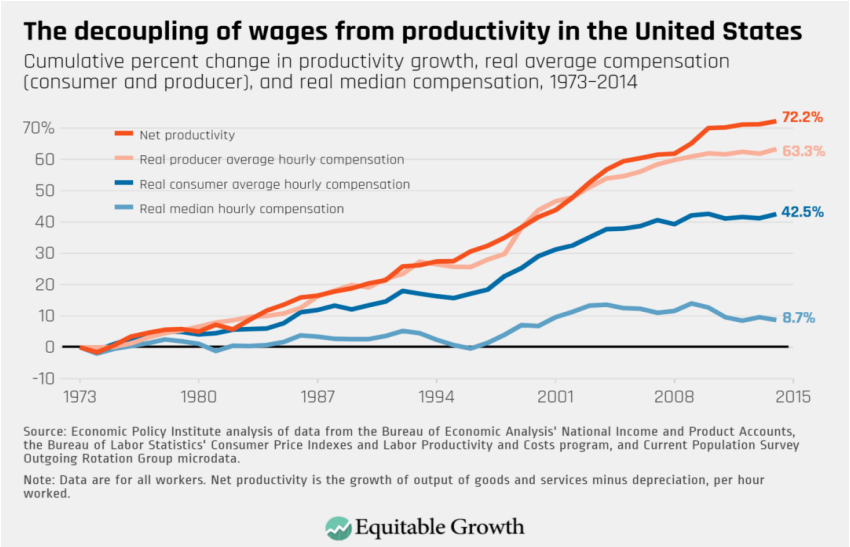
Divergence of wages and average productivity growth



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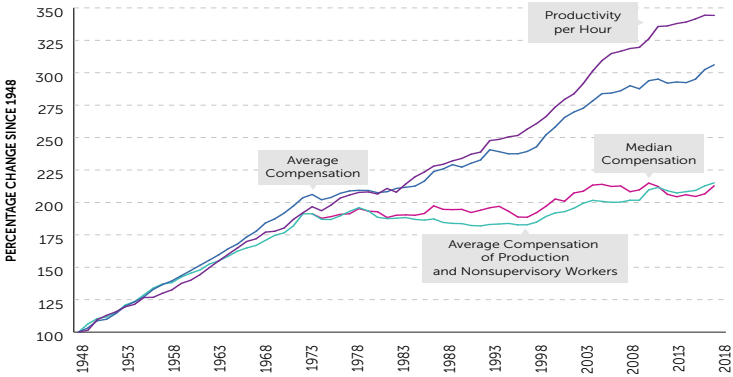
Divergence: Longer term perspective

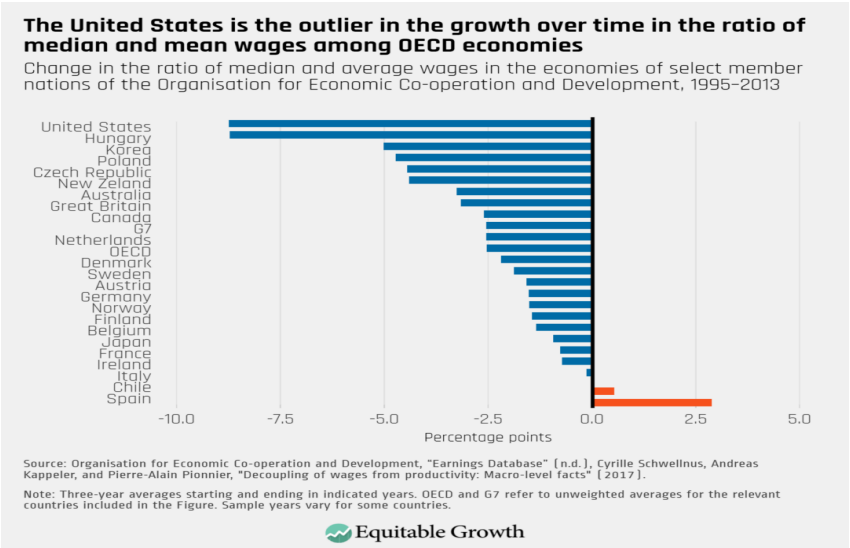
Figure 4. Productivity and Compensation Growth in the United States, 1948–2016



Source: Summers and Stansbury (2018, Figures 1 and 2). Note: Data from BLS, Bureau of Economic Analysis (BEA), and Economic Policy Institute. Labor productivity is total economy real output per hour. Average compensation is total economy real compensation per hour, deflated by Consumer Price Index CPI-U-RS series (CPI-U-RS). Compensation is median economy real compensation per hour and mean real compensation for production and nonsupervisory workers, both deflated by CPI-U-RS. The chart depicts the percent change in each series from its value in 1948 for all series except median compensation. The median compensation series starts in 1973 and is normalized to equal the average compensation of production and nonsupervisory workers in that year.

Summers and Stansbury 2018

Divergence between mean and median wages across OECD, 1993 – 2013



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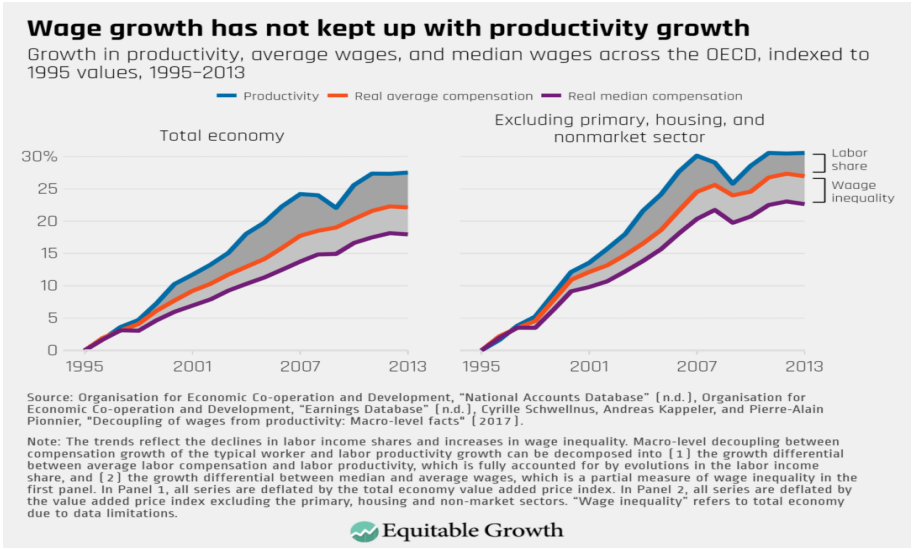
Great divergence: Contributions of rising inequality and falling labor share



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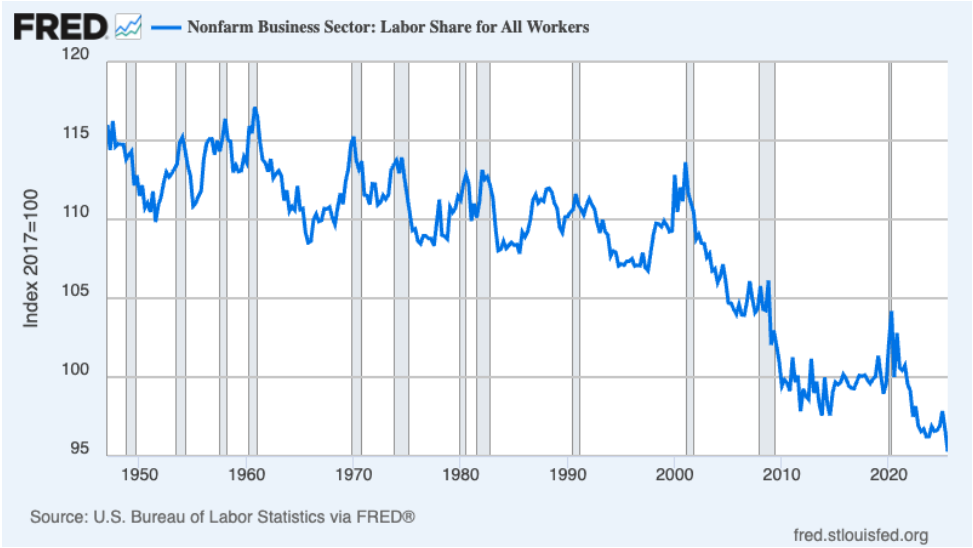
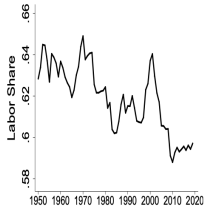
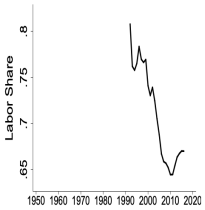
Falling labor share in the United States (FRED series PRS85006173)



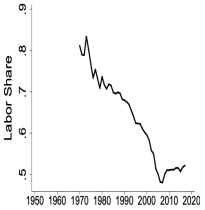
Falling labor share around the world: Part 1



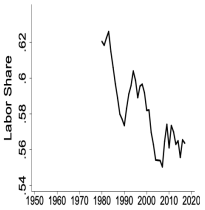
(a) United States



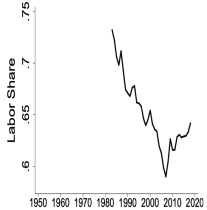
(b) China



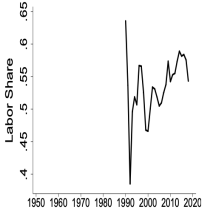
(c) India



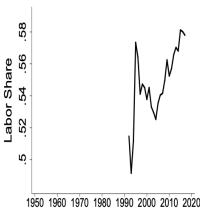
(d) Japan



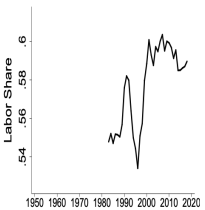
(e) Germany



(f) Russia



(g) Brazil

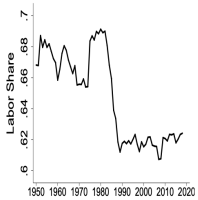


(h) United Kingdom

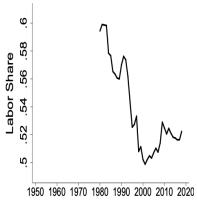
Karabarbounis 2024

Falling labor share around the world: Part 2

(e) Germany



(f) Russia



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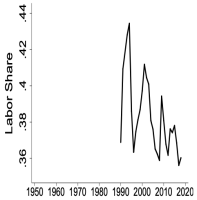

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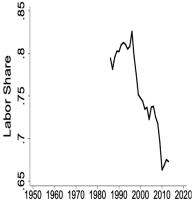
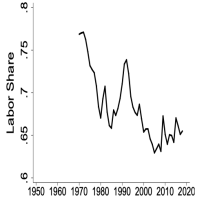
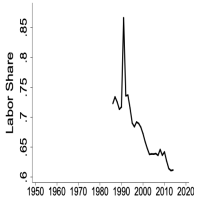


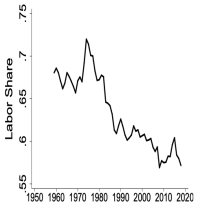
(i) France



(j) Italy



(k) Mexico



(l) Korea

(m) Canada

(n) Spain

(o) Australia

(p) Thailand

Karabarbounis 2024

Agenda

1. Topics from now to Lorenzo
2. Course Expectations/Requirements
3. **Context: Education and earnings inequality**
   - Earnings inequality
   - Broader / different metrics of inequality
   - Productivity, mean and median earnings, labor share
   - Supply of skills
   - Education and inequality
   - Demographics and genentocracy
4. The canonical model
   - Building blocks
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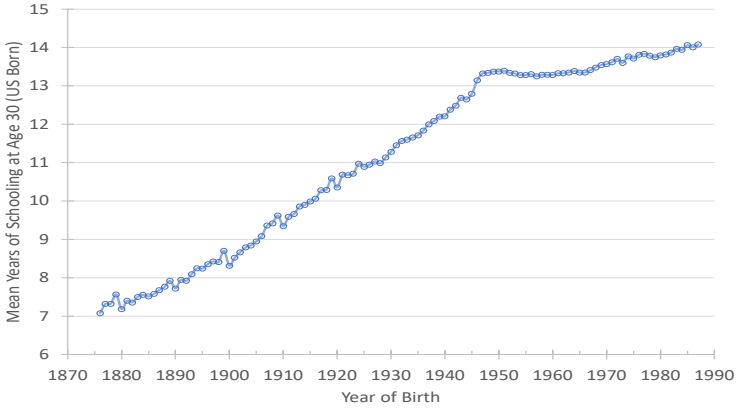
   - Tinbergen and the education race
   - Education race with data: Katz-Murphy '92
   - Capital-skill complementarity
5. International comparisons of wage inequality: Supply, demand and institutions

Years of completed schooling by birth cohort and sex, 1876 - 1988



Sources and Notes: US Census IPUMS data from 1940 to 2000 and CPS MORG data from 2005 to 2018. The figure updates Goldin and Katz (2007, figure 7). See the on-line appendix for details.

Autor, Goldin, Katz 2020

U.S. high school completion rates by birth cohort 1930 – 1975

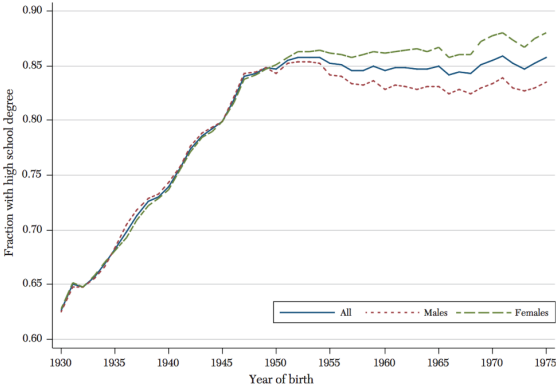


Figure 7. High School Completion Rates by Birth Cohort: 1930–1975

Source: Census IPUMS 1 percent samples for years 1960, 1970, 1980, 1990, and 2000. Sample includes adults ages 25 through 64 born after 1930 with nonmissing education. Plotted values correspond to predicted high school completion rates at age 35 by birth cohort. Predictions are obtained from an OLS regression of a high school completion dummy on sex by birth-year dummies and a quartic in age. Individuals are coded as high school graduates if they have completed twelve years of school (1960, 1970 and 1980 Census) or if they report a high school diploma or GED (1990 and 2000 Census).

Acemoglu and Autor 2012

U.S. college completion rates by birth cohort 1930 – 1975

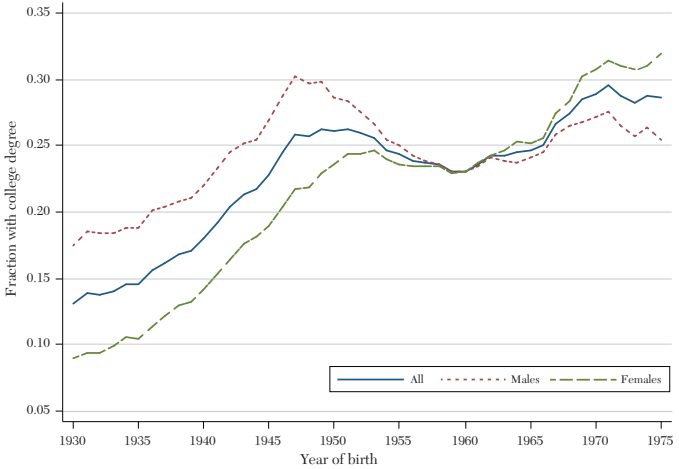
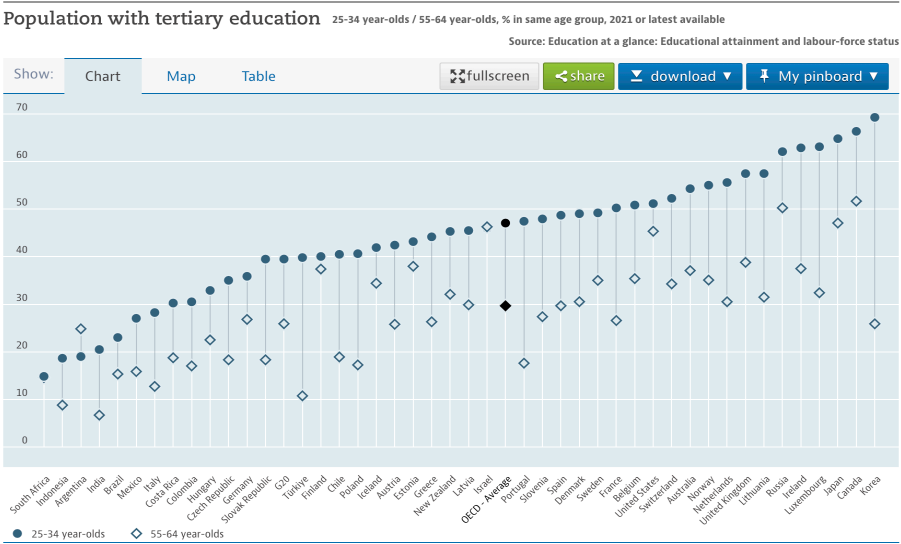


Figure 8. College Completion Rates by Birth Cohort: 1930–1975

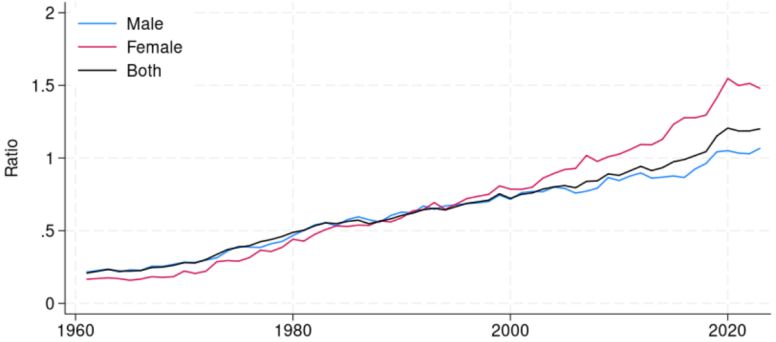
Acemoglu and Autor 2012

Tertiary education completion in OECD countries as of 2022 by age group



College/high school labor supply (hours worked) overall and by gender, 1962-2023

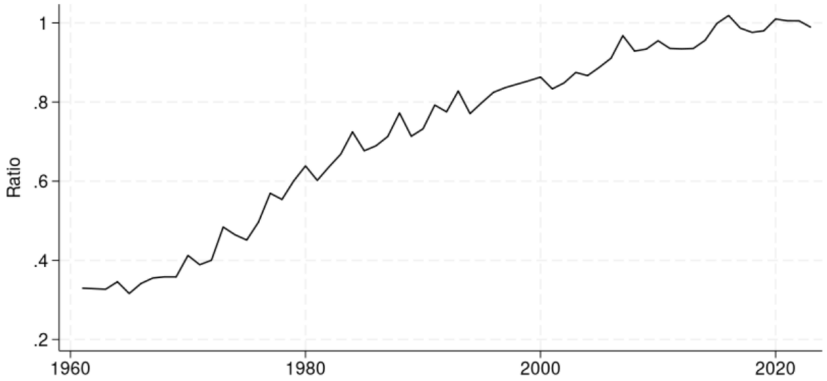
Figure 5: Relative supply of college educated to high school educated labor, overall and by gender



Note: Years are survey reference years. Relative supply is the ratio of the college educated labor supply to the high school educated labor supply, as defined in the text; however, relative to the text description, the series in this figure are calculated for all age groups of men or women together. The sample used to compute supply includes all classes of part- and full-time workers of all education levels, aged 25–64. Labor supplied by individuals with less than a high school degree, some college, or above a college degree is allocated to 'college educated labor' and 'high school educated labor' as described in the text.

Changing gender ratio of college-educated workers (hours) 1962-2023

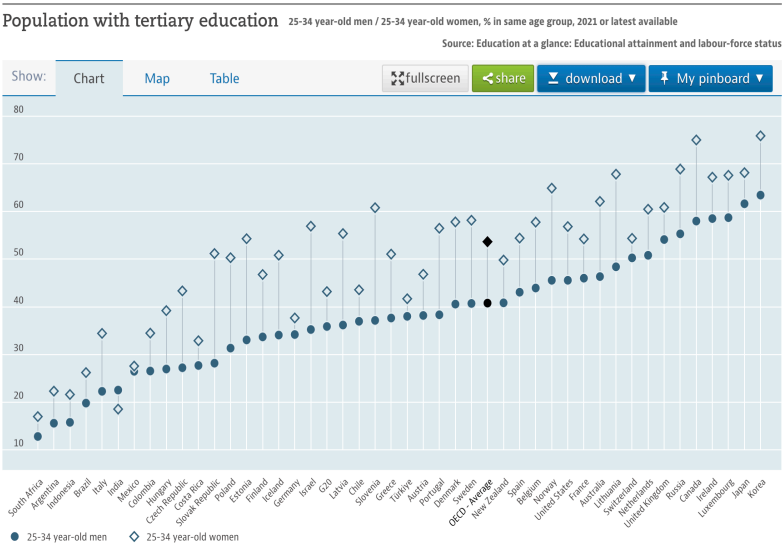
Figure 6: Relative supply of female to male college educated labor



Note: Years are survey reference years. College educated labor supply created as defined in the text; however, relative to the text description, the series used to create this figure are calculated for all age groups of men or women together. The sample used to compute supply includes all classes of part- and full-time workers of all education levels, aged 25–64 Labor supplied by individuals with some college or above a college degree is allocated to 'college educated labor' as described in the text.
Source: Authors' calculations from CPS ASEC microdata.

Bengali, Valletta, Zhao 2025

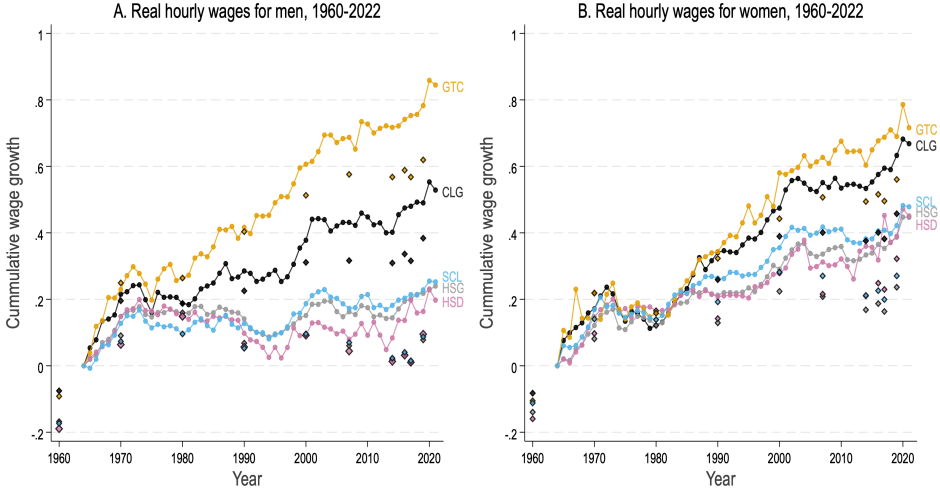
Tertiary education completion in OECD countries as of 2022 by gender



Agenda

Evolution of US real hourly wages by education level, 1960 - 2022

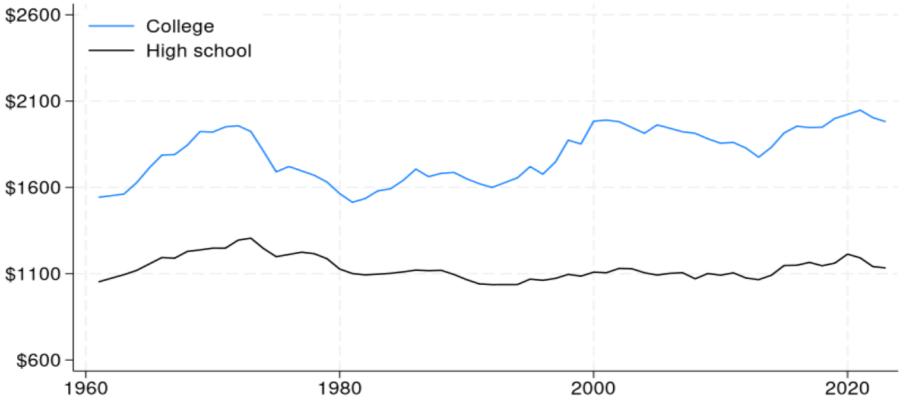
(Weekly wages look similar)



Autor 2019, Acemoglu and Restrepo 2023

Evolution of US real weekly wages by education level, 1962 - 2023

Figure 3: Overall real weekly earnings, college graduates and high school graduates

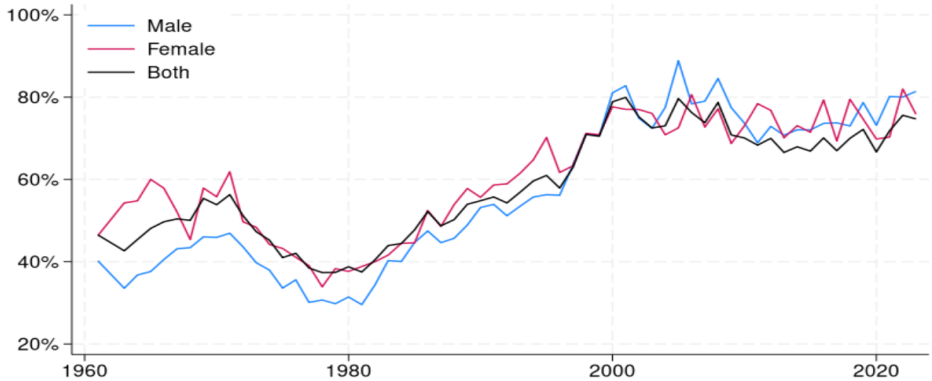


Note: Years are survey reference years. Earnings are real weekly earnings ($ 2023), measured as defined in the text. The sample used to compute earnings includes only full-time wage and salary workers aged 25–64 with exactly a college or high school degree who earn at least $50 per week (in 1989 dollars).
Source: Authors' calculations from CPS ASEC microdata.

Bengali, Valletta, Zhao 2025

Raw college/high school log earnings gap, 1962 - 2023

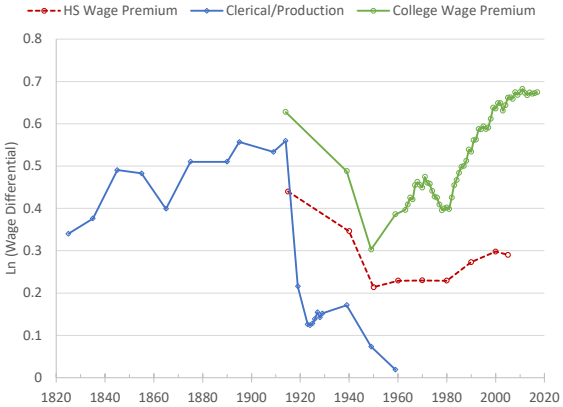
Figure 1: College to high school earnings gap, overall and by gender



Note: Years are survey reference years. Earnings are weekly earnings, measured as defined in the text. The sample used to compute earnings includes only full-time wage and salary workers aged 25–64 with exactly a college or high school degree who earn at least $50 per week (in 1989 dollars).
Source: Authors' calculations from CPS ASEC microdata.

Bengali, Valletta, Zhao 2025

Educational and occupational wage differentials in the US, 1825 to 2017



Autor, Goldin, Katz 2020

Notes and Sources: Clerical/production worker series for 1825 to 1875 is based on Katz and Margo (2014, table 1.5), and that for 1890 to 1959 is from Goldin and Katz (2008, table 2.2). High school wage premium series is from Goldin and Katz (2008, table D.1). College wage premium series from Goldin and Katz (2008, table 8.2) updated to 2017. See the on-line appendix for details.

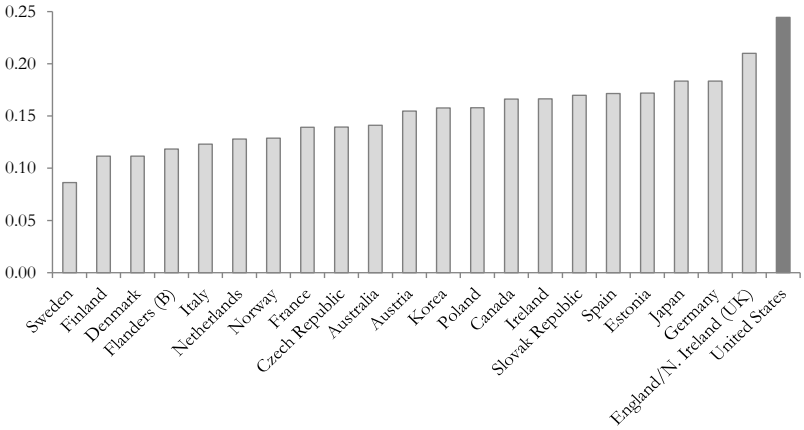
Earnings differentials between "college" and "high school" young adults 30 - 44 in OECD countries, 2005

Country	Differential
Denmark	22%
Sweden	22%
Spain	30%
Australia	34%
Belgium	34%
Finland	38%
Italy	43%
Netherlands	47%
Austria	48%
France	48%
Korea	48%
Germany	50%
Ireland	59%
UK	61%

OECD (2007): Education at a Glance

Cross-national differences in estimated wage returns to PIAAC (2012) 'skills'

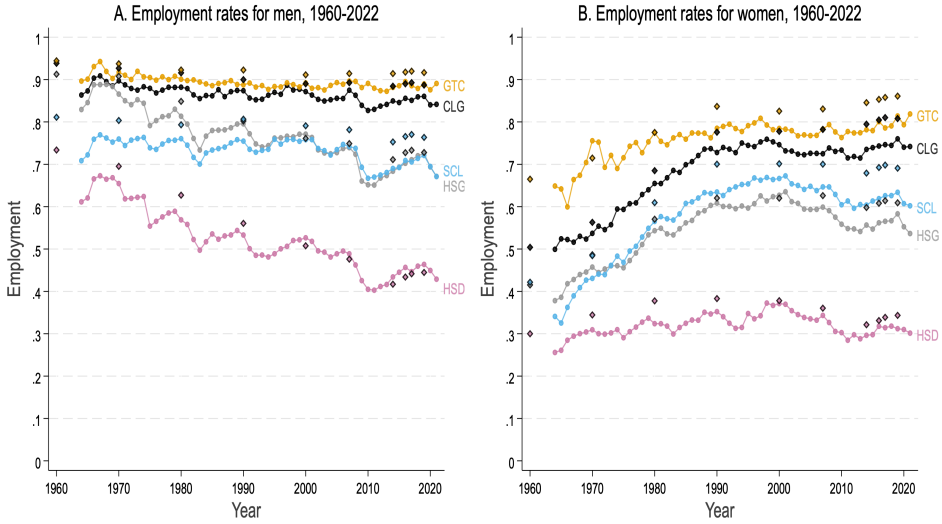
Figure 1: Returns to skill



Notes: The figure shows the coefficient on skill from a regression of log hourly wages (including bonuses) for wage and salary earners on standardised numeracy scores.

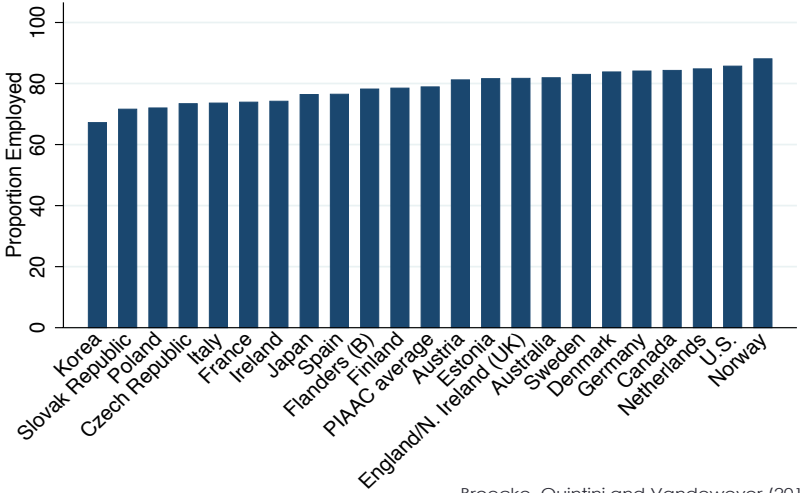
Broecke, Quintini and Vandeweyer 2016

Emp/Pop-rates by education level, 1960 - 2022



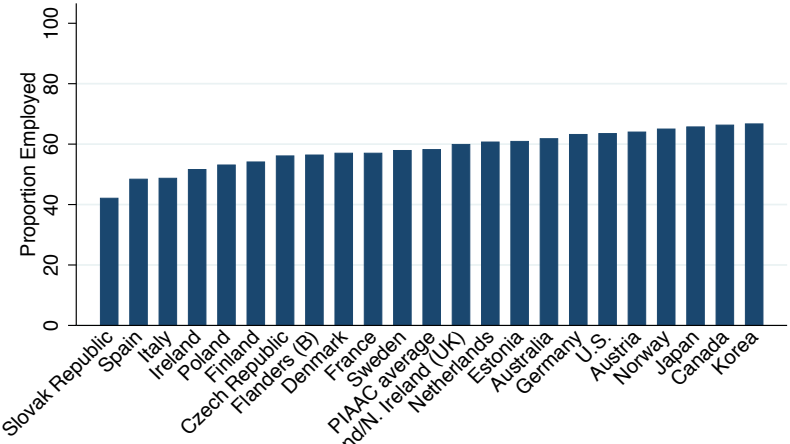
Autor 2019, Acemoglu and Restrepo 2023

Across countries, EPop uniformly high (EPOP $\approx$ 80%) among Top tercile PIAAC scorers (2012 data)



Broecke, Quintini and Vandeweyer (2015)

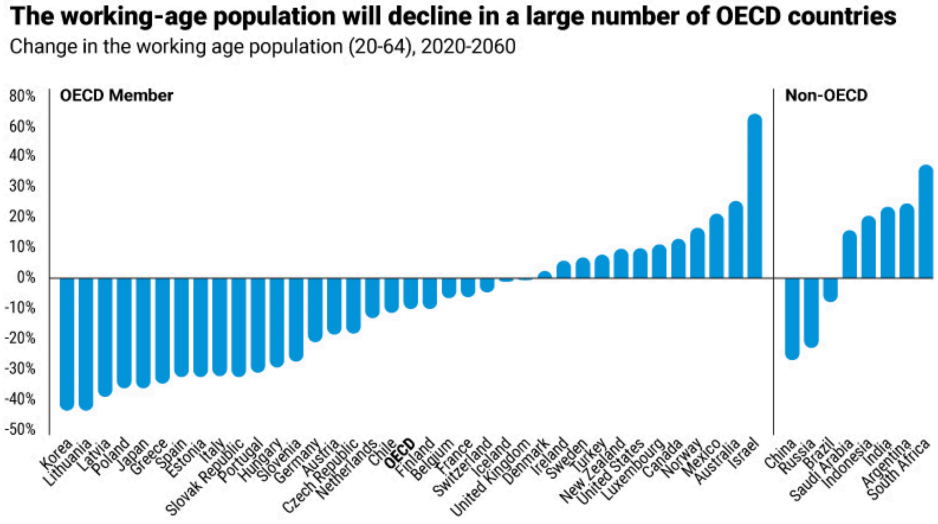
Across countries, EPop uniformly low (EPOP $<$ 60%) among bottom tercile PIAAC scorers (2012 data)



Broecke, Quintini and Vandeweyer (2015)

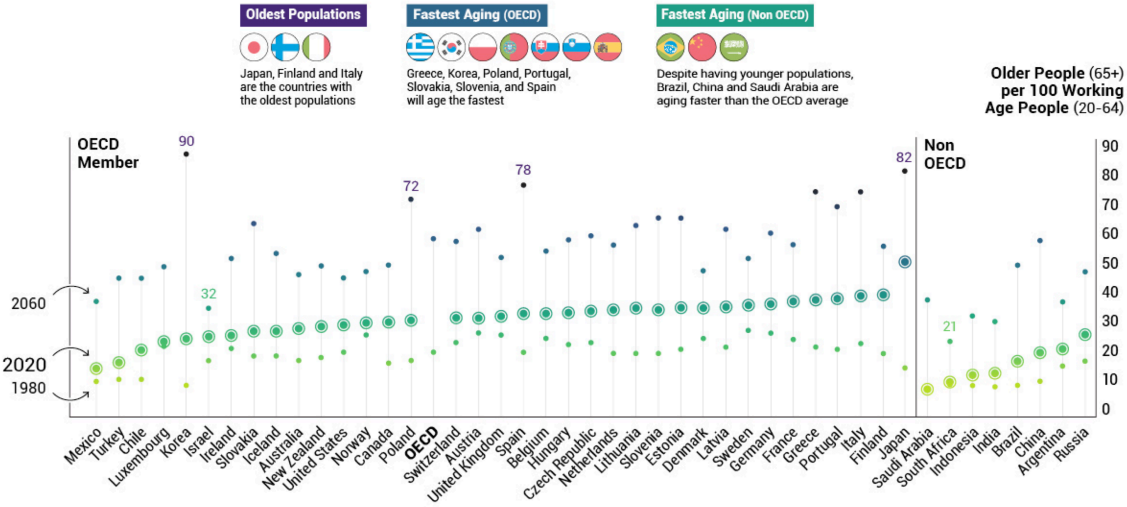
Agenda

Shrinking working-age populations in OECD



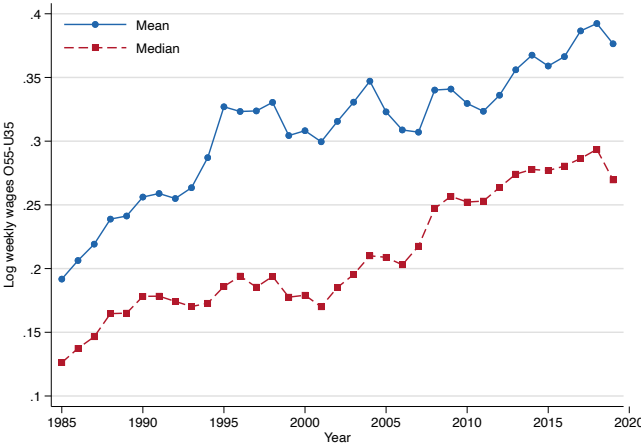
OECD 2020

Rising dependency ratios worldwide



The Visual Capitalist 2020

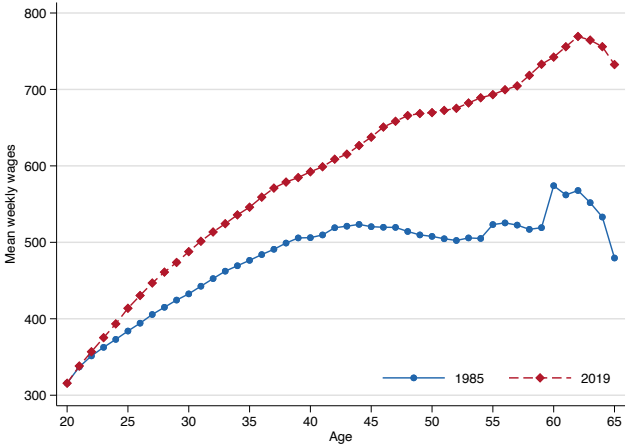
The rising gerontocracy in Italy (and likely other countries): age 55 v. age 35



Panel A: Gap in log mean and median weekly wages

Bianchi and Paradisi 2024

The rising gerontocracy in Italy (and likely other countries), continued



Panel B: Age profiles for
mean weekly wages

Bianchi and Paradisi 2024

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   - Education race with data: Katz-Murphy '92
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Agenda

Building blocks

The simplest framework for interpreting skill premia

1. Competitive supply-demand framework
2. Closed economy setting
3. Factors are paid their marginal products
4. Economy operates on the demand curve
5. *Note: this is a model of labor demand not labor supply*

Model is a workhorse...

- Common as livestock
- Can carry a big load
- Often a bit overburdened

The canonical model: Setup

- Two types of workers, **skilled** v **unskilled** (or high v low education, college v non-college, etc.)
  - *Types are imperfect substitutes*
- Suppose that there are $L(t)$ unskilled workers and $H(t)$ skilled workers supplying labor inelastically at time t.
- The production function for the aggregate economy takes the constant elasticity of substitution (CES) form:

$$Y(t) = \left[(A_l(t)L(t))^{\rho} + (A_h(t)H(t))^{\rho} \right]^{1/\rho}$$

  where $\rho \leq 1$ [i.e., $\rho \in (-\infty, 1)$]
- Ignore capital for now and drop time subscripts
- Q: *Why is imperfect substitutability crucial for interpreting wage inequality trends?*

The canonical model

- Aggregate production function:

$$Y = \left[(A_l L)^\rho + (A_h H)^\rho\right]^{1/\rho}$$

  where $\rho \leq 1$ [i.e., $\rho \in (-\infty, 1)$]

- Elasticity of substitution is given by

$$\sigma \equiv 1/(1-\rho), \ \rho \in (-\infty, 1)$$

- Reminder: σ is $\%\Delta$ in relative demand for low (high) skill workers per $\%\Delta$ in relative wage of high (low) skill workers.

The canonical model

Aggregate production function

$$Y = \left[(A_l L)^{\rho} + (A_h H)^{\rho}\right]^{1/\rho}$$

$$\sigma = 1/(1-\rho)$$

Three cases

1. $\sigma \to 0$ (or $\rho \to -\infty$): Skilled and unskilled workers are Leontief. Fixed proportions. 'Perfect complements'
2. $\sigma \to \infty$ (or $\rho \to 1$): Skilled and unskilled workers are perfect substitutes. Changes in aggregate supplies affect *overall* price of skill. Relative wage of skilled vs. unskilled (w_H/w_L) constant.
3. $\sigma \to 1$ (or $\rho \to 0$): Production function is Cobb-Douglas, with fixed shares paid to each factor

The canonical model

Seriously, what is σ?

- Aggregate production function is an abstraction
- *Not* intended to correspond to production function of any given firm
- Combines substitution in production and consumption across consumers, industries, firms, plants within firms, etc.
- Would expect factors to be less substitutable at the firm level than at the aggregate level

Where do aggregate production functions come from?

- See Houthakker 1955 *ReStud*, Jones 2005 *QJE*

What are plausible values of σ?

- Surprising degree of consensus: $\sigma \in [1, 2]$

A more general production function with skill-replacing technologies

$$Y(t) = K^{\alpha}\left[(1-b)\left[A_l L + B_l\right]^{\rho} + b\left[A_h H + B_h\right]^{\rho}\right]^{(1-\alpha)/\rho}$$

- In prior setup, only *factor augmenting* technologies
- Here, B_l, B_h are directly *skill-replacing* technologies
- Intensive versus extensive technical changes
  - A_l, A_h terms are 'intensive' technical changes, augmenting without reallocating—*Literature has focused on these*
  - $b's$ are technologies that shift the allocation of tasks among factors – *become quite important later*
- K is capital: enters in Hicks-neutral form above, no bearing on skill premium
- Note that if $\sigma \to 1$, the $b(t)$ terms limit to the exponents in the Cobb-Douglas production function

The skill premium

Three interpretations of this aggregate model

1. Only one good, skilled and unskilled workers are imperfect substitutes in its production
2. Two-good economy:
   - Consumers have utility function $[Y_l^\rho + Y_h^\rho]^{1/\rho}$ with elasticity of substitution $\sigma = 1/(1-\rho)$
   - Good Y_h is produced with $Y_h = A_h H$
   - Good Y_l is produced with $Y_l = A_l L$
3. A mixture of these two where different sectors produce goods that are imperfect substitutes, and high and low education workers are employed in all sectors

Wage setting

Given competitive labor markets, wages are set by marginal products

$$w_L = \frac{\partial Y}{\partial L} = A_l^\rho [A_l^\rho + A_h^\rho (H/L)^\rho]^{(1-\rho)/\rho}$$

and

$$w_H = \frac{\partial Y}{\partial H} = A_h^\rho [A_h^\rho + A_l^\rho (H/L)^{-\rho}]^{(1-\rho)/\rho}$$

Two immediate results

1. First $\partial w_H / \partial (H/L) < 0$. Why? (Unless?)
2. Second $\partial w_L / \partial (H/L) > 0$. Why? (Unless?)

Gross complements vs. gross substitutes

Aggregate production function

$$Y = [(A_l L)^\rho + (A_h H)^\rho]^{1/\rho}$$

Key distinction

- $\sigma < 1$: Gross complements. A reduction in supply of one input *reduces* demand for the other
- $\sigma > 1$: Gross substitutes. A reduction in supply of one input *raises* demand for the other

The skill premium

Combining the wage equations to get skill premium π

$$\pi = \frac{w_H}{w_L} = \left(\frac{A_h}{A_l}\right)^{\rho} \left(\frac{H}{L}\right)^{-(1-\rho)} = \left(\frac{A_h}{A_l}\right)^{(\sigma-1)/\sigma} \left(\frac{H}{L}\right)^{-1/\sigma}$$

Taking logs

$$\ln \pi = \left(\frac{\sigma - 1}{\sigma}\right) \ln \left(\frac{A_h}{A_l}\right) - \frac{1}{\sigma} \ln \left(\frac{H}{L}\right)$$

Notice that

$$\frac{\partial \ln \pi}{\partial \ln(H/L)} = -\frac{1}{\sigma} < 0$$

- *Relative* demand curve for H vs. L is downward sloping (recall that $\sigma \geq 0$)
- For given 'skill bias,' A_h/A_l, an increase in relative supplies H/L lowers relative wages with elasticity σ (*except when?*)

Agenda

Technological change and the skill premium

How does the skill premium respond to factor augmenting technical change?

- $\partial \ln \pi / \partial \ln(A_h/A_l)$ is...?
- Differentiating

$$\ln \pi = \left(\frac{\sigma - 1}{\sigma}\right) \ln \left(\frac{A_h}{A_l}\right) - \frac{1}{\sigma} \ln \left(\frac{H}{L}\right)$$

  yields

$$\frac{\partial \ln \pi}{\partial \ln(A_h/A_l)} = \frac{\sigma - 1}{\sigma},$$

- Q: Why would an increase in the productivity of more skilled workers, that is a rise in A_h/A_l, cause their wages to fall (when $\sigma < 1$)?

Summary of key relationships: Factor-biased technical change

An exogenous increase in A_h, holding A_l and L/H constant

1. $\pi = W_H/W_L$ rises if $\sigma > 1$, falls if $\sigma < 1$, and is unchanged if $\sigma = 1$
2. Wages of L workers rise if $\sigma < \infty$. Why not if $\sigma = \infty$?
3. Both W_H and W_L rise if $1 < \sigma < \infty$. Why not if $\sigma < 1$?

General takeaways

- It's hard for factor-augmenting technical change to lower wages (though of course π may rise) if factors are *gross substitutes*
- But this result will change qualitatively when we focus (later) on 'intensive' margin technical changes that shift the allocation of inputs across factors
- We will eventually label *intensive margin* technical change as *task-replacing* technical change

Agenda

Tinbergen: Education race

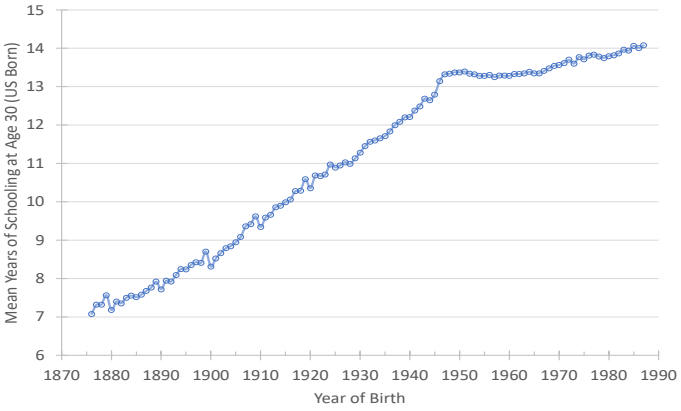
Jan Tinbergen, 1975

> *"The two preponderant forces at work are technological development, which made for a relative increase in demand and hence in the income ratio... and increased access to schooling, which made for a relative decrease."*

Translation

- Long term trend increases towards greater relative demand *and* greater supply of skilled workers
- Bursts of supply and/or technologically-induced demand accelerations/decelerations that cause demand to temporarily move out more rapidly than supply or vice versa in some eras.

Years of completed schooling by birth cohort and sex, 1876 - 1988



Sources and Notes: US Census IPUMS data from 1940 to 2000 and CPS MORG data from 2005 to 2018. The figure updates Goldin and Katz (2007, figure 7). See the on-line appendix for details.

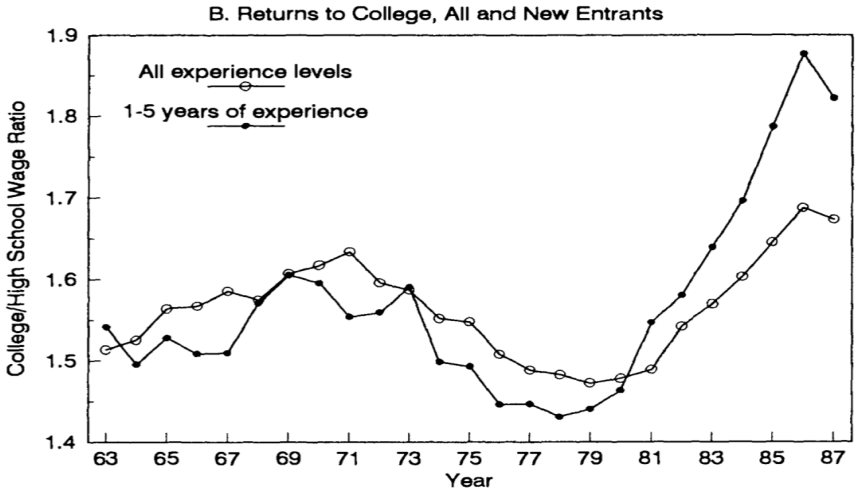
Autor, Goldin, Katz 2020

The long term skill bias of technical change

Key implication: As H/L increases, the skill premium (π) falls

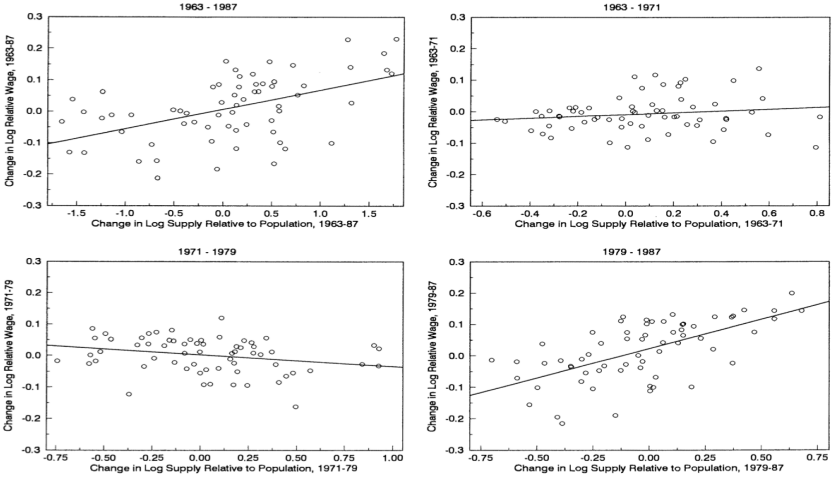
- In every advanced country the supply of educated workers has risen dramatically in the past seven decades
  - **Yet**, relative wages of better educated workers have remained consistently above those of less educated
  - U.S. college-educated share rose from 6.4 to 29.7 percent from 1940 to 2000, and to approximately 35 percent by 2017. High school dropout share fell from 68 to < 9 percent of the workforce
  - The skill premium in 2000 or 2018 (measured in a variety of ways) was at or above that of in 1940 or 1915
  - Note: the skill premium has been relatively stable for 20 years and may be *falling*
- If we take this model even a little bit seriously, it suggests that relative demand for skilled workers *must* have risen practically everywhere

Katz-Murphy '92: Evolution of college premium



Katz and Murphy 1992

Wages by skill group: 1963-1987 (Katz-Murphy 1992)



Katz and Murphy 1992

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Bringing the model to the data

Relative productivity of skilled workers

$$\ln \pi = \ln W_h/W_l = \left(\frac{\sigma-1}{\sigma}\right) \ln \left(\frac{A_h}{A_l}\right) - \frac{1}{\sigma} \ln \left(\frac{H}{L}\right)$$

- The technological parameter is $\frac{\sigma-1}{\sigma} \ln (A_h/A_l)$
- Must have increased considerably since 1939 (i.e., first representative data on skill supplies and wages)

How much has $\frac{(\sigma-1)}{\sigma} \ln (A_h/A_l)$ increased?

- We can observe H/L and $\pi = \ln W_h/W_l$
- If we knew σ, could infer $\Delta \ln (A_h/A_l)$
- This approach pioneered by Katz and Murphy 1992

If we wanted to estimate this model with time-series data

'Structural' equation

$$\ln \pi = \frac{\sigma - 1}{\sigma} \ln \left(\frac{A_h}{A_l} \right) - \frac{1}{\sigma} \ln \left(\frac{H}{L} \right)$$

- Add time subscripts to everything except for σ

$$\ln \pi_t = \gamma_0 + \gamma_1 t + \gamma_2 \ln(H/L)_t + e_t.$$

- We observe $(H/L)_t$ and π_t
- Unknowns are σ and $(A_h/A_L)_t$
- γ_o is a constant, γ_1 gives the time trend on $(\frac{\sigma-1}{\sigma}) \ln(A_{ht}/A_{Lt})$, and $\hat{\gamma}_2$ is an estimate of $1/\sigma$
- Identification assumptions: (1) $\ln(H/L)_t$ is exogenous or quasi-fixed; (2) $\partial \ln(A_h/A_L)/\partial t$ is approximately linear (time trend is log-linear)

What if H/L is endogenous?

The key identification concern

- If higher skill premia induce more skill acquisition, H/L responds positively to π
- This creates *attenuation bias*: OLS estimate of $1/\sigma$ is biased toward zero
- Implication: We would *underestimate* the true elasticity of substitution

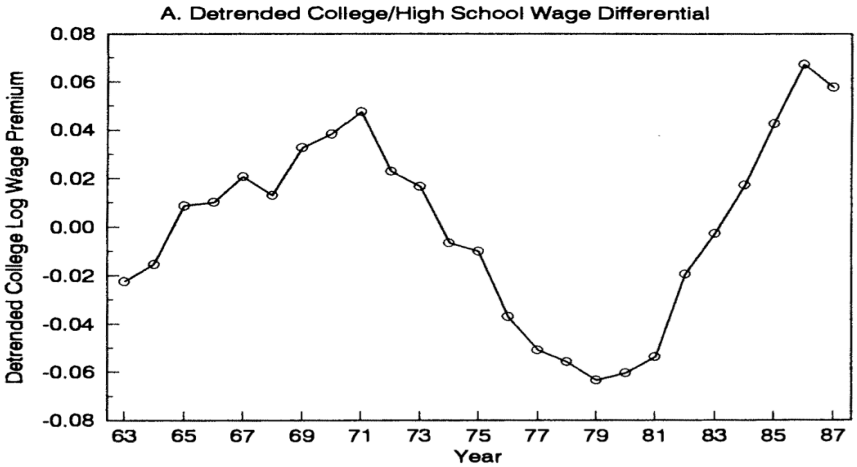
Why might quasi-exogeneity be reasonable in the short-to-medium run?

- Education decisions made 5–10+ years before labor market entry
- Cohort sizes largely determined by past fertility, not current wages
- Year-to-year variation in H/L driven by demographic flows, not contemporaneous price responses

But over longer horizons...

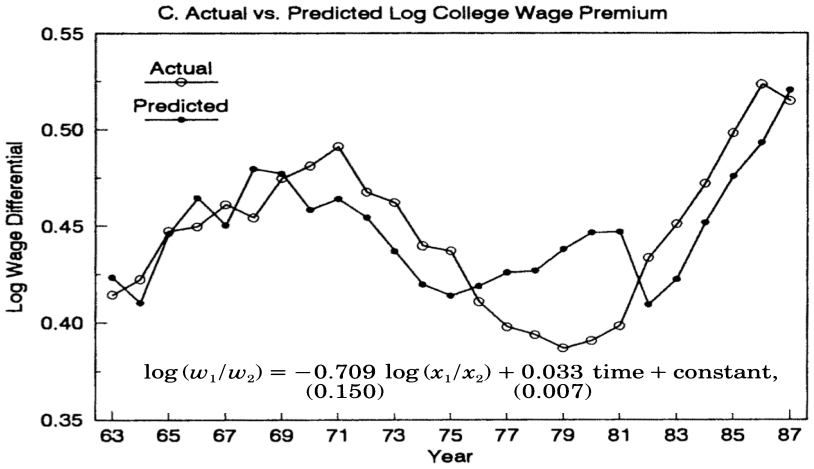
- Supply clearly responds: college enrollment rose with the skill premium in 1980s–2000s
- The 'Education Race' interpretation imlies that both supply and demand are shifting

Data to be explained: Katz-Murphy 1992



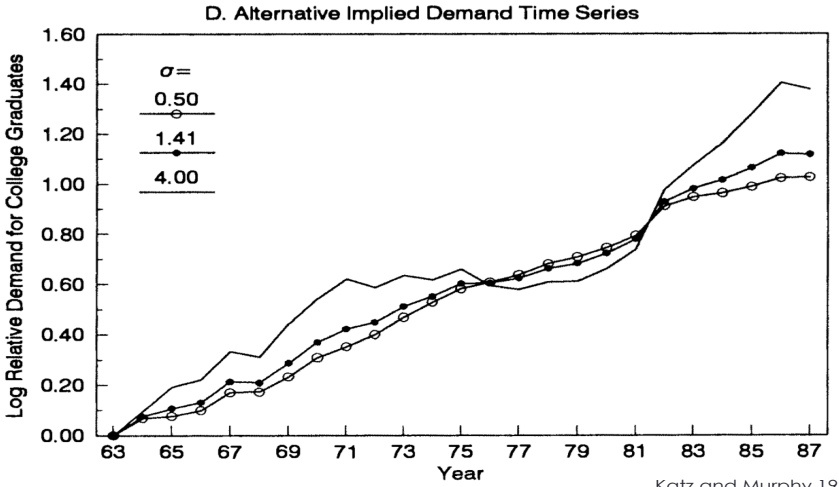
Katz and Murphy 1992

Model fit: $\hat{\sigma} = -(1/0.71) = 1.41$ $[R^2 = 0.52]$



Katz and Murphy 1992

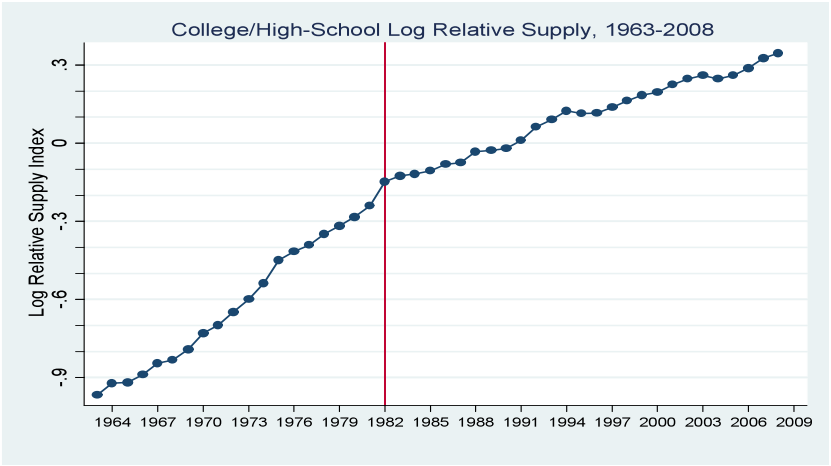
Implied demand series: Alternative values of σ



Katz and Murphy 1992

Note: $D_t \equiv (\sigma - 1) \ln (A_{ht}/A_{lt})$

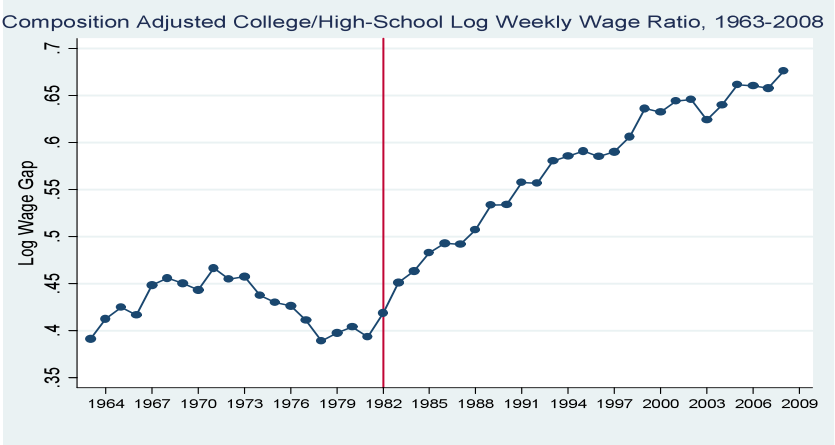
Acemoglu-Autor replication/update: Supply series



Source: March CPS data for earnings years 1963-2008. Labor supply is calculated using all persons ages 16-64 who reported having worked at least one week in the earnings years, excluding those in the military. The data are sorted into

Acemoglu-Autor 2011

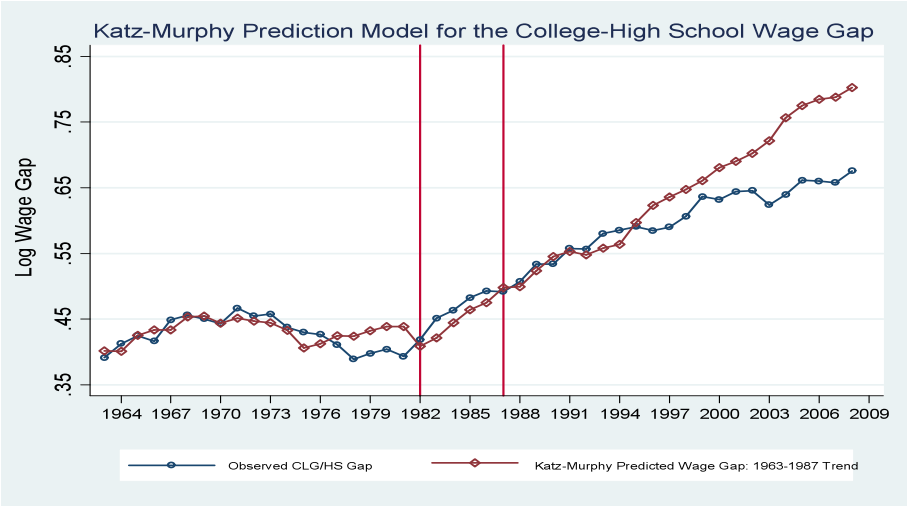
Acemoglu-Autor replication/update to 2008



Source: March CPS data for earnings years 1963-2008. Log weekly wages for full-time, full-year workers are regressed in each year on four education dummies (high school dropout, some college, college graduate, greater than college), a quartic in experience, interactions of the education dummies and experience quartic, and two race categories (black,

Acemoglu-Autor 2011

KM model fit 1963-1987, out of sample 1987-2008

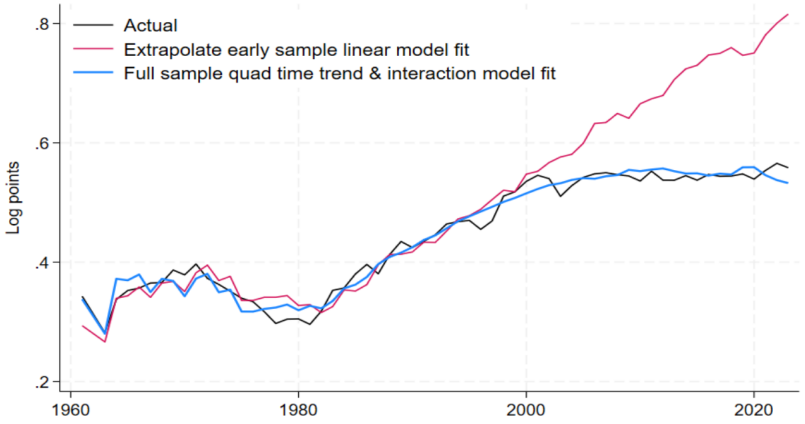


Acemoglu-Autor 2011

Recent data: 1961–'96 in sample, 1997–'23 out of sample, quad full sample

Figure 9. College wage premium, actual and model fits

Panel A: Early sample (1961–1996) linear fit, full sample quadratic & interaction fit



Bengali, Valletta, Zhao 2025

Bengali et al. 2025: KM model fit, regression version, 1961-2023

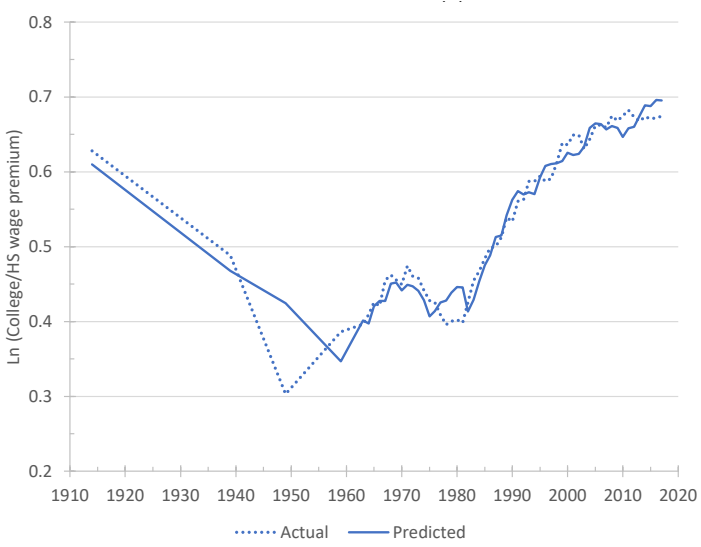
Table A4: Estimation of the college wage premium, **annual data only (single stage, no sub-groups)**

	(1) 1961-1996	(2) 1961-1996	(3) 1997-2023	(4) 1997-2023	(5) 1961-2023	(6) 1961-2023	(7) 1961-2023	(8) 1961-2023
Aggregate relative supply index	-0.377***	-0.438***	-0.052	-0.037	-0.146***	-0.421***	-0.651***	-0.704***
	(0.038)	(0.051)	(0.075)	(0.090)	(0.032)	(0.040)	(0.051)	(0.056)
Linear trend	0.017***	0.022***	0.001	0.001	0.007***	0.024***	0.048***	0.052***
	(0.001)	(0.004)	(0.002)	(0.002)	(0.001)	(0.002)	(0.004)	(0.005)
Quadratic trend/100		-0.008		-0.001		-0.014***	-0.047***	-0.050***
		(0.005)		(0.009)		(0.002)	(0.005)	(0.006)
(Agg supply)*trend							0.014***	0.012***
							(0.002)	(0.002)
(Agg supply) x (quad trend/100)								0.005*
								(0.003)
Constant	-0.247***	-0.366***	0.498***	0.502***	0.139***	-0.361***	-0.691***	-0.800***
	(0.062)	(0.093)	(0.034)	(0.029)	(0.050)	(0.070)	(0.080)	(0.096)
Observations	35	35	27	27	62	62	62	62
R-squared	0.863	0.869	0.015	0.017	0.779	0.907	0.945	0.947

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Note: Estimates of text Equation 7 (modified to annual data excluding groups). Robust standard errors are in parentheses. Models are fit by weighted least squares to the yearly college-high school wage premium. Weights are inverse sampling variances of the estimated wage premium.
Source: Authors' calculations from CPS ASEC microdata.

Bengali, Valletta, Zhao 2025

The Katz-Murphy model fit to a century of data, 1914 - 2017



Autor, Goldin, Katz 2020

Models for the college/high school wage premium, 1914 - 2017

	(1)	(2)	(3)	(4)
(College/high school) supply	-0.592	-0.619	-0.640	-0.651
	(0.070)	(0.077)	(0.057)	(0.071)
(College/high school) supply × post-1949				0.0111
				(0.0414)
Time	0.00472	0.0102	0.0106	0.0111
	(0.00182)	(0.00205)	(0.0015)	(0.0026)
Time × post-1949	0.0197			
	(0.0011)			
Time × post-1959		0.0161	0.0160	0.0154
		(0.0010)	(0.0008)	(0.0022)
Time × post-1992	-0.00769	-0.00971	-0.00938	-0.00940
	(0.00135)	(0.00156)	(0.00117)	(0.00118)
1949 Dummy			-0.136	-0.143
			(0.021)	(0.035)
Constant	-0.592	-0.694	-0.717	-0.742
	(0.148)	(0.163)	(0.122)	(0.156)
R^2	0.953	0.945	0.970	0.970
Number of observations	59	59	59	59

Autor, Goldin, Katz 2020

An omitted variable: The minimum wage

The canonical model assumes competitive wage-setting

- Wages equal marginal products; no frictions or wage floors
- But if labor market institutions compress wages, this affects measured skill premia

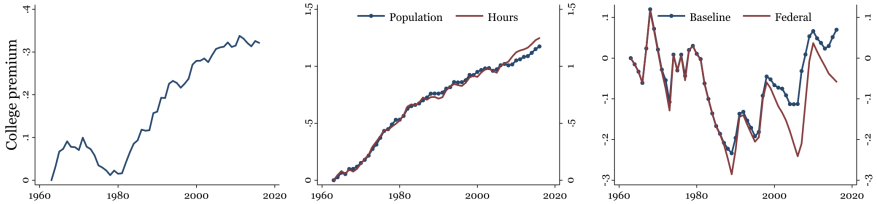
The minimum wage as a potential confounder

- Real minimum wage fell sharply 1980–1990, then partially recovered
- Timing coincides with rising (then stabilizing) college premium
- If the minimum wage binds for low-skill workers, its erosion mechanically raises measured π

Implication for the KM framework

- Part of 'demand shift' may actually reflect institutional change
- Previews later lectures on labor market institutions and wage-setting

The college premium and the minimum wage (Vogel 2025)



(A) The College Premium (B) The Relative Supply of College Workers (C) The Real Minimum Wage

FIGURE I

National Relative Wages, Relative Supplies, and Real Minimum Wages

Panels A and B display the national composition-adjusted college premium and relative supply of college labor. The relative supply of college labor is measured two ways: hours worked and populations. Panel C displays the baseline real minimum wage series, which averages minimum wages across states, and the real federal minimum wage; both series are deflated by the GDP deflator. All series are normalized to zero in 1963.

Vogel 2025

The college premium and the minimum wage

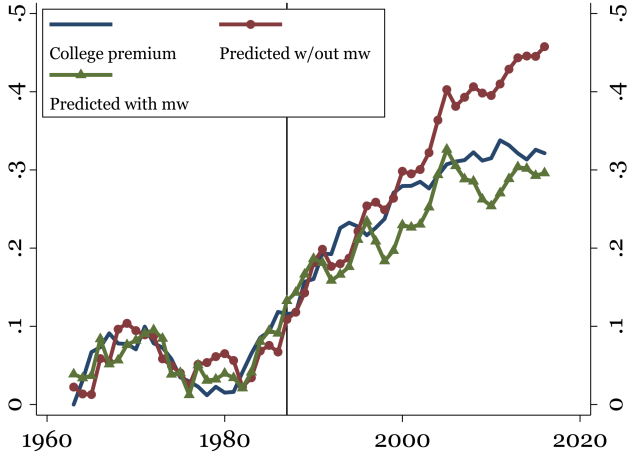


FIGURE III

Out-of-Sample Predictions of the Canonical Model and the Extended Canonical Model at the National Level

Vogel 2025

The college premium and the minimum wage: National time series estimates

TABLE I

REGRESSION MODELS FOR THE NATIONAL COLLEGE WAGE PREMIUM

	1963–1987	1963–2016	1963–1987	1963–2016			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Relative supply of college workers	−0.781	−0.411	−0.687	−0.632	−0.703	−0.608	−0.541
	(0.186)	(0.064)	(0.137)	(0.069)	(0.077)	(0.104)	(0.067)
Real minimum wage			−0.311	−0.220	−0.199	−0.133	
			(0.064)	(0.048)	(0.059)	(0.052)	
Real federal minimum wage							−0.161
							(0.044)
Time	0.027	0.016	0.021	0.021			0.019
	(0.006)	(0.001)	(0.005)	(0.002)			(0.002)
Constant	−0.004	0.007	0.017	0.009	−0.000	0.033	0.010
	(0.021)	(0.008)	(0.018)	(0.007)	(0.014)	(0.027)	(0.007)
Time polynomial	1	1	1	1	2	3	1
Observations	25	54	25	54	54	54	54
R-squared	0.271	0.936	0.636	0.957	0.957	0.966	0.951

Notes. Results of estimating equation (1)in columns (1) and (2) and of estimating equation (2) in columns (3)–(7). All regressions are estimated using 2SLS, instrumenting for the "relative supply of college workers" measured as the log relative supply of college-to-noncollege hours worked using the population-based measure. The sample is 1963–1987 in columns (1) and (3) and 1963–2016 elsewhere. "Real minimum wage" and "real federal minimum wage" are the logs of the real minimum wage (which averages across states) and real federal FLSA minimum wage. "Time polynomial" refers to the degree of the polynomial of time; the coefficient on the linear trend on "time" is omitted from the table whenever this polynomial is of degree two or greater. Robust standard errors are reported in parentheses.

Vogel 2025

Distinguishing wages from prices: A composition issue

The KM framework treats average wages as skill prices

- But average wage of college workers $\neq$ price of a unit of college skill
- If the *composition* of workers within education groups changes, average wages move even if prices are constant

Two distinct concepts

- **Wage:** Average earnings of workers with a given credential
- **Price:** Return to a standardized unit of skill (holding quality constant)

Why this matters

- If college graduates in 2020 are lower quality than in 1980 (on average), the stable college premium in *wages* understates the rise in skill *prices*
- Similarly, if high school graduates are negatively selected over time, the falling HS wage understates the true price of HS-level skill

Alternative inequality interpretation: Quality adjustment—Wages versus prices

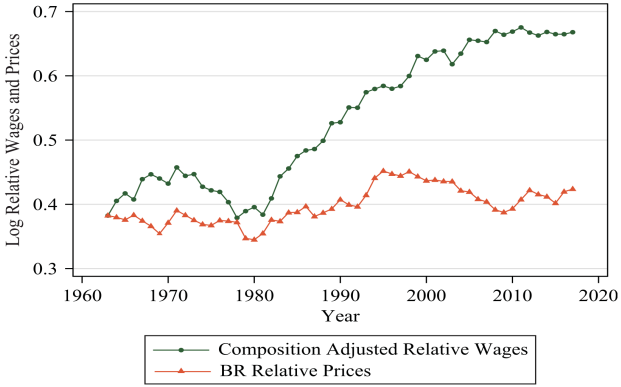


Figure 1

Composition-Adjusted Log Relative Wages and Bowlus and Robinson (2012) Log Relative Prices

Notes: Log relative skill prices, $\ln(\pi_t)$, are normalized to the same 1963 value as composition-adjusted log relative wages, $\ln(w_t^C)$.

Bowlus, Lochner, Robinson, Soleymonoglu 2023

Alternative inequality interpretation: Quality adjustment—Implied quality series

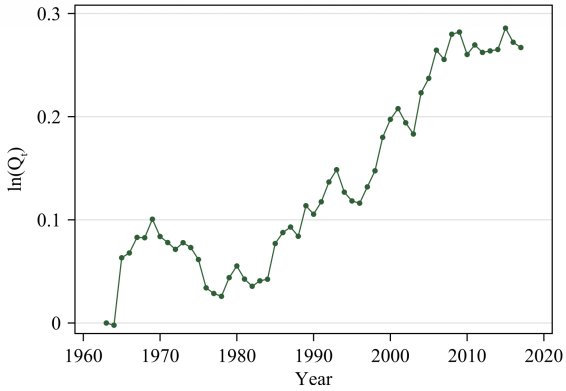


Figure 2

Log Relative Quality, $ln(Q_t)$

Notes: This figure reports deviations in log relative skill quality, $\ln(Q_t) = \ln(H_t/L_t) - \ln(H_t^c/L_t^c)$, from the 1963 value.

Bowlus, Lochner, Robinson, Soleymonoglu 2023

Alternative inequality interpretation: Quality adjusted supply

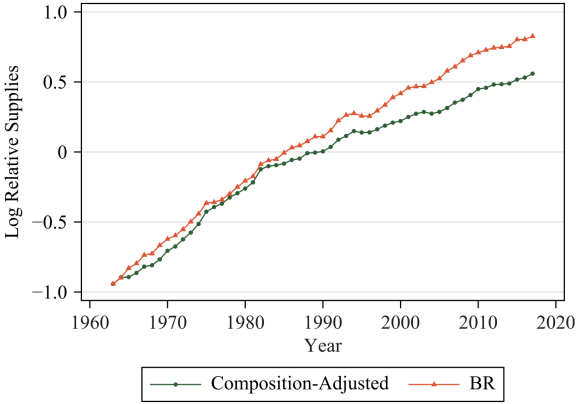


Figure 3

Composition-Adjusted and Bowlus–Robinson Log Relative Supplies

Notes: Bowlus–Robinson log relative skill supplies, $\ln(H_t/L_t)$, are normalized to the same 1963 value as composition-adjusted log relative skill supplies, $\ln(H_t^c/L_t^c)$.

Bowlus, Lochner, Robinson, Soleymonoglu 2023

Agenda

Krusell, Ohanian, Rios-Rull, and Violante, 2000: Declining Log Relative Price of Equipment Capital, 1963 – 1992

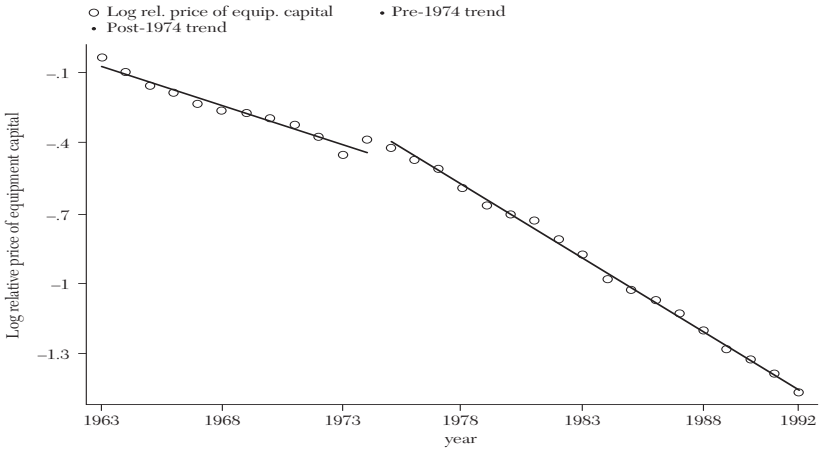


Figure 6. Behavior of the Log Relative Price of Equipment Capital, 1963–92

Krussell, Ohanian, Rios-Rull and Violante, 2000 (reprinted in Acemoglu 2002)

KORRV 2000: An alternative explanation, declining Log relative price of equipment capital, 1963 – 1992

$$G\left(k_{st}, k_{et}, L_t, H_t\right) = k_{st}^{\alpha}\left[\beta L_t^{\delta} + \left(1-\beta\right)\left(\lambda k_{et}^{\rho} + \left(1-\lambda\right) H_t^{\rho}\right)^{\delta/\rho}\right]^{(1-\alpha)/\delta}$$

- k_{st} is structures capital, k_{et} is equipment capital
- α is structure share of output (note: Cobb-Douglas)
- β is the extensive margin technological parameter
- $\sigma_e = 1/\left(1-\rho\right)$ is elasticity btwn H labor and equipment capital k_e
- $\sigma_u = 1/\left(1-\delta\right)$ is elasticity btwn $H + K_e$ aggregate and L

Key condition: $\sigma_u > \sigma_e$

- If σ between L and $(H + K_e)$ is greater than σ between K_e and H, then K_e is a *relative* complement to H
- $\sigma_u > \sigma_e$ implies **equipment-skill complementarity**

Estimation of K-S complementarity model (KORRV 2000)

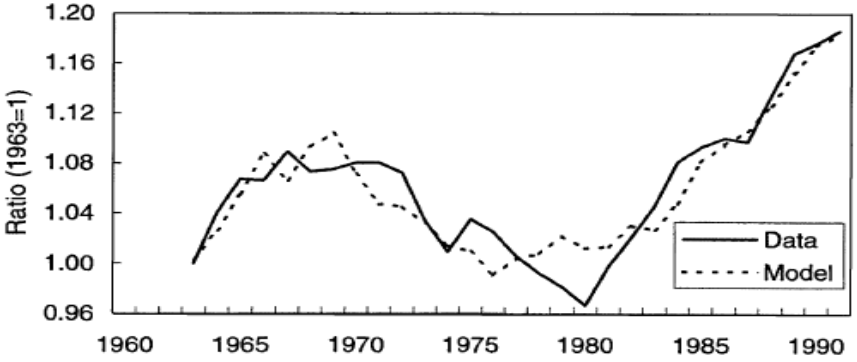
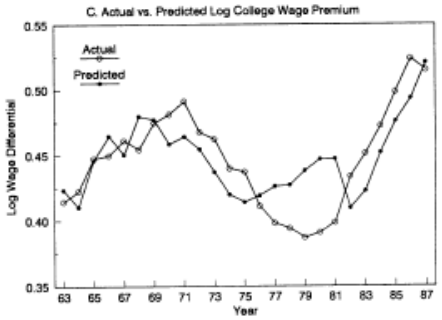


Figure 8. The skill premium: Skilled vs. unskilled wages per hour (normalized with 1963=1).

Krussell, Ohanian, Rios-Rull and Violante, 2000

Does this chart look familiar?



Katz and Murphy 1992

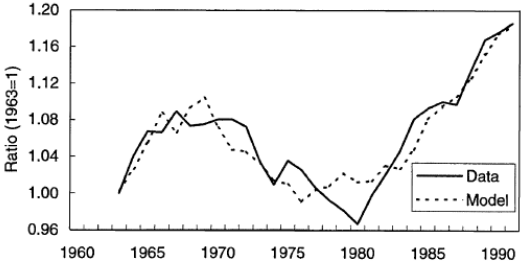


Figure 8. The skill premium: Skilled vs. unskilled wages per hour (normalized with 1963=1).

Krussell, Ohanian, Rios-Rull and Violante, 2000

The problem: Log equipment prices fell nearly linearly over this period—almost perfectly collinear with a time trend. Hard to distinguish capital-skill complementarity from secular skill-biased technical change.

Equipment prices – or time trend?

TABLE 2
THE EFFECT OF THE RELATIVE PRICE OF EQUIPMENT ON SKILLED PREMIA

Dependent variable is log college premium	(1)	(2)	(3)	(4)	(5)
Relative supply	–0.742 (0.053)	–0.388 (0.037)	–0.610 (0.068)	–0.691 (0.100)	–0.740 (0.054)
Time	0.026 (0.002)			0.022 (0.007)	0.024 (0.005)
Log relative price		–0.323 (0.024)		–0.051 (0.084)	
Relative price			–0.875 (0.086)		–0.056 (0.167)
Adjusted R^2	0.900	0.864	0.795	0.898	0.897

Note: This table reports the regression of the log college premium on a linear time trend, the log relative supply of skilled workers and various measures of the relative price of equipment capital. For comparability, all data taken from Krusell et al. (2000).

Acemoglu 2002

Takeaway: This is an *identification problem*, not a refutation of capital-skill complementarity. Both stories may be true—we simply cannot distinguish them with these time-series data. Cross-sectional or quasi-experimental variation would help.

Agenda

1. Topics from now to Lorenzo
2. Course Expectations/Requirements
3. Context: Education and earnings inequality
   - Earnings inequality
   - Broader / different metrics of inequality
   - Productivity, mean and median earnings, labor share
   - Supply of skills
   - Education and inequality
   - Demographics and genentocracy
4. The canonical model
   - Building blocks
   - Technological change and the skill premium
   - Tinbergen and the education race
   - Education race with data: Katz-Murphy '92
   - Capital-skill complementarity
5. **International comparisons of wage inequality: Supply, demand and institutions**

From time-series to cross-sectional variation

So far: U.S. time-series analysis

- Katz-Murphy use *within-country, over-time* variation in H/L and π
- Identification challenge: Hard to separate supply, demand, and institutions when all move together over time

Now: Cross-national comparisons

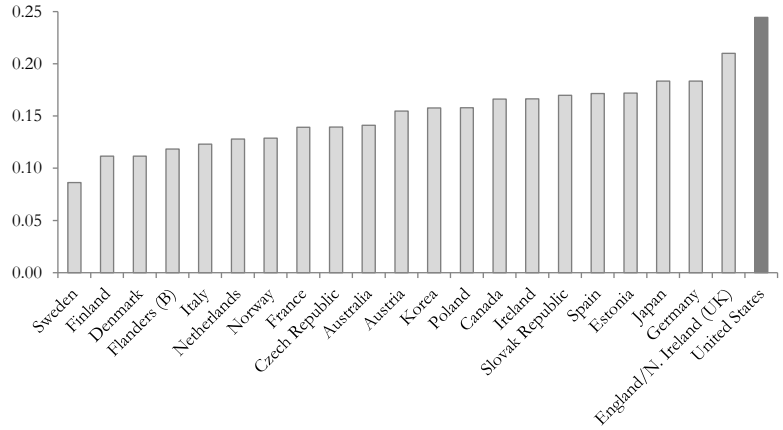
- Same supply-demand logic, but applied *across countries* at a point in time
- Countries differ in skill supplies, demand structures, *and* labor market institutions
- Potentially more variation to exploit—but also more confounds

Key questions:

- How much of cross-country inequality differences reflect skill supply vs. demand vs. institutions?
- Does the supply-demand framework 'work' cross-sectionally?

Cross-national differences in estimated wage returns to PIAAC (2012) skills

Figure 1: Returns to skill



Notes: The figure shows the coefficient on skill from a regression of log hourly wages (including bonuses) for wage and salary earners on standardised numeracy scores.

Broecke, Quintini and Vandeweyer 2016

What explains vast cross-country diffs in skill differentials and wage dispersion?

1. Differences in underlying skill dispersion?
2. Differences in skill prices?
3. Differences in institutions?

Abstract: Blau and Kahn, JPE 1996

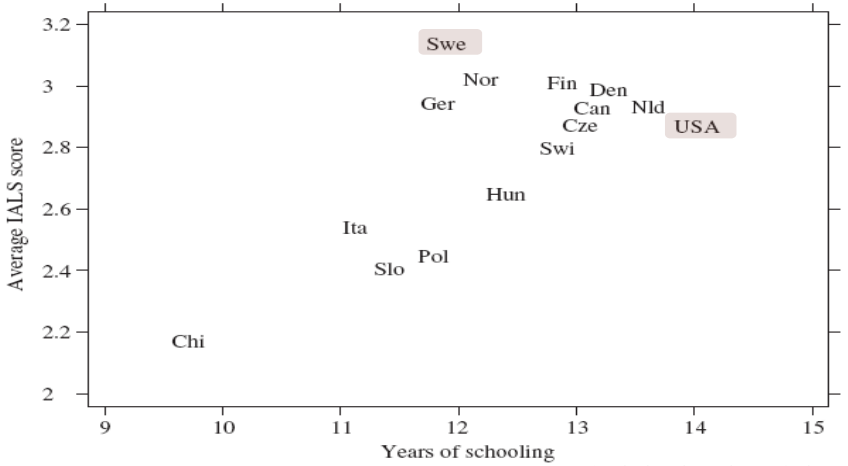
International Differences in Male Wage Inequality: Institutions versus Market Forces

Francine D. Blau
Cornell University and National Bureau of Economic Research

Lawrence M. Kahn
Cornell University

This paper studies the considerably higher level of wage inequality in the United States than in nine other OECD countries. We find that the greater overall U.S. wage dispersion primarily reflects substantially more compression at the bottom of the wage distribution in the other countries. While differences in the distribution of measured characteristics help to explain some aspects of the international differences, higher U.S. prices (i.e., rewards to skills and rents) are an important factor. Labor market institutions, chiefly the relatively decentralized wage-setting mechanisms in the United States, provide the most persuasive explanation for these patterns.

Does more school equal more skill?



Leuven, Oosterbeek and van Ophem 2004

Fig. 1. *Cross Sectional Relation Between Years of Schooling and Skill*

IALS data used by Leuven, Oosterbeek and van Ophem

- *Prose literacy* – the knowledge and skills needed to understand and use information from texts including editorials, news stories, poems and fiction,
- *Document literacy* – the knowledge and skills required to locate and use information contained in various formats, including job applications, payroll forms, transportation schedules, maps, tables and graphics; and
- *Quantitative literacy or numeracy* – the knowledge and skills required to apply arithmetic operations, either alone or sequentially, to numbers embedded in printed materials, such as balancing a checkbook, figuring out a tip, completing an order form or determining the interest on a loan from an advertisement.

A cross-national supply demand analysis: Supply index

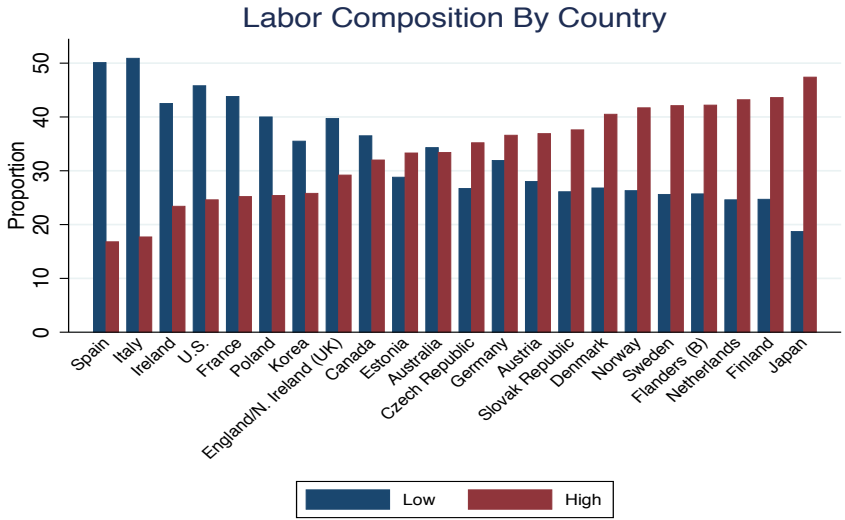
Constructing a skill supply measure: s_{kj}

- Choose a baseline country b, and group workers in *all* countries into three skill groups $k = \{\text{low, medium, high}\}$
- Use as cut-points the values in country b that break the skill distribution (proxied by IALS scores) into three even parts
- For each country $j \neq b$, LOvO form a relative skill *supply index* of:

$$s_{kj} = \ln\left(E_{kj}/E_{kb}\right)$$

where E_{kj}, E_{kb} are the shares of total labor input supplied by skill group k in countries j and b respectively (the latter being equal to $\frac{1}{3}$ by construction)

Labor force skill shares by country: PIAAC terciles 2012



Broecke, Quintini and Vandeweyer (2015)

A cross-national supply demand analysis: Demand index

Demand index d_{kj}:

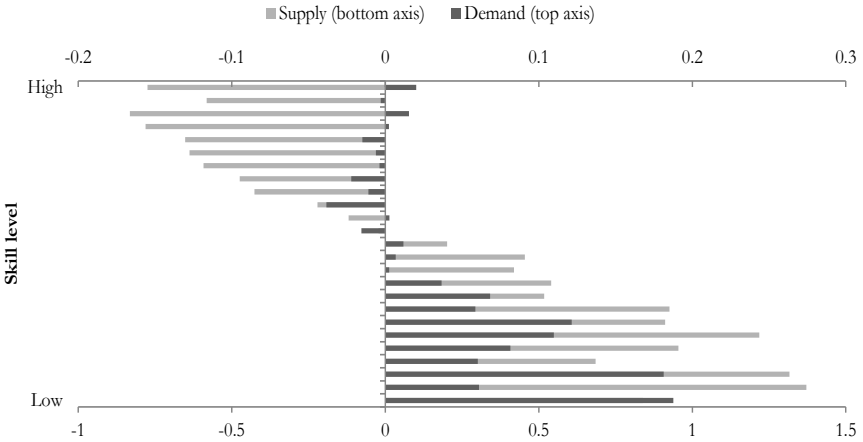
- Let c_{ok} be base emp share in country b in skill group κ in ind-occ cell o
- **Industries**: 1) Agriculture; 2) Mining, manufacturing, and construction; 3) Transportation, communications, and public utilities; 4) Trade; 5) Finance, insurance, real estate, and services; 6) Government
- **Occupations**: 1) Managers and professionals; 2) Clerical and sales workers; 3) Craft workers, operatives, laborers, and service workers

$$d_{kj} = \ln\left(1 + \sum_{0} c_{ok} \frac{\Delta E_{oj}}{E_{kb}}\right)$$

- where ΔE_{oj} is the country j minus country b Δ in emp share in industry-occupation o
- E_{kb} is emp share of skill group k in country b (equal to $\frac{1}{3}$)

Comparing skill supply & demand in US vs Netherlands

Figure 4: The supply of and demand for skills in the United States versus the Netherlands



Broecke, Quintini and Vandeweyer 2016

Demand and supply indices by country relative to the US, 2012 PIAAC

Table 4: The demand for and supply of skills relative to the United States

	Low-level skills*		High-level skills*	
	Demand	Supply	Demand	Supply
Australia	0.002	0.580	0.055	-0.386
Austria	-0.032	0.932	0.068	-0.404
Canada	0.058	0.405	-0.034	-0.326
Czech Republic	-0.086	1.273	0.209	-0.266
Denmark	0.023	1.040	0.016	-0.569
England/N. Ireland (UK)	-0.039	0.303	0.079	-0.194
Estonia	-0.080	1.012	0.107	-0.237
Finland	0.012	1.247	0.031	-0.701
Flanders (B)	0.008	0.918	0.025	-0.624
France	-0.044	0.044	0.087	0.068
Germany	-0.044	0.641	0.112	-0.426
Ireland	-0.036	0.370	0.088	0.162
Italy	-0.149	0.057	0.339	0.644
Japan	-0.003	1.680	0.090	-0.675
Korea	-0.133	0.647	0.211	0.368
Netherlands	0.097	0.928	-0.005	-0.597
Norway	0.058	0.860	-0.001	-0.623
Poland	-0.084	0.341	0.167	0.041
Slovak Republic	-0.085	0.845	0.074	-0.315
Spain	-0.093	-0.035	0.258	0.796
Sweden	-0.027	0.894	0.023	-0.656

*Low (high)-level skills are defined as the bottom (top) ten skills intervals (out of a total of 25).

Estimating equation

Regressing rel. wage gap on rel. supply-demand gap:

- Define w_{kj} as the mean relative wage of skill group k relative to a base skill group in country j
- LOvO estimate the following model for relative wages:

$$(w_{kj} - w_{kb}) = \alpha + \beta \left[(s_{kj} - d_{kj}) - (s_{kb} - d_{kb}) \right] + \varepsilon_j$$

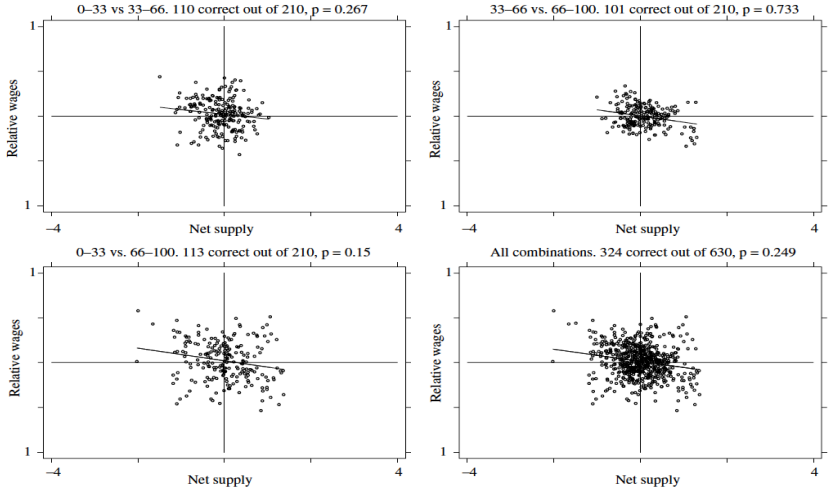
In fact, they do this as a diff-in-diff

- Let Δ equal the difference between two skill groups k (e.g., $w_{Hj} - w_{Lj}$ or $w_{Hj} - w_{Mj}$

$$(\Delta w_{kj} - \Delta w_{kb}) = \alpha + \beta \left[(\Delta s_{kj} - \Delta d_{kj}) - (\Delta s_{kb} - \Delta d_{kb}) \right] + \varepsilon_j$$

What's the expected sign of β?

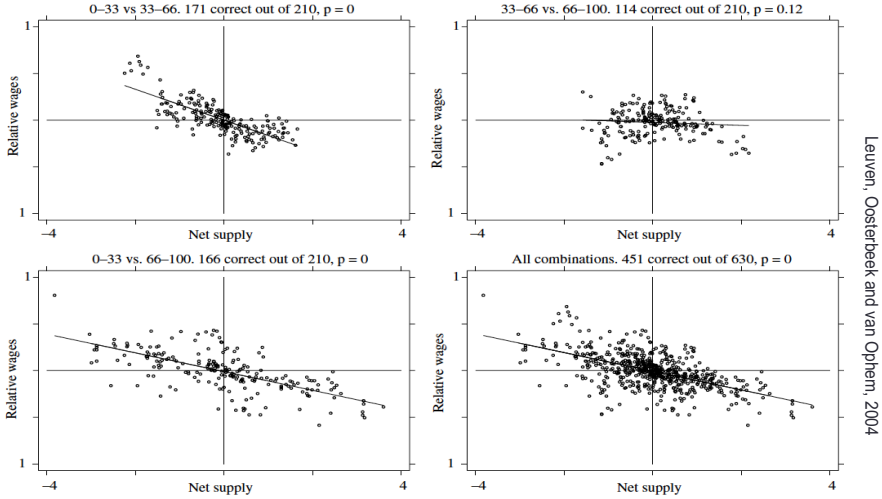
Leuven et al: Fit using years of schooling



Leuven, Oosterbeek and van Ophem, 2004

Fig. 2. *Relative Wages and Net Supply, S_{BK}*

Leuven et al: Fit using IALS scores



Leuven, Oosterbeek and van Ophem, 2004

Fig. 3. *Relative Wages and Net Supply, S_{IALS}*

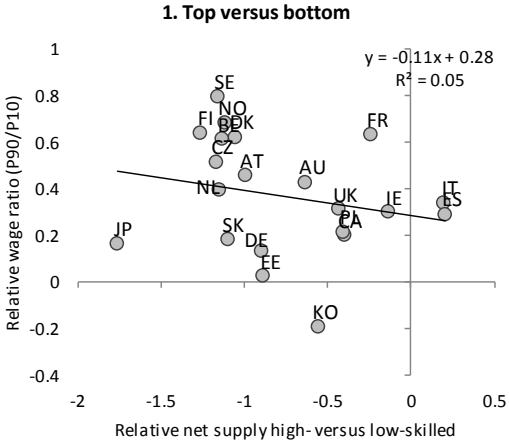
Broecke et al. update of LoVo: Cross-country regressions for 90/50 wage gaps (relative to U.S.)

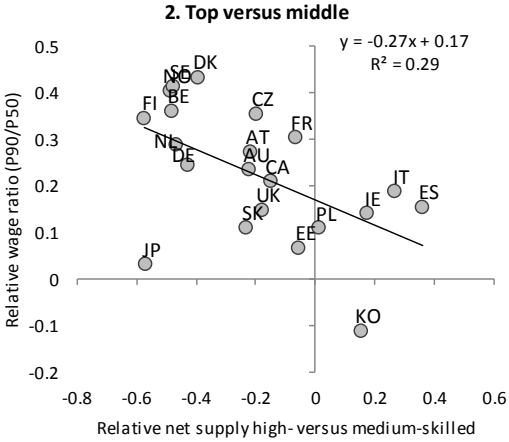
Panel (ii) Dependent variable: P90/P50 (in logs, relative to US)

	(i)	(ii)	(iii)	(iv)	(v)	(vii)	(vii)
Net supply of skills (high v. medium)	-0.270**	-0.198*	-0.263**	-0.179***	-0.187***	-0.250**	-0.163***
	0.11	0.095	0.101	0.042	0.063	0.1	0.031
Statutory minimum wage (MW dummy)[a]		-0.178*					0.039
		0.088					0.075
Level of minimum wage[b] x MW dummy		-0.325					0.136
		0.285					0.226
Employment protection legislation[c]			-0.237**				-0.029
			0.11				0.109
Union coverage				-0.161***			-0.123***
				0.019			0.029
Size of public sector[d]					-0.207***		-0.105**
					0.045		0.048
Generosity of unemployment benefits[e]						-0.283***	-0.054
						0.08	0.047
Constant	0.170***	0.263***	0.006	-0.027	0.176***	0.073*	-0.028
	0.032	0.039	0.087	0.027	0.024	0.036	0.088
N	*21*	*21*	*21*	*21*	*21*	*21*	*21*
R^2	*0.288*	*0.507*	*0.385*	*0.812*	*0.657*	*0.539*	*0.889*
Adjusted R^2	*0.25*	*0.42*	*0.317*	*0.792*	*0.619*	*0.488*	*0.829*

Broecke, Quintini and Vandeweyer (2016)

Broecke update of LOvO analysis for 90/10 and 90/50 gaps using PIAAC 2012





Broecke, Quintini and Vandeweyer '15

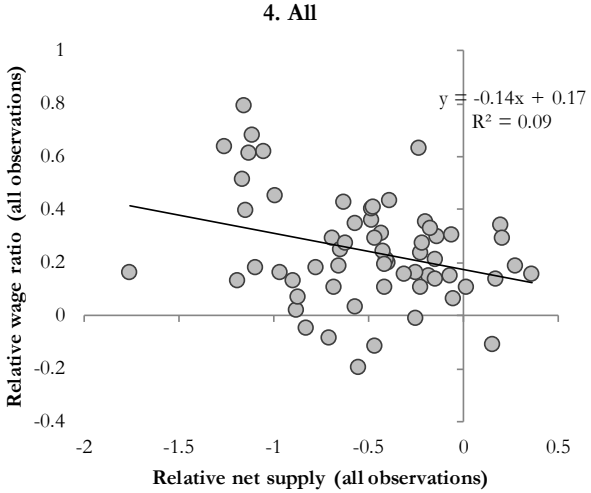
Broecke et al. update of LoVo: Cross-country regressions for 50/10 wage gaps (relative to U.S.)

Panel (iii) Dependent variable: P50/P10 (in logs, relative to US)

	(i)	(ii)	(iii)	(iv)	(v)	(vii)	(vii)
Net supply of skills (medium v. low)	0.027	-0.105	0.03	-0.053	-0.038	-0.003	-0.14
	0.07	0.084	0.066	0.066	0.086	0.079	0.08
Statutory minimum wage (MW dummy)[a]		-0.185**					-0.033
		0.081					0.096
Level of minimum wage[b] x MW dummy		-0.605**					-0.337
		0.227					0.213
Employment protection legislation[c]			-0.135				0.067
			0.157				0.185
Union coverage				-0.131***			-0.119*
				0.029			0.062
Size of public sector[d]					-0.182***		-0.101
					0.058		0.087
Generosity of unemployment benefits[e]						-0.153	0.091
						0.099	0.097
Constant	0.160***	0.135	0.067	-0.061	0.114**	0.089	-0.038
	0.048	0.079	0.097	0.057	0.05	0.061	0.12
N	*21*	*21*	*21*	*21*	*21*	*21*	*21*
R^2	*0.004*	*0.29*	*0.042*	*0.411*	*0.347*	*0.087*	*0.58*
Adjusted R^2	*-0.049*	*0.165*	*-0.065*	*0.346*	*0.274*	*-0.015*	*0.354*

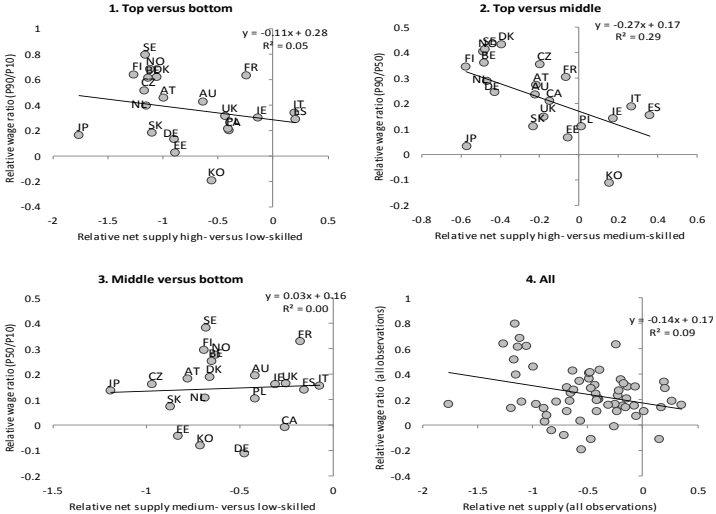
Broecke, Quintini and Vandeweyer (2016)

Broecke update of LOvO analysis for All gap: 90/10, 90/50, & 50/10



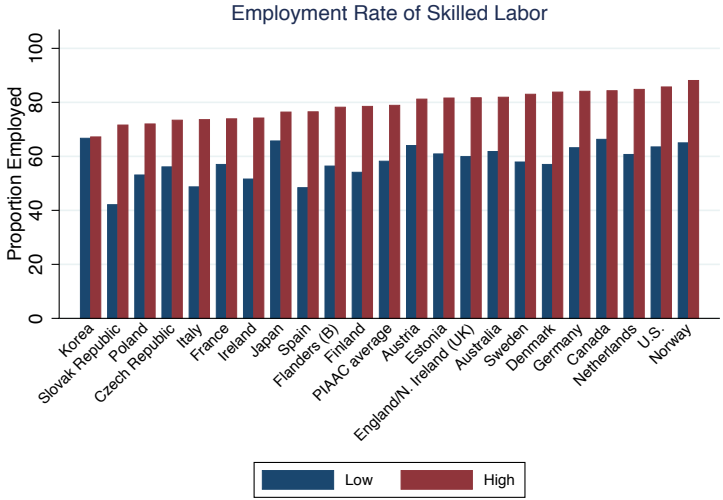
Broecke, Quintini and Vandeweyer '15

Broecke update of LOvO analysis for 90/50/10 gaps using PIAAC 2012



Broecke, Quintini and Vandeweyer '15

Employment rates of top and bottom skill terciles by country: PIAAC 2012



Broecke, Quintini and Vandeweyer (2016)

Employment rates by skill tercile: PIAAC 2012

	Employment rate		
	Low-skilled	Medium-skilled	High-skilled
Australia	61.8	76.8	81.9
Austria	64.0	72.7	81.2
Canada	66.3	78.4	84.3
Czech Republic	56.1	65.0	73.4
Denmark	57.0	73.9	83.8
England/N. Ireland (UK)	59.9	74.4	81.7
Estonia	60.9	71.8	81.6
Finland	54.1	70.8	78.5
Flanders (B)	56.4	70.0	78.2
France	57.0	65.6	73.9
Germany	63.2	77.6	84.1
Ireland	51.6	64.5	74.2
Italy	48.7	59.2	73.6
Japan	65.7	70.1	76.4
Korea	66.7	68.1	67.2
Netherlands	60.7	75.9	84.8
Norway	65.0	77.7	88.1
Poland	53.1	63.3	72.0
Slovak Republic	42.1	62.8	71.6
Spain	48.4	64.9	76.5
Sweden	57.9	73.9	83.0
United States	63.5	78.4	85.7
PIAAC average	58.2	70.7	78.9

Broecke, Quintini and Vandeweyer (2016)