Graduate Labor Economics

Lecture 3: The College Wage Premium and the "Canonical Model"

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Where we are in the course

- Four lectures on the "neoclassical" wage structure
  1. The college wage premium
  2. Skill-biased technical change
  3. The task structure of employment
  4. Job amenities and compensating differentials
- Then incorporate frictions

Today's lecture

- A first look at inequality
    - College wage premium
    - Experience premium
    - Residual inequality
- A supply-demand framework
    - Katz and Murphy (1992)
    - Subsequent extensions

Notions of inequality

- Different types of inequality:
  - Wage inequality ($w_i e_i$)
  - Earnings inequality ($w_i e_i h_i$)
  - Compensation inequality ($w_i e_i h_i + b_i$)
  - Income, wealth, consumption ...
- Another dimension: cross-sectional, life-cycle, intergenerational
- Our focus: cross-sectional wage inequality
  - Competitive markets + no amenities: $w = MPL$
  - Question: how does the market reward skill?

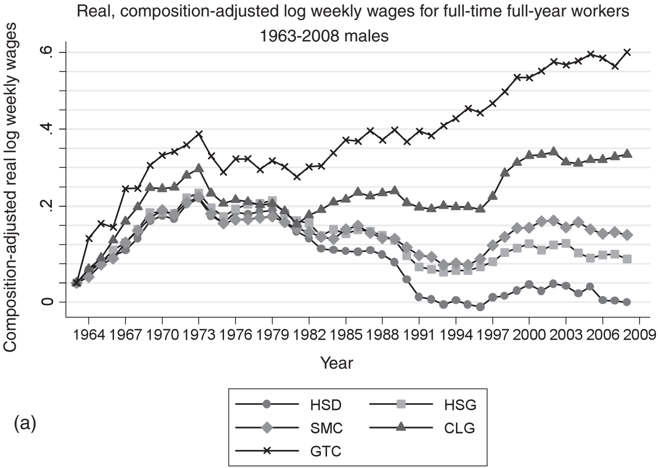
Measures of inequality

- Lots of different statistical measures:
  - Variance
  - Gini coefficient
  - Quantiles
- "Between-group" and "within-group" (residual)
  - $\text{Var}(y_i) = \text{Var}(\mathbb{E}(y_i \mid x_i)) + \mathbb{E}(\text{Var}(y_i \mid x_i))$
  - Model-dependent: which x's are we using?
- "Overall", "lower-tail", and "upper-tail"
  - log 90–10, log 50–10, and log 90–50
  - $\log\left(\frac{w_{90}}{w_{10}}\right) = \log\left(\frac{w_{90}}{w_{50}}\right) + \log\left(\frac{w_{50}}{w_{10}}\right)$
- Practical issues:
  - Measurement error
  - Topcoding (right-censoring)

Cross-sectional regularities

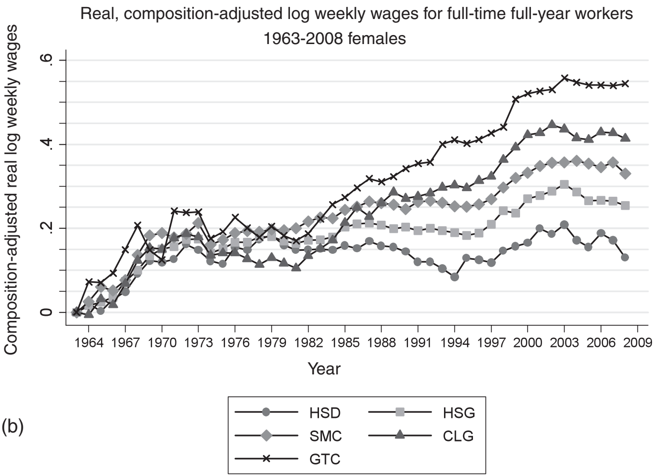
- Demographic disparities:
  - Gender wage gap
  - Black-white wage gap
  - College wage premium
  - Returns to experience
- Firm-side regularities:
  - Union wage premium
  - Firm size premium
  - Exporter premium
  - "AKM effects"
- Today: focus on college premium
  - Big share of wage inequality (level and trend)
  - Central to academic + policy debates

Rising wage gaps across education groups: men



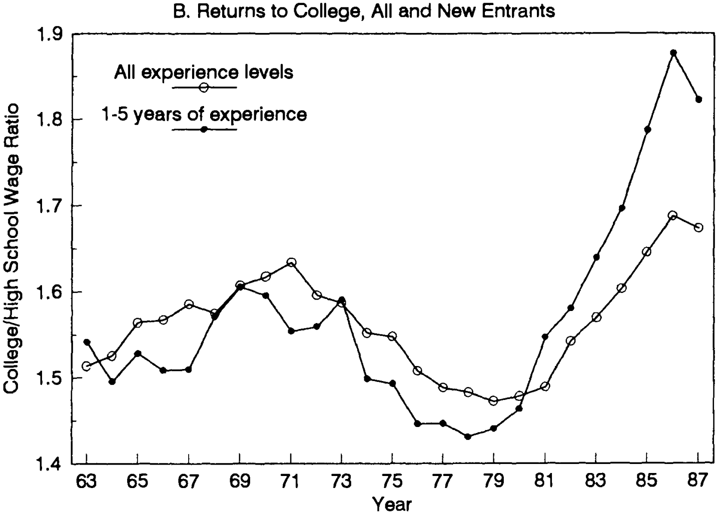
(Acemoglu and Autor, 2011, Figure 4a)

Rising wage gaps across education groups: women



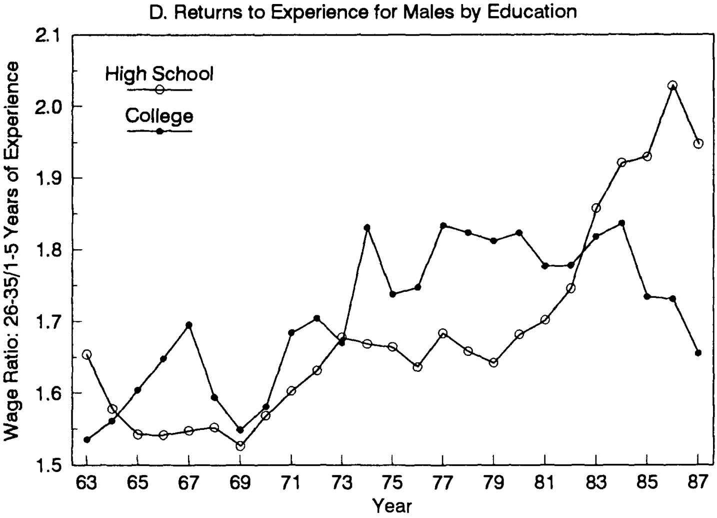
(Acemoglu and Autor, 2011, Figure 4b)

The rise, fall, and rise of the college wage premium



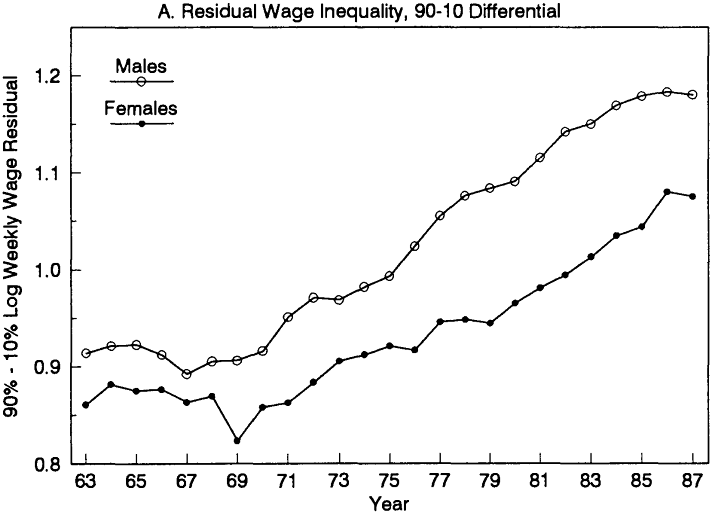
(Katz and Murphy, 1992, Figure 1b)

The rising return to (potential) experience



(Katz and Murphy, 1992, Figure 1d)

The growth of residual inequality



(Katz and Murphy, 1992, Figure 2a)

Katz and Murphy (1992)

- General impression: rising return to "skill"
  - Observed determinants: education, experience
  - Unobserved determinants: talent, work ethic
- Tinbergen (1974): race between education and technology
  - Skill-biased technical change raises the return to skill
  - Rising educational attainment depresses the return to skill
- Katz and Murphy (1992) formalize Tinbergen's race
  - Secular skill-biased changes in demand
  - Fluctuations in relative skill supplies
- Very influential: "canonical model" of the skill premium

Ingredient #1: changes in relative demand

- Aggregate production $F(X_t)$ is a function of K labor inputs
- (Conditional) factor demands

$$X_t = D(W_t, Z_t)$$

where W_t are factor prices, Z_t are demand shifters

- Totally differentiate: $dX_t = D_w dW_t + D_z dZ_t$
- Concave production function $\implies D_w$ negative semidefinite

$$dW_t'(dX_t - D_z dZ_t) = dW_t' D_w dW_t \leq 0$$

- If relative demand is stable $(dZ_t = 0)$,

$$dW_t' dX_t \leq 0$$

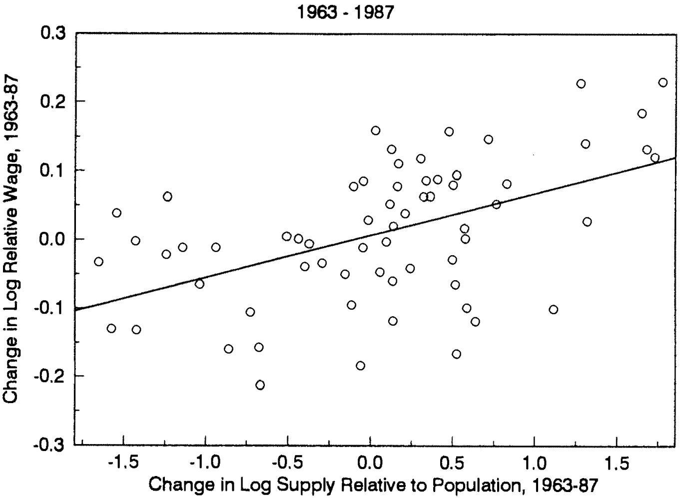
Testing for stable (relative) demand

- Let's take this idea to the data
- Discrete version of the inequality:

$$\Delta W_t' \Delta X_t \leq 0$$

- Divide the workforce into 64 cells:
  - 2 sexes $\times$ 4 education groups $\times$ 8 experience groups
- "One-sided test":
  - If $\Delta W_t' \Delta X_t > 0$, data *reject* stable demand
  - If $\Delta W_t' \Delta X_t \leq 0$, data *fail to reject* stable demand

Employment + wage changes reject stable demand

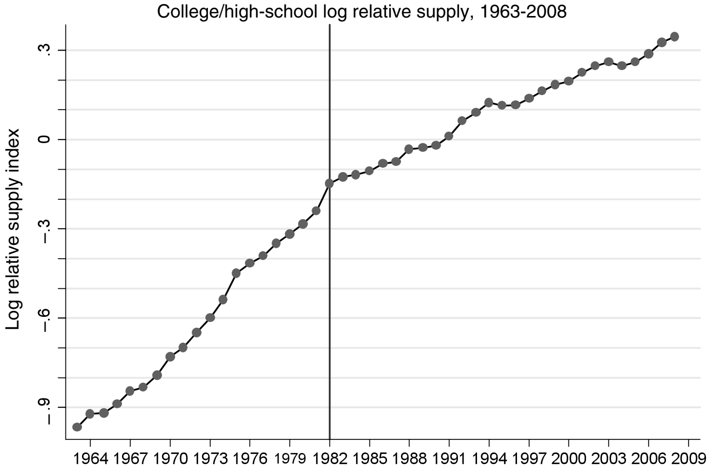


(Katz and Murphy, 1992, Figure 3)

Measuring changes in relative demand

- Section V tries to quantify shifts in relative demand
- Basic idea: do sectoral shifts favor certain groups?
  - Essentially a "Bartik instrument"
  - We'll discuss these later in the course
- Skip in interest of time . . . but main takeaways:
  - Between-sector shifts towards college grads, women
  - Residual demand shifts within sectors

Ingredient #2: changes in relative supply



(Acemoglu and Autor, 2011, Figure 2)

The "canonical model" combines these elements

- CES aggregate production function

$$F(L_t, H_t) = \left[(A_{Lt}L_t)^{\rho} + (A_{Ht}H_t)^{\rho}\right]^{\frac{1}{\rho}}$$

- Letting $e_{it} \equiv$ efficiency and $h_{it} \equiv$ hours worked,

$$L_t = \sum_{i \in \mathcal{L}} e_{it}h_{it}, \quad H_t = \sum_{i \in \mathcal{H}} e_{it}h_{it}$$

- Multiple interpretations
  - Low-skill and high-skill tasks within each firm
  - Low-skill and high-skill sectors
  - Some mix of both
- Strong assumptions (relaxed in subsequent literature)
  - Exogenous technology
  - Exogenous skill supplies
  - Ignore capital-skill complementarity

Deriving the skill premium

- Cost minimization: $w = MPL$

$$w_{Ht} = A_{Ht}^{\rho} H_t^{\rho-1} \left[(A_{Lt} L_t)^{\rho} + (A_{Ht} H_t)^{\rho}\right]^{\frac{1-\rho}{\rho}}$$

- Factor price ratio $= MRTS$

$$\frac{w_{Ht}}{w_{Lt}} = \left(\frac{A_{Ht}}{A_{Lt}}\right)^{\rho} \left(\frac{H_t}{L_t}\right)^{\rho-1}$$

- Take logs, define $\sigma \equiv \frac{1}{1-\rho}$

$$\log\left(\frac{w_{Ht}}{w_{Lt}}\right) = \underbrace{\frac{\sigma-1}{\sigma} \log\left(\frac{A_{Ht}}{A_{Lt}}\right)}_{\text{relative demand effect}} - \underbrace{\frac{1}{\sigma} \log\left(\frac{H_t}{L_t}\right)}_{\text{relative supply effect}}$$

From theory to empirics

- Rewrite the skill premium equation:

$$\log\left(\frac{w_{Ht}}{w_{Lt}}\right) = D_t - \frac{1}{\sigma}\log\left(\frac{H_t}{L_t}\right)$$

- Looking like a regression equation, but ...
    - How do we measure the skill premium?
    - How do we measure skill supplies?
    - How do we model D_t?

Data and sample construction

- Data: March Current Population Survey (CPS)
  - Survey years 1964–1988 $\Longrightarrow$ earnings years 1963–1987
  - "Wage" $\equiv$ annual earnings / annual weeks worked
- Two separate samples (why?):
  - Wage sample: full-time wage and salary workers
  - Count sample: everyone who worked at all

Defining college and high school equivalents

- Need to aggregate into two skill groups
  - 12 years of schooling: 1 high school equivalent
  - 16+ years of schooling: 1 college equivalent
  - Less than high school? some college?

- Assume some-college is a mix of both types:

$$w_{SMC} = \lambda_{HSG} w_{HSG} + \lambda_{CLG} w_{CLG}$$

- Regress SMC wages on HSG and CLG wages
  - SMC = 0.29 HSG + 0.69 CLG

- Do the same for less than high school
  - <HS = 0.93 HSG − 0.05 CLG

Computing skill supplies and the skill premium

- KM want composition-adjusted supplies and skill premium
  - Goal: isolate changes in price per efficiency unit
- Split workers into sex × experience cells
- Composition-adjusted supply of low-skill labor:

$$L_t = 0.93 \sum_{c \in <\text{HS}} e_c h_{ct} + 1.00 \sum_{c \in \text{HSG}} e_c h_{ct} + 0.29 \sum_{c \in \text{SMC}} e_c h_{ct}$$

  where e_c is the cell's "efficiency" (mean wage over 1963–1987)
- Analogous calculation for supply of high-skill labor
- Similar procedure for skill premium

Estimating the model

- Recall our skill-premium equation:

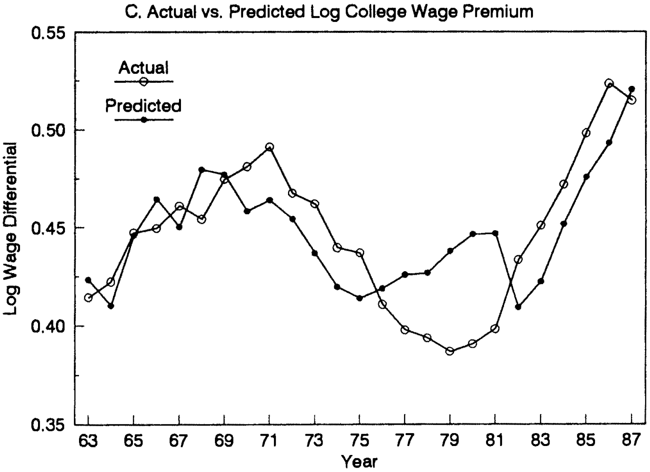
$$\log\left(\frac{w_{Ht}}{w_{Lt}}\right) = D_t - \frac{1}{\sigma}\log\left(\frac{H_t}{L_t}\right)$$

- Assume D_t is a linear trend plus noise:

$$\log\left(\frac{w_{Ht}}{w_{Lt}}\right) = \alpha_0 + \alpha t + \beta\log\left(\frac{H_t}{L_t}\right) + \varepsilon_t$$

- Results: $\widehat{\log\left(\frac{w_{Ht}}{w_{Lt}}\right)} = \text{constant} + 0.033t - 0.709\log\left(\frac{H_t}{L_t}\right)$
  - Implies that $\hat{\sigma} = \frac{1}{\hat{\beta}} = 1.41 \implies \hat{\sigma} > 1$
  - Secular demand shift of ∼3.3 percent per year

Model fits well (except for late 1970s)



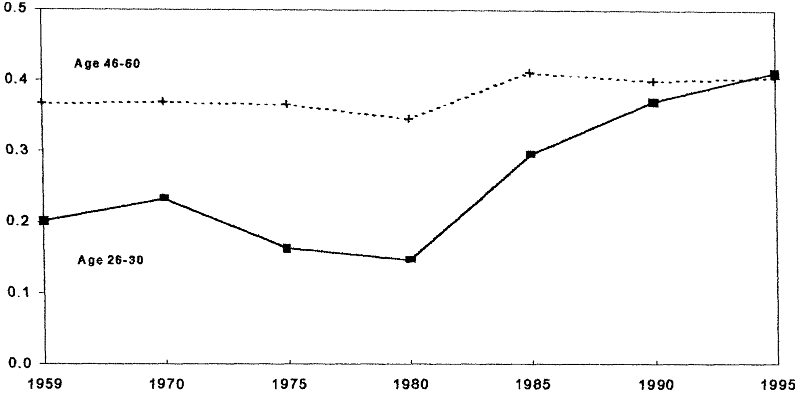
(Katz and Murphy, 1992, Figure 4C)

Subsequent extensions

- KM1992 has stimulated decades of research
- We'll touch on two noteworthy extensions:
  - Card and Lemieux (2001)
  - Krusell et al. (2000)
- Other extensions (not covered):
  - Acemoglu (1998): endogenous technical change
  - Carneiro and Lee (2011): changes in "quality" of college grads
  - Bowlus et al. (2017): further adjustments for cohort composition

Extension #1: Card and Lemieux (2001)

College wage premium among younger/older US workers:



(Card and Lemieux, 2001, Figure 1A)

Extension #1: Card and Lemieux (2001)

- Puzzle: why did skill premium rise only for young workers?
  - Canonical model: same proportional change for all age groups
  - Also implicit in the Mincer equation
- Card and Lemieux: imperfect substitution between age groups
- Nested CES: $Y_t = [(A_{Lt}L_t)^\rho + (A_{Ht}H_t)^\rho]^{\frac{1}{\rho}}$, but

$$L_t = \left(\sum_j (L_{jt})^\eta\right)^{\frac{1}{\eta}}, \quad H_t = \left(\sum_j (H_{jt})^\eta\right)^{\frac{1}{\eta}}$$

- Age-specific skill premium now depends on skill supplies by age
- Educational slowdown $\implies$ rising skill premium for the young

Extension #2: Krusell et al. (2000)

- Standard explanation for rise in $\frac{w_H}{w_L}$: skill-biased demand shifts
- An alternative explanation: capital-skill complementarity
  - Three factors: unskilled labor, skilled labor, capital
  - Nested CES: $Y_t = \left[u_t^\eta + (k_t^\rho + s_t^\rho)^{\eta/\rho}\right]^{1/\eta}$
  - Elasticities $\sigma_{ku} \equiv \frac{1}{1-\eta}$, $\sigma_{ks} \equiv \frac{1}{1-\rho}$, $\sigma_{ku} > \sigma_{ks}$
- Equipment capital is getting cheaper $\implies$ growing capital stock
- Krusell et al. argue that this explains secular rise in skill premium

Wrap-up

- Major facts:
  - Across-the-board rise of wage inequality
  - Rise, fall, and rise of the college wage premium
- Leading paradigm: canonical model
  - Skill-biased demand shifts
  - Fluctuations in relative skill supplies
- Next class: where did these demand shifts come from?
  - Skill-biased shifts in product demand
  - Skill-biased technical change (SBTC)