The Allocation of Talent and U.S. Economic Growth

Chang-Tai Hsieh
Erik Hurst
Chad Jones
Pete Klenow

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Big changes in the occupational distribution

White Men in 1960:

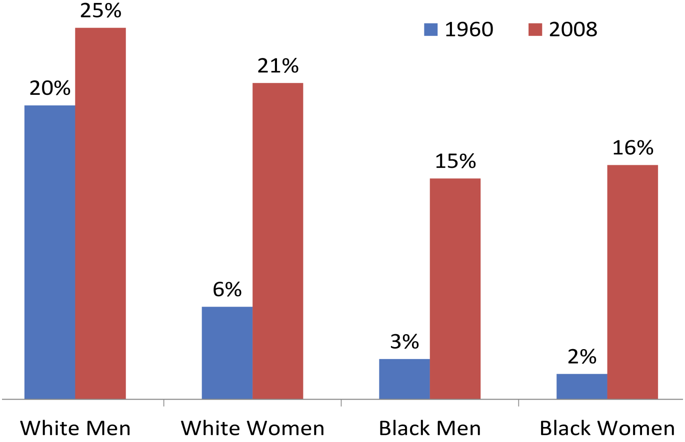
94% of Doctors, 96% of Lawyers, and 86% of Managers

White Men in 2008:

63% of doctors, 61% of lawyers, and 57% of managers

Sandra Day O'Connor...

Share of Each Group in High Skill Occupations



High-skill occupations are lawyers, doctors, engineers, scientists, architects, mathematicians and executives/managers.

Our question

Suppose distribution of talent for each occupation is **identical** for whites, blacks, men and women.

Then:

- Misallocation of talent in both 1960 and 2008.
- But *less* misallocation in 2008 than in 1960.

How much of productivity growth between 1960 and 2008 was due to the better allocation of talent?

Outline

1. Model
2. Evidence
3. Counterfactuals

Model

- N occupations
- Live for three periods (“young”, “middle age”, “old”)
- Draw talent in each occupation $\{\epsilon_i\}$ and at home
- Young: Choose lifetime occupation (i) and human capital (s, e)
- All ages: Decide to work or stay at home

Preferences	$U = c_y^{\beta} c_m^{\beta} c_o^{\beta} (1-s) z$
Human capital	$h = s^{\phi_i} \, e^{\eta} \, \epsilon$
Consumption	$c = (1-\tau_w) w h - (1+\tau_h) e$

What varies across occupations/groups/cohorts

w_{it} = the wage per unit of human capital in occupation i (endogenous)

ϕ_{it} = the elasticity of human capital wrt time invested for occupation i

τ^{w}_{igt} = labor market barrier facing group g in occupation i (time effect)

τ^{h}_{igc} = human capital barrier facing group g for i (cohort effect)

z_{igc} = preference for occupation i by group g (cohort effect)

Timing

- Individuals draw and observe an ϵ_i for each occupation.
  - See current ϕ_i, τ_{ig}^w, τ_{ig}^h, and z_{ig}.
  - Anticipate w_i

$\Rightarrow$ choose occupation, s, and e.

- Then observe ϵ^{home}
  - Decide to work or stay home when young.
- Age to next stage of life
  - See new τ_{ig}^w and w_i
  - Decide to work or stay home.

Some Possible Barriers

Acting like τ^w

- Discrimination in the labor market.

Acting like τ^h

- Family background.
- Quality of public schools.
- Discrimination in school admissions.

Individual Choices

The solution to an individual's utility maximization problem, given an occupational choice:

$$s_i^* = \frac{1}{1+\frac{1-\eta}{e\beta\phi_i}}$$

$$e_{ig}^*(\epsilon) = \left(\frac{\eta(1-\tau_i^w w_i s_i^{\phi_i}\epsilon}{1+\tau_i^h}\right)^{\frac{1}{1-\eta}}$$

$$U(\tau_{ig}, w_i, \epsilon_i) = \bar{\eta}^\beta \left(\frac{w_i s_i^{\phi_i}[z_i(1-s_i)]^{\frac{1-\eta}{3\beta}}\epsilon_i}{\tau_{ig}}\right)^{\frac{3\beta}{1-\eta}}$$

where $\quad \tau_{ig} \equiv \frac{(1+\tau_{ig}^h)^\eta}{1-\tau_{ig}^w}$

The Distribution of Talent

We assume independent **Fréchet** for each occupation:

$$F_i(\epsilon) = \exp(-\epsilon^{-\theta})$$

- McFadden (1974), Eaton and Kortum (2002)
- θ governs the dispersion of skills

Home sector talent drawn from this same distribution.

Result 1: Occupational Choice

$$U_{ig} = \left(\tilde{w}_{ig}\epsilon_i\right)^{\frac{3\beta}{1-\eta}}$$

Extreme value theory: $U(\cdot)$ is Fréchet $\Rightarrow$ so is $\max_i U(\cdot)$

Let p_{ig} denote the fraction of people in group g that work in occupation i:

$$p_{ig} = \frac{\tilde{w}_{ig}^{\theta}}{\sum_{s=1}^{N} \tilde{w}_{sg}^{\theta}} \quad \text{where} \quad \tilde{w}_{ig} \equiv \frac{w_i s_i^{\phi_i} \left[z_{ig}(1-s_i)\right]^{\frac{1-\eta}{3\beta}}}{\tau_{ig}}.$$

Note: $\tilde{w}_{ig}$ is the reward to working in an occupation for a person with average talent

Result 2: Labor Force Participation

$LFP_{ig}(c,t) \equiv$ fraction of people in i,c,g at time t who decide to work.

$$LFP_{ig}(c,t) = \frac{1}{1 + \tilde{p}_{ig}(c) \cdot \left[\frac{\Omega_g^{home}(c)}{(1-\tau_{ig}^w(t))\cdot w_i(t)}\right]^{\theta}}.$$

We do not observe $\tilde{p}$ or LFP. But their product is the observed fraction of people of a cohort-group actually working in an occupation, p_{ig}:

$$\underbrace{p_{ig}(c,t)}_{\text{observed}} = \underbrace{\tilde{p}_{ig}(c)}_{\text{occ choice}} \cdot \underbrace{LFP_{ig}(c,t)}_{\text{lfp}}.$$

Result 3: Average Quality of Workers

- The average quality of workers in each occupation is

$$\mathbb{E}\left[h_{ig}(c,t)\cdot\epsilon_{ig}(c,t)\right]=\gamma s_i(c)^{\phi_i(t)}.$$

$$\left[\left(\frac{\eta\cdot s_i(c)^{\phi_i(c)}\cdot w_i(c)\cdot(1-\tau^w_{ig}(c))}{1+\tau^h_{ig}(c)}\right)^{\eta}\left(\frac{1}{p_{ig}(c,t)}\right)^{\frac{1}{\theta}}\right]^{\frac{1}{1-\eta}}$$

- $\uparrow p_{ig} \Rightarrow$ lower average quality (other things equal)...

Result 4: Occupational Earnings

- Let $\overline{\text{wage}}_{ig}(c,t)$ denote average earnings in occupation i by group g.
- Then wage of young cohort is

$$\begin{aligned}\overline{\text{wage}}_{ig}(t,t) &\equiv (1-\tau^w_{ig}(t))\cdot w_i(t)\cdot\ \mathbb{E}\left[h_{ig}(c,t)\cdot\epsilon_{ig}(c,t)\right]\\ &=\gamma\bar{\eta}\ \left(\frac{m_g(t,t)}{LFP_{ig}(t,t)}\right)^{\frac{1}{\theta}\cdot\frac{1}{1-\eta}}\cdot\left[(1-s_i(c))z_{ig}(c)\right]^{-\frac{1}{3\beta}}\end{aligned}$$

where $m_g(c,t)=\sum_{i=1}^{M}\tilde{w}_{ig}(c,t)^{\theta}$.

- So occupational wage gaps depend only on LFP and z_{ig}.

Occupational Choice

- Focusing only on the young (who make occupational decisions):

$$\frac{p_{ig}}{p_{i,wm}} = \left(\frac{\tau_{ig}}{\tau_{i,wm}}\right)^{-\theta} \left(\frac{\overline{\text{wage}}_{ig}}{\overline{\text{wage}}_{i,wm}}\right)^{-\theta(1-\eta)}$$

- Misallocation of talent comes from **dispersion** of τ's across occupation-groups.

- This equation allows us to recover τ_{ig}...

Inferring Barriers

$$\frac{\tau_{ig}}{\tau_{i,wm}} = \left(\frac{p_{ig}}{p_{i,wm}}\right)^{-\frac{1}{\theta}} \left(\frac{\overline{\text{wage}}_{ig}}{\overline{\text{wage}}_{i,wm}}\right)^{-(1-\eta)}$$

We infer high τ barriers for a group with low average wages.

We infer particularly high barriers when a group is underrepresented in an occupation.

We pin down the *levels* by assuming $\tau_{i,wm} = 1$.

Aggregates

Human Capital $H_i = \sum_{g=1}^{G} \int h_{jgi} \, dj$

Production $Y = \left(\sum_{i=1}^{I} (A_i H_i)^{\rho} \right)^{1/\rho}$

Expenditure $Y = \sum_{i=1}^{I} \sum_{g=1}^{G} \int (c_{jgi} + e_{jgi}) \, dj$

Competitive Equilibrium

1. Given occupations, individuals choose c, e, s to maximize utility.
2. Each individual chooses the utility-maximizing occupation.
3. A representative firm chooses H_i to maximize profits:

$$\max_{\{H_i\}} \left(\sum_{i=1}^{I} (A_i H_i)^{\rho} \right)^{1/\rho} - \sum_{i=1}^{I} w_i H_i$$

4. The occupational wage w_i clears each labor market:

$$H_i = \sum_{g=1}^{G} \int h_{jgi} \, dj$$

5. Aggregate output is given by the production function.

A Special Case

- Live for one period only
- $\sigma = 1$ so that $w_i = A_i$.
- 2 groups, men and women.
- $\phi_i = 0$ (no schooling time).

$$\overline{wage}_m = \left(\sum_{i=1}^{N} A_i^{\theta} \right)^{\frac{1}{\theta} \cdot \frac{1}{1-\eta}}$$

$$\overline{wage}_f = \left(\sum_{i=1}^{N} \left(\frac{A_i \left(1 - \tau_i^w\right)}{(1 + \tau_i^h)^{\eta}} \right)^{\theta} \right)^{\frac{1}{\theta} \cdot \frac{1}{1-\eta}}$$

Further Intuition

Adding the assumption that A_i and $1 - \tau_i^w$ are jointly log-normal:

$$\ln \overline{wage}_f = \ln \left(\sum_{i=1}^{N} A_i^{\theta} \right)^{\frac{1}{\theta} \cdot \frac{1}{1-\eta}}$$

$$+ \frac{1}{1-\eta} \cdot \ln \left(1 - \overline{\tau}^w\right) - \frac{1}{2} \cdot \frac{\theta - 1}{1-\eta} \cdot \mathrm{Var}(\ln(1 - \tau_i^w)).$$

Also helpful for understanding comparative statics:

$$\mathrm{Var} \ln(1 - \tau^w) = \frac{1}{\theta^2} \cdot \mathrm{Var} \ln \frac{p_{ig}}{p_{i,wm}}$$

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Data

- U.S. Census for 1960, 1970, 1980, 1990, and 2000
- American Community Survey for 2010–2012
- 67 consistent occupations, one of which is the “home” sector.
- Look at full-time and part-time workers, hourly wages.
- Prime-age workers (age 25-55).

Examples of Baseline Occupations

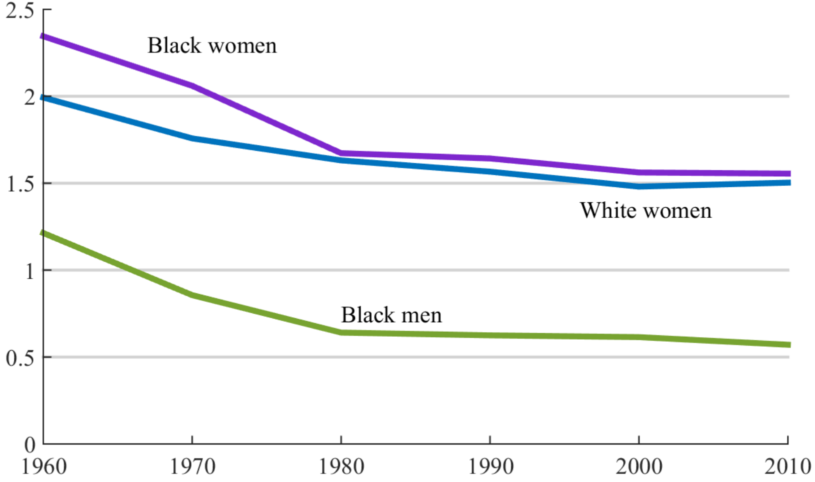
Health Diagnosing Occupations

- Physicians
- Dentists
- Veterinarians
- Optometrists
- Podiatrists
- Health diagnosing practitioners, n.e.c.

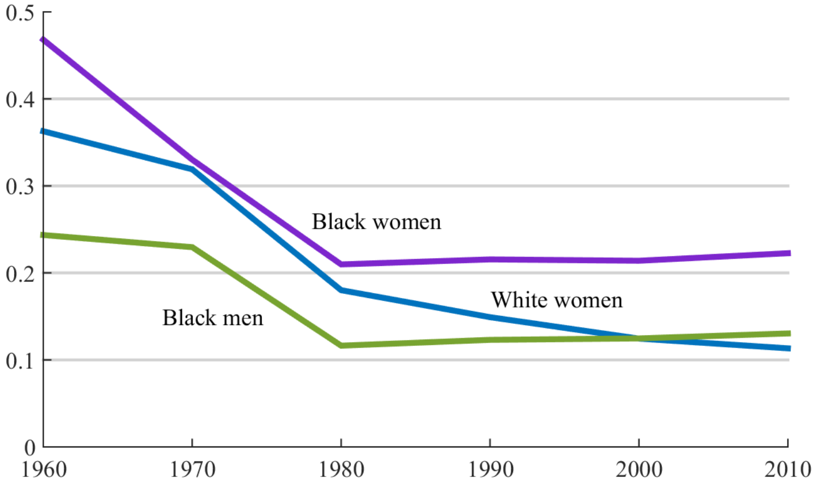
Health Assessment and Treating Occupations

- Registered nurses
- Pharmacists
- Dietitians

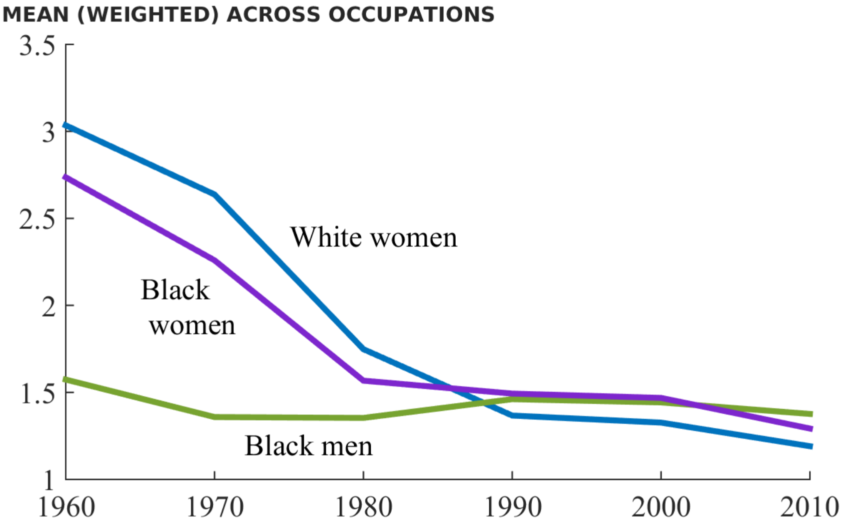
Standard Deviation of Relative Occupational Shares



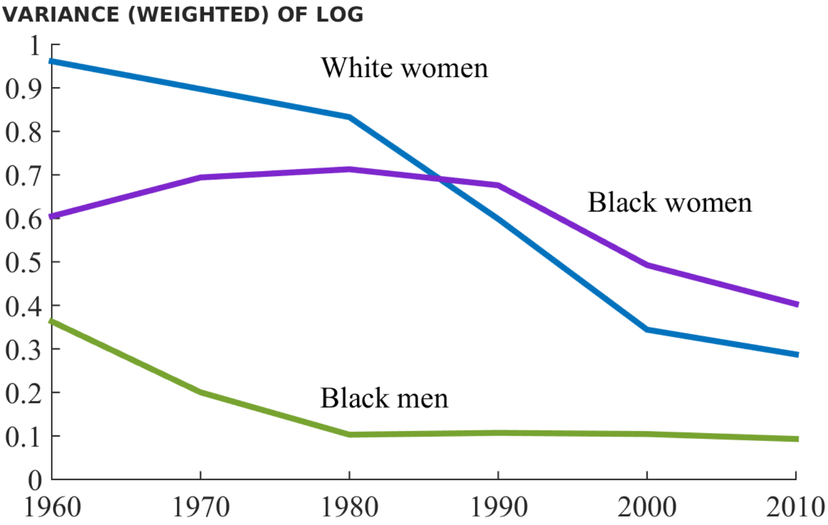
Standard Deviation of Wage Gaps by Decade



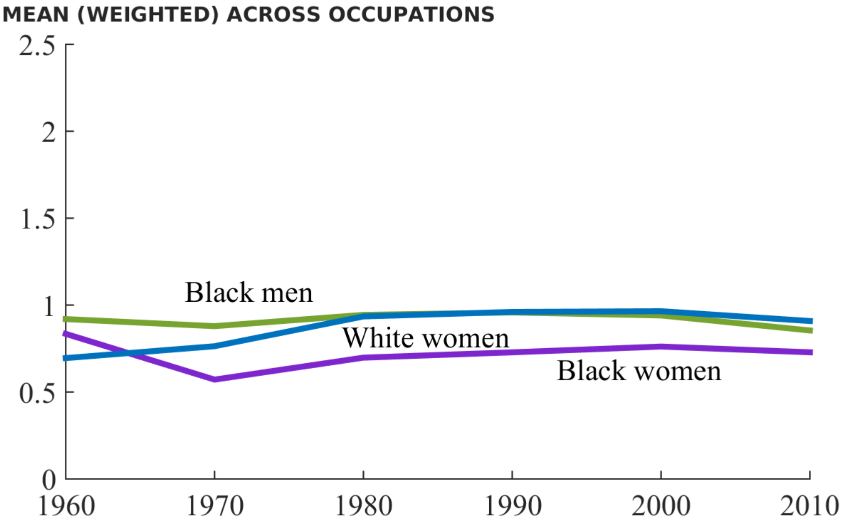
Mean of τ_{ig}



Variance of τ_{ig}

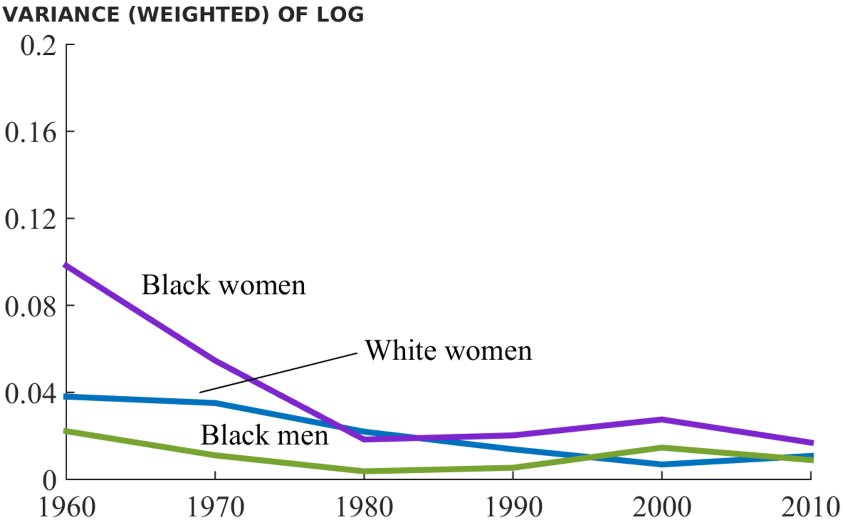


Mean of z_{ig}

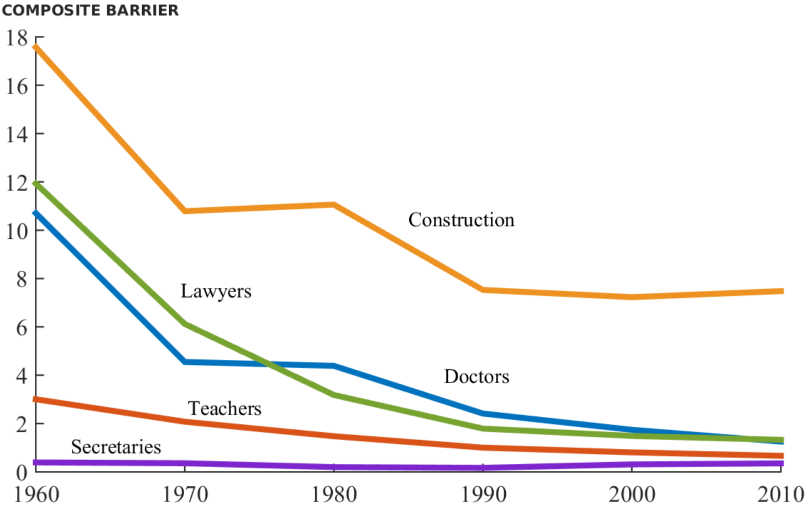


MEAN (WEIGHTED) ACROSS OCCUPATIONS
2.5
2
1.5
1
0.5
0
1960
1970
1980
1990
2000
2010
Black men
White women
Black women

Variance of z_{ig}



Estimated Barriers (τ_{ig}) for White Women



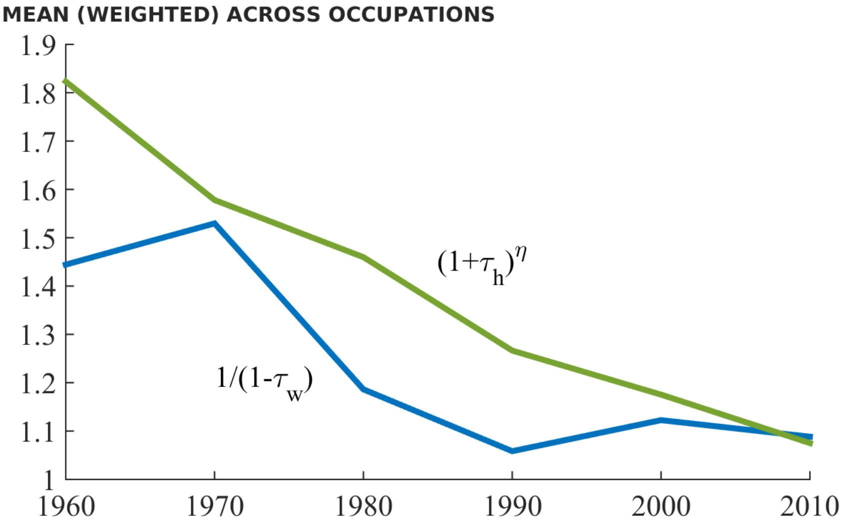
Baseline Parameter Values and Variable Normalizations

Parameter	Definition	Value
θ	Fréchet shape	2.12
η	Goods elasticity of human capital	0.103
σ	EoS across occupations	3
β	Consumption weight in utility	$\frac{1}{3} \cdot 0.693$
$z_{i,wm}$	Occupational preferences (white men)	1
$\tau^h_{i,wm}$	Human capital barriers (white men)	0
$\tau^w_{i,wm}$	Labor market barriers (white men)	0

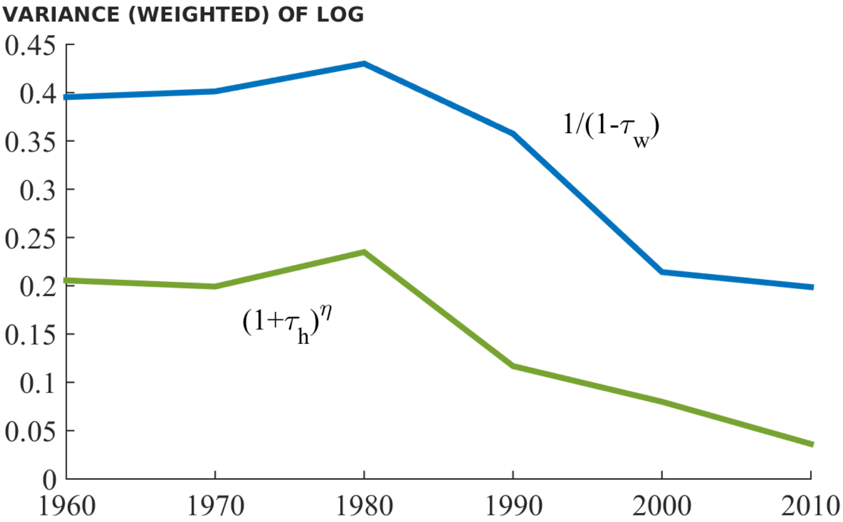
Endogenous Variables and Empirical Targets

Parameter	Definition	Empirical Target
$A_i(t)$	Technology by occupation	Occupations of young white men
$\phi_i(c)$	Time elasticity of human capital	Average wages by occ, white men
$\tau^h_{i,g}(c)$	Human capital barriers	Occupations of young by group
$\tau^w_{i,g}(t)$	Labor market barriers	Life-cycle wage changes by group
$z_{ig}(c)$	Occupational preferences	Occ wage gaps of young by group
$\Omega^{home}_g(c)$	Home sector talent/taste	Labor force participation

Mean of τ^h and τ^w: White Women



Variance of τ^h and τ^w: White Women



Model versus Data: Earnings and Labor Force Participation

Year	Earnings Data	Earnings Model	LFP Data	LFP Model
1960	26,191	26,199	0.599	0.599
1970	35,593	36,142	0.636	0.597
1980	32,925	33,703	0.702	0.643
1990	38,026	39,357	0.764	0.708
2000	47,772	50,195	0.747	0.689
2010	50,981	53,898	0.759	0.723

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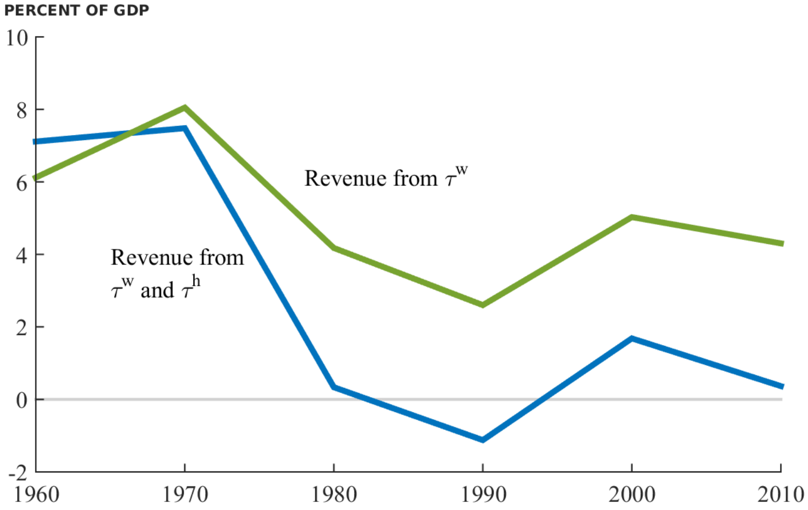
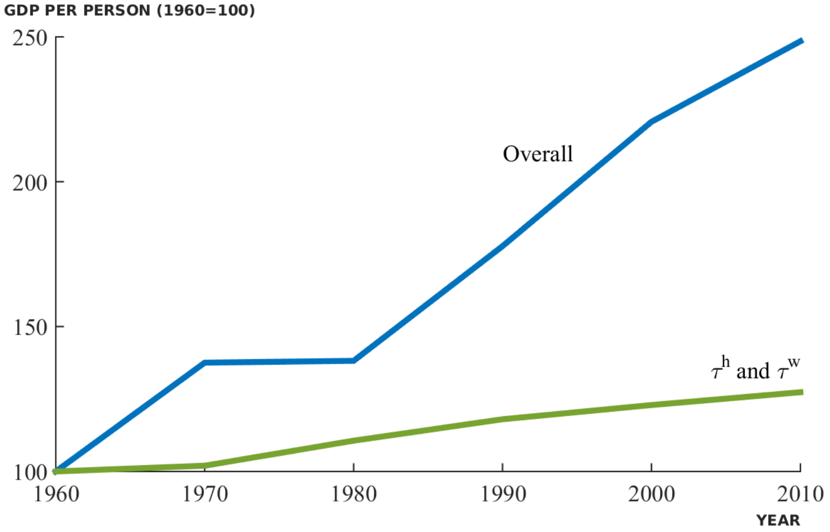
Share of Growth due to Changing Frictions (all ages)

	Share of growth accounted for by	
	τ^h and τ^w	τ^h, τ^w, z
Earnings per person	28.7%	29.2%
GDP per person	26.6%	27.3%
Labor force participation	55.1%	41.9%
GDP per worker	19.1%	23.5%

Rents as share of GDP in the Model



GDP per person, Data and Model Counterfactual



Share of Growth due to Changing Frictions (young only)

	Share of growth accounted for by τ^h and τ^w
GDP per person (young)	38.8%
Earnings per person (young)	41.6%
Consumption per person (market, young)	31.8%
Consumption per person (home+market, young)	34.7%
Utility per person (consumption equivalent, young)	56.5%

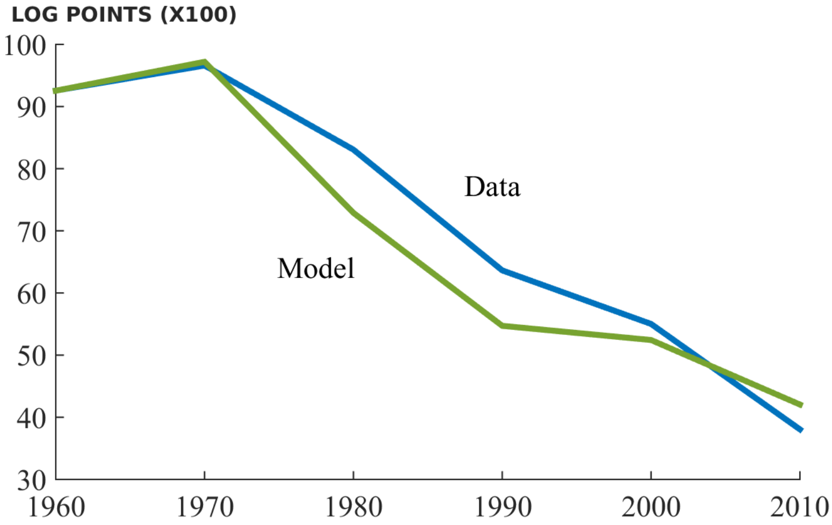
Share of Growth due to Changing Labor- vs. Product-Market Frictions

	Share of growth accounted for by		
	τ^h and τ^w	τ^h only	τ^w only
GDP per person	26.6%	18.3%	8.4%
GDP per person (young)	38.8%	26.9%	12.3%
Earnings per person (young)	41.6%	21.0%	20.5%
Consumption (market)	31.8%	16.3%	15.5%
Consumption (home+market)	34.7%	21.8%	13.0%
Utility per person (young)	56.5%	37.4%	15.7%

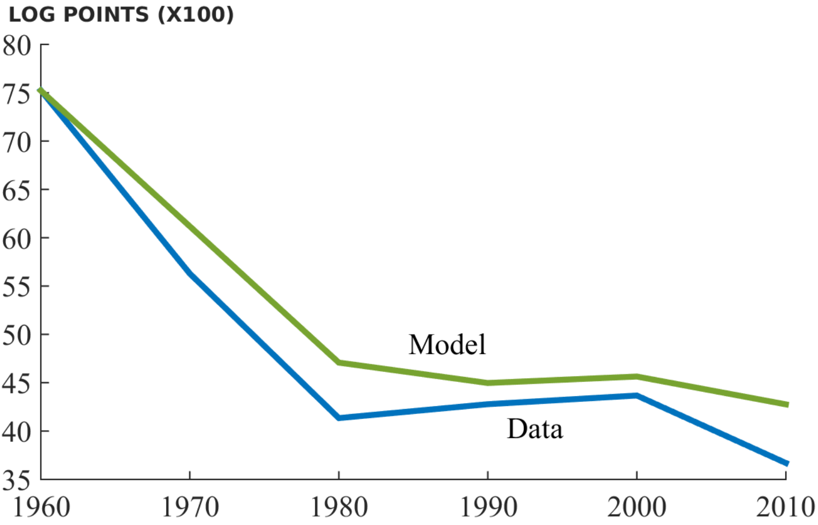
Wage Gaps and Earnings by Group and Changing Frictions

	—— Share of growth accounted for by ——			Full
	τ^h and τ^w	τ^h, τ^w, z	τ^h, τ^w, z, Ω_g^{home}	Model
Wage gap, WW	158.0%	171.5%	88.3%	104.9%
Wage gap, BM	85.4%	93.4%	81.0%	104.0%
Wage gap, BW	110.2%	124.6%	81.8%	98.0%
Earnings, WM	0.2%	0.0%	1.0%	104.6%
Earnings, WW	67.6%	68.2%	86.8%	100.2%
Earnings, BM	20.7%	20.4%	22.5%	96.0%
Earnings, BW	48.0%	49.5%	61.5%	96.9%
LF Participation	55.1%	41.9%	185.4%	79.4%

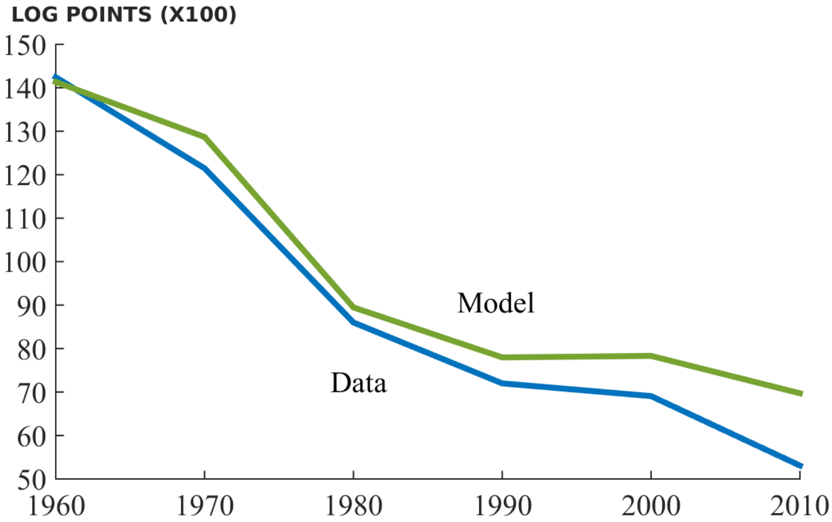
Wage Gaps in Model vs. Data: White Women



Wage Gaps in Model vs. Data: Black Men



Wage Gaps in Model vs. Data: Black Women



Share of Growth in GDP per Person due to Different Groups

1960–2010	τ^h and τ^w	τ^h only	τ^w only
All groups	26.6%	18.3%	8.4%
White women	22.3%	15.2%	7.3%
Black men	1.4%	1.1%	0.3%
1960–1980			
All groups	31.2%	12.6%	19.0%
White women	24.9%	9.2%	16.1%
Black men	2.8%	1.5%	1.3%
1980–2010			
All groups	24.0%	21.5%	2.6%
White women	20.8%	18.5%	2.5%
Black men	0.6%	0.8%	-0.2%

Back-of-the-Envelope Calculations

- Log-normal model approximation:
  - Declining $\bar{\tau}$: 0.05 log points
  - Declining $Var \ln \tau$: 0.21 log points
  - $0.26/0.91 \approx 28.6\%$ of growth.
- Mechanically apply declining earnings gaps
  - Declining wage gaps and rising LFP
    $\Rightarrow$ 37.3% of growth in earnings per person
  - Why larger? Attributes entire decline in gaps to frictions, whereas differential productivity growth and returns to schooling also mattered.

Robustness to Alternative Counterfactuals

	GDP per person growth accounted for by τ^h and τ^w
Benchmark	26.6%
Wage gaps halved	23.3%
Zero wage gaps	21.5%
No frictions in “brawny” occupations	22.9%
No frictions in 2010	26.4%

Robustness to Parameter Values

	GDP per person growth accounted for by		
	τ^h and τ^w	τ^h alone	τ^w alone
Benchmark	26.6%	18.3%	8.4%
$\theta = 4$	27.0%	15.2%	12.5%
$\eta = 0.05$	24.7%	6.4%	18.4%
$\eta = 0.20$	28.2%	25.0%	3.1%
$\sigma = 1.05$	27.0%	18.7%	8.4%
$\sigma = 10$	26.3%	18.1%	8.5%

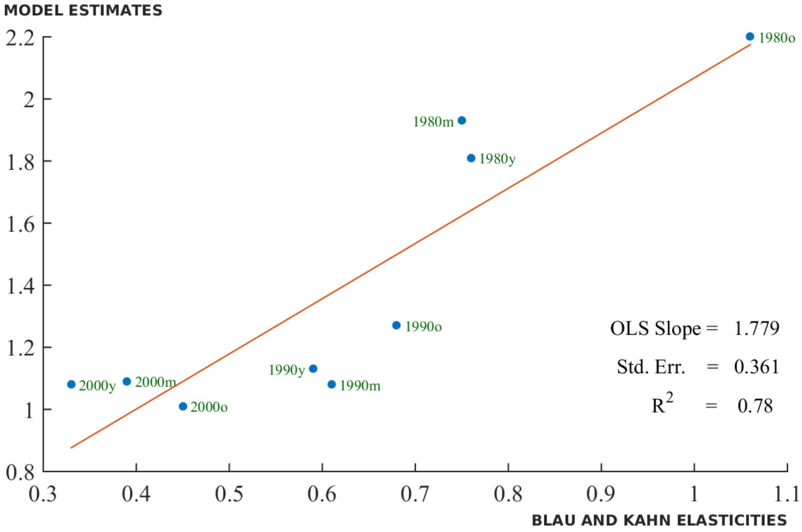
Changing Only the Dispersion of Ability

Value of θ	GDP per person growth accounted for by τ^h and τ^w
1.9	13.0%
2.12 (baseline)	26.6%
3	67.1%
4	99.8%
5	128.4%

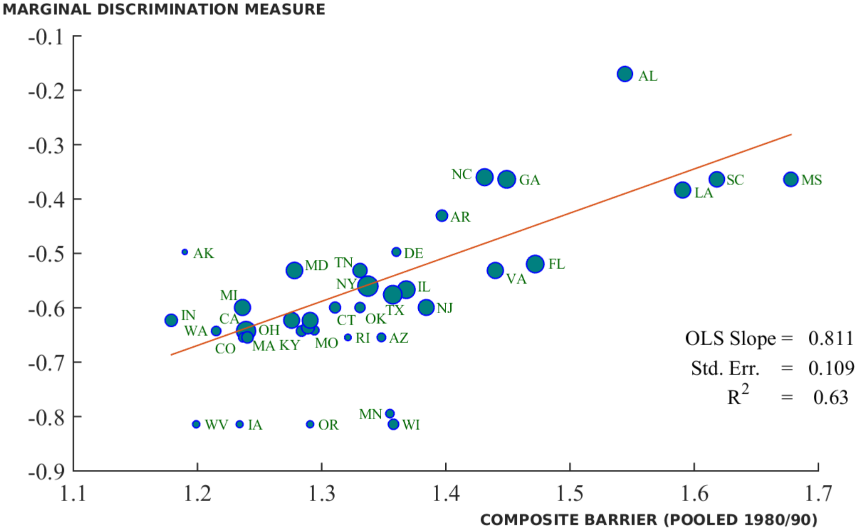
More Robustness

	— GDP growth accounted for by —		
	τ^h and τ^w	τ^h only	τ^w only
Benchmark	26.6%	18.3%	8.4%
Weight on $p_{ig} = 1$	23.8%	21.9%	2.0%
Weight on $p_{ig} = 1/2$	25.2%	22.7%	2.4%
Weight on $p_{ig} = 0$	27.2%	8.1%	19.1%
50/50 split of $\hat{\tau}_{i,g}$ in 1960	26.6%	19.1%	7.7%
50/50 split of $\hat{\tau}_{i,g}$ in all years	28.8%	19.8%	9.3%
LFP minimum factor = 1/3	26.5%	18.6%	8.2%
LFP minimum factor = 2/3	26.4%	17.9%	8.8%
No constraint on τ^h	26.4%	21.8%	4.6%

Labor Supply Elasticities for White Women



Model τ's for Black Men vs. Survey Measures of Discrimination, by U.S. State



Future

Absolute advantage correlated with comparative advantage:

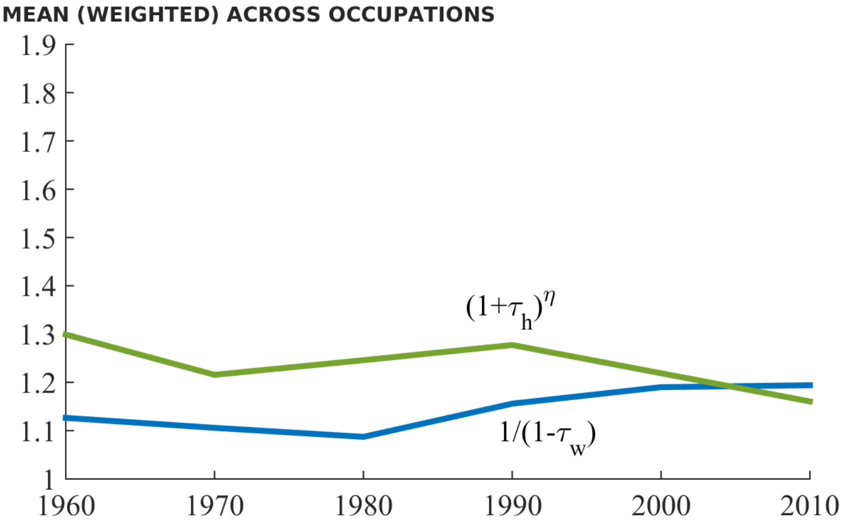
- Talented 1960 women went into teaching, nursing, home sector?
- As barriers fell, lost talented teachers, child-raisers?
- Could explain Mulligan and Rubinstein (2008) facts.

Separate paper:

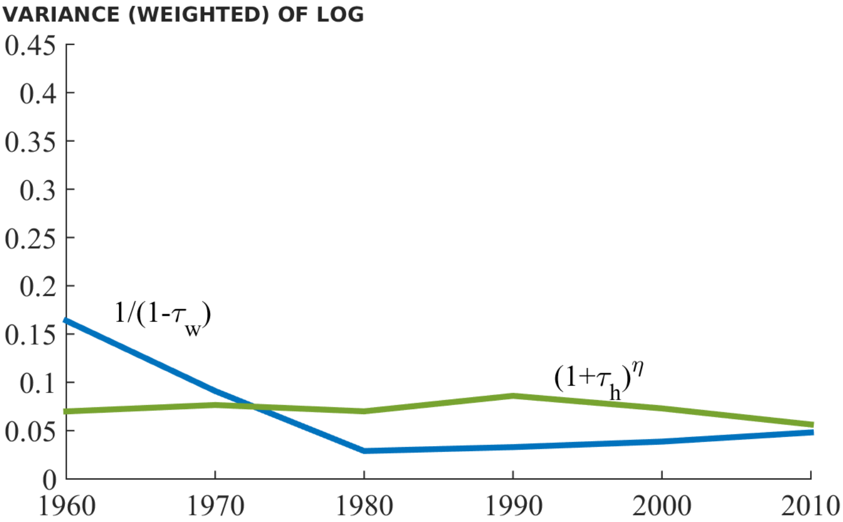
Rising inequality from misallocation of human capital investment?

Extra Slides

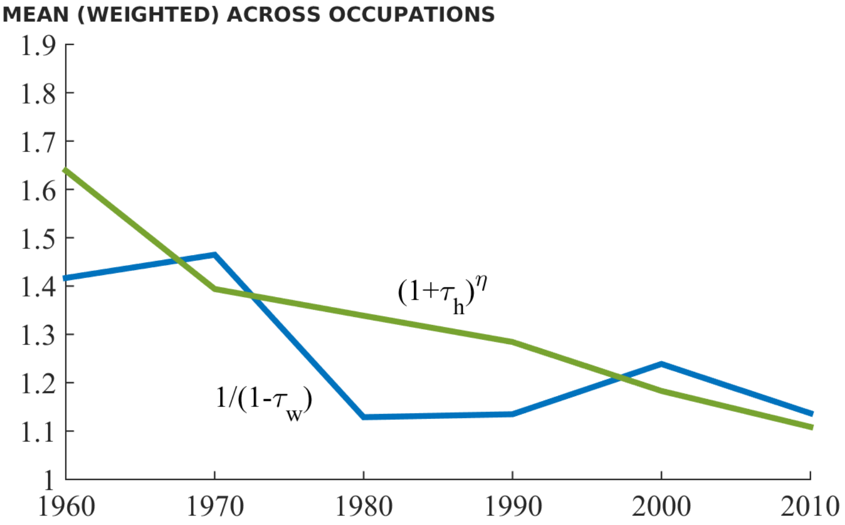
Mean of τ^h and τ^w: Black Men



Variance of τ^h and τ^w: Black Men



Mean of τ^h and τ^w: Black Women



Variance of τ^h and τ^w: Black Women