The Allocation of Talent and U.S. Economic Growth

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Big changes in the occupational distribution

White Men in 1960:

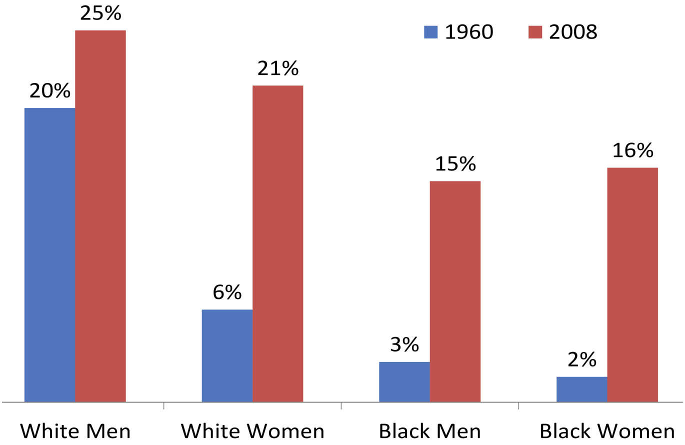
94% of Doctors, 96% of Lawyers, and 86% of Managers

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, one of which is "home".

Individuals draw talent in each occupation $\{\epsilon_i\}$.

Individuals then choose occupation (i) and human capital (s, e).

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

What varies across occupations and/or groups

w_i = the wage per unit of human capital in occupation i (endogenous)

ϕ_i = the elasticity of human capital wrt time invested for occupation i

τ^w_{ig} = labor market barrier facing group g in occupation i

τ^h_{ig} = barrier to building human capital facing group g for i

Timing

Individuals draw and observe an ϵ_i for each occupation.

They also see ϕ_i, τ_{ig}^w, and τ_{ig}^h.

They anticipate w_i.

Based on these, they choose their occupation, their s, and their e.

w_i will be determined in GE (production details later).

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.

Identification Problem (currently)

Empirically, we will be able to identify:

$$\tau_{ig} \equiv \frac{(1+\tau^h_{ig})^\eta}{1-\tau^w_{ig}}$$

But not τ^w_{ig} and τ^h_{ig} separately.

For now we analyze the composite τ_{ig} or one of two polar cases:

- All differences are from τ^h_{ig} barriers to human capital accumulation ($\tau^w_{ig} = 0$)
- Or all differences are due to τ^w_{ig} labor market barriers ($\tau^h_{ig} = 0$).

Individual Consumption and Schooling

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

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

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

$$c_{ig}^*(\epsilon) = \bar{\eta}\left(\frac{w_i s_i^{\phi_i}\epsilon}{\tau_{ig}}\right)^{\frac{1}{1-\eta}}$$

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

The Distribution of Talent

We assume **Fréchet** for analytical convenience:

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

- McFadden (1974), Eaton and Kortum (2002)
- θ governs the dispersion of skills
- T_{ig} scales the supply of talent for an occupation

Benchmark case: $T_{ig} = T_i$ — identical talent distributions

T_i will be observationally equivalent to production technology parameters, so we normalize $T_i = 1$.

Result 1: Occupational Choice

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

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:

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

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

Result 2: Wages and Wage Gaps

Let $\overline{\text{wage}}_{ig}$ denote the average earnings in occupation i by group g:

$$\overline{\text{wage}}_{ig} \equiv \frac{(1-\tau^w_{ig})w_i H_{ig}}{q_g p_{ig}} = (1-s_i)^{-1/\beta}\gamma\bar{\eta}\left(\sum_{s=1}^{N}\tilde{w}_{sg}^{\theta}\right)^{\frac{1}{\theta}\cdot\frac{1}{1-\eta}}$$

The wage gap between groups is the **same** across occupations:

$$\frac{\overline{\text{wage}}_{i,women}}{\overline{\text{wage}}_{i,men}} = \left(\frac{\sum_s \tilde{w}_{s,women}^{-\theta}}{\sum_s \tilde{w}_{s,men}^{-\theta}}\right)^{\frac{1}{\theta}\cdot\frac{1}{1-\eta}}$$

- Selection exactly offsets τ_{ig} differences across occupations because of the Fréchet assumption
- Higher τ_{ig} barriers in one occupation reduce a group's wages proportionately in **all** occupations.

Occupational Choice

Therefore:

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

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

Inferring Barriers

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

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 $\tau_{i,wm} = 1$. The results are similar if we instead impose a zero average τ in each occupation.

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

- $\rho = 1$ 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:

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

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

or

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

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

Weaknesses

Main weaknesses of setup:

- Talent of teachers does not affect human capital of students
  - Very talented women teachers in the 1960s are now doctors and lawyers?
- No childbearing
  - Within a broad occupation, women may choose jobs with lower pay but more flexibility (e.g. optometry vs surgery)
- No dynamics

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Data

- U.S. Census for 1960, 1970, 1980, 1990, and 2000
- American Community Survey for 2006-2008
- 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

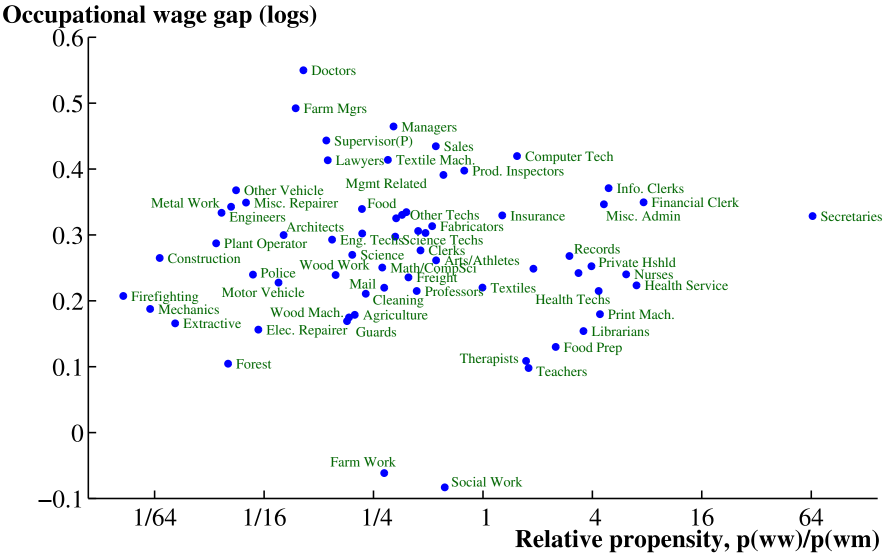
Health Diagnosing Occupations

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

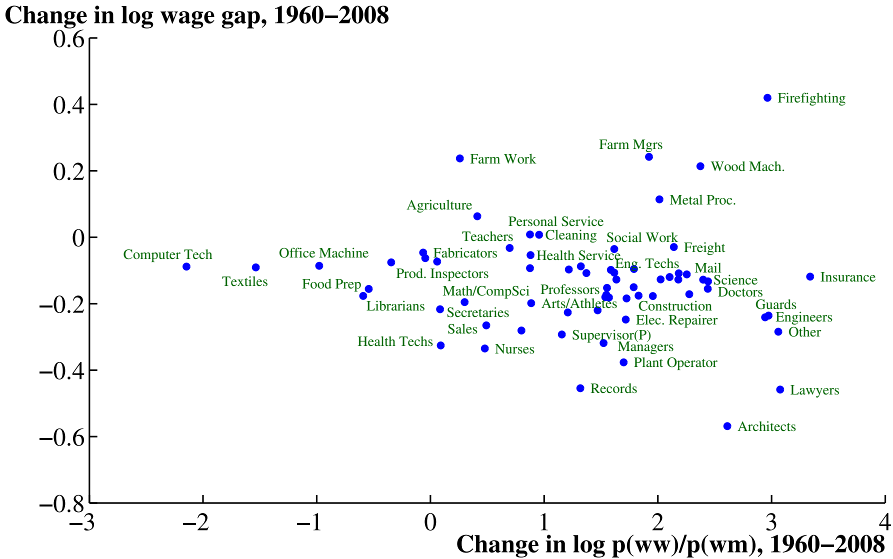
Health Assessment and Treating Occupations

- Registered nurses
- Pharmacists
- Dietitians

Occupational Wage Gaps for White Women in 1980



Change in Wage Gaps for White Women, 1960–2008



Test of Model Implications: Changes by Schooling

Occupational Similarity to White Men	1960	2008	1960–2008
High-Educated White Women	0.38	0.59	0.21
Low-Educated White Women	0.40	0.46	0.06

Wage Gap vs. White Men	1960	2008	1960–2008
High-Educated White Women	-0.50	-0.24	-0.26
Low-Educated White Women	-0.56	-0.27	-0.29

Estimating $\theta(1-\eta)$

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

Under Fréchet, wages within an occupation-group satisfy

$$\frac{\text{Variance}}{\text{Mean}^2} = \frac{\Gamma(1-\frac{2}{\theta(1-\eta)})}{\left(\Gamma(1-\frac{1}{\theta(1-\eta)})\right)^2} - 1.$$

- Assume $\eta = 1/4$ for baseline (midway between 0 and 1/2).
- Then use this equation to estimate θ.
- Attempt to control for “absolute advantage” as well (next slide).

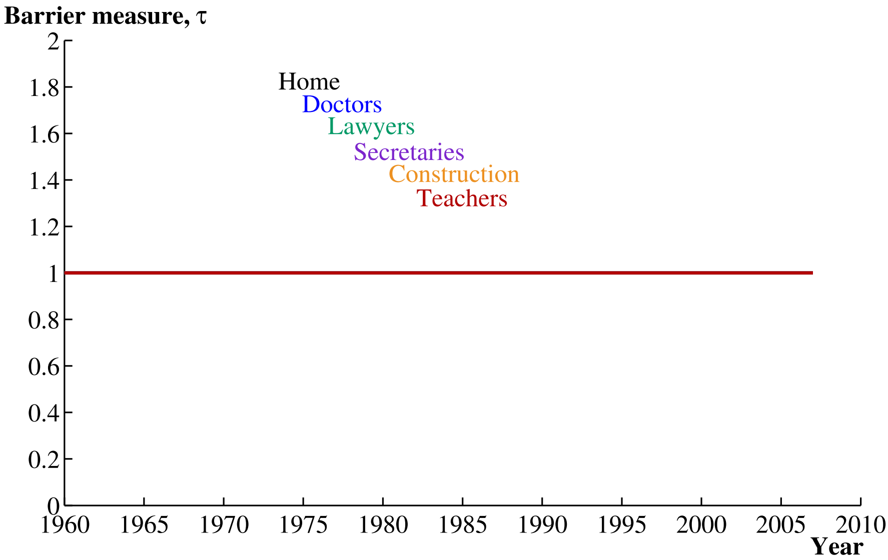
Estimating $\theta(1-\eta)$ (continued)

Adjustments to Wages	**Estimates of $\theta(1-\eta)$**
Base controls	3.11
Base controls + Adjustments	**3.44**
Wage variation due to absolute advantage:	
25%	**3.44**
50%	4.16
75%	5.61
90%	8.41

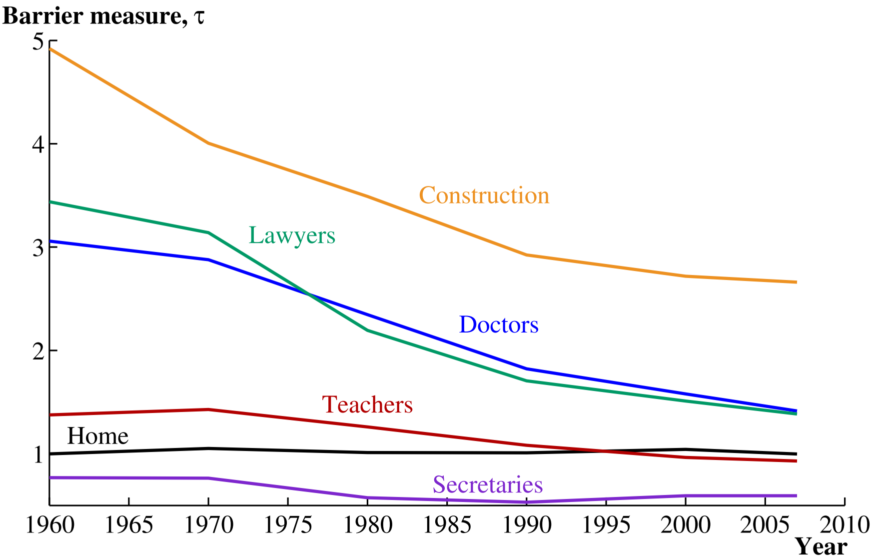
Base controls = potential experience, hours worked, occupation-group dummies

Adjustments = transitory wages, AFQT score, education

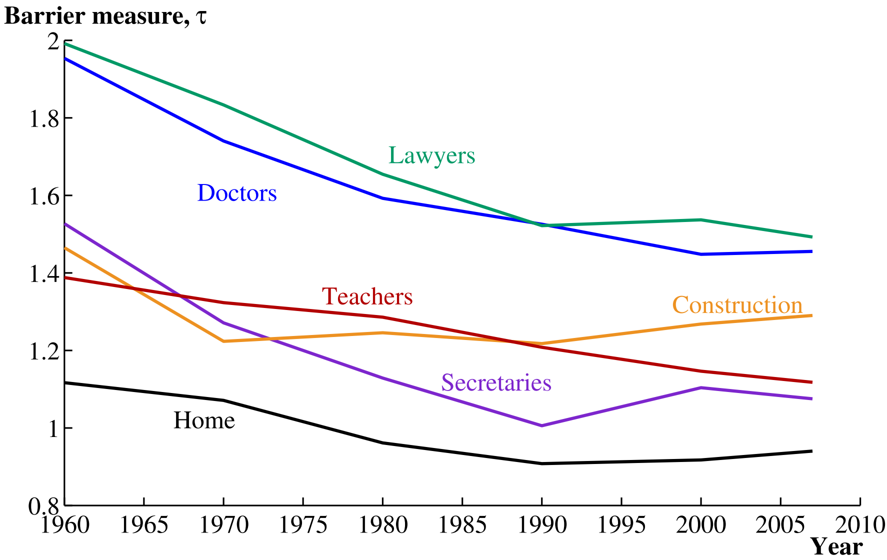
Assumed Barriers (τ_{ig}) for White Men



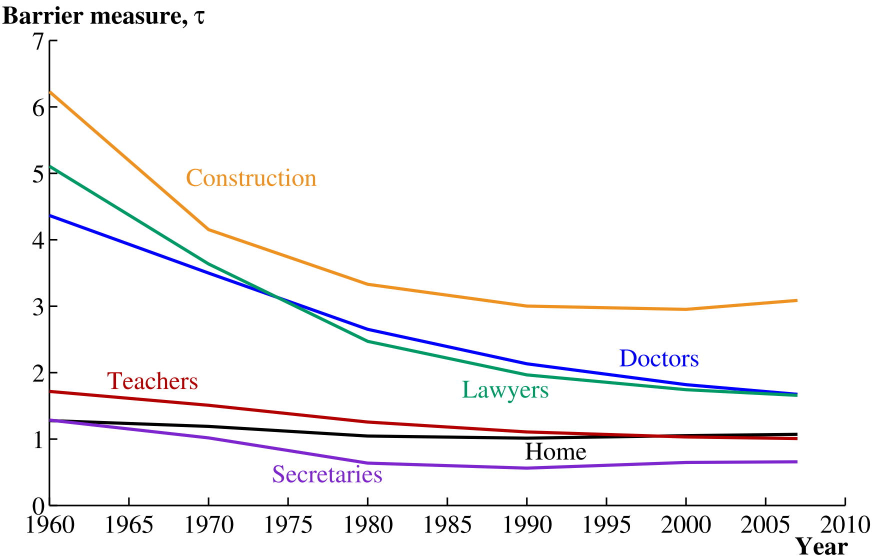
Estimated Barriers (τ_{ig}) for White Women



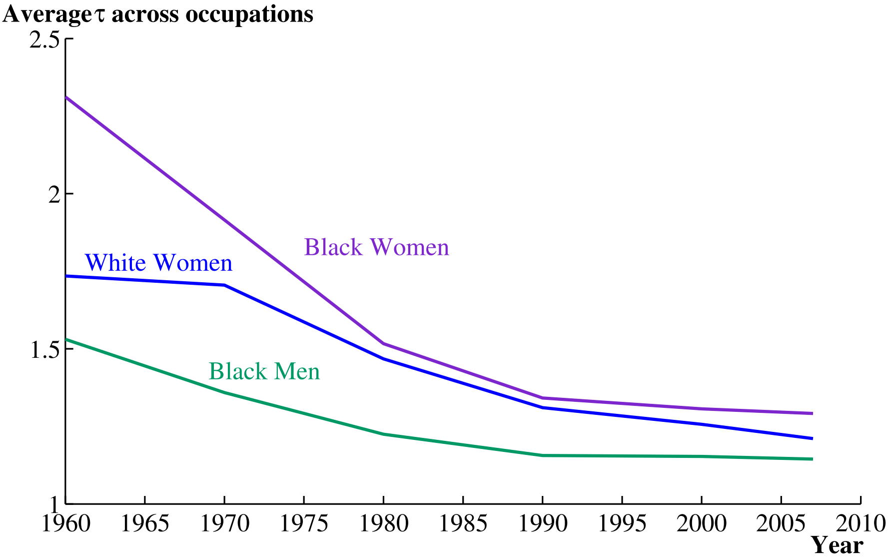
Estimated Barriers (τ_{ig}) for Black Men



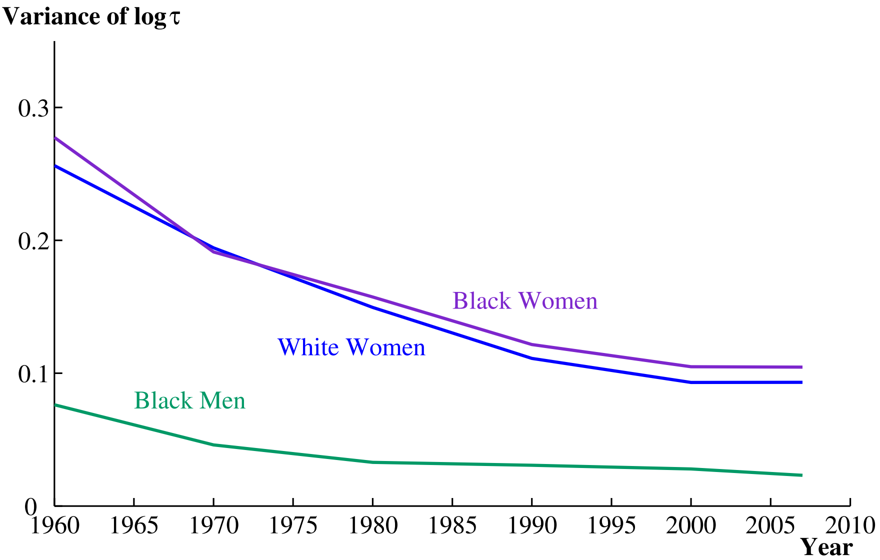
Estimated Barriers (τ_{ig}) for Black Women



Average Values of τ_{ig} over Time



Variance of log τ_{ig} over Time



Driving Forces

Allow A_i, ϕ_i, τ_{ig}, and population to vary across time to fit observed employment and wages by occupation and group in each year.

- A_i: Occupation-specific productivity
  - Average size of an occupation
  - Average wage growth
- ϕ_i: Occupation-specific return to education
  - Wage differences across occupations
- τ_{ig}: Occupational sorting

Trends in A_i could be skill-biased and market-occupation-biased.

Baseline Parameter Values

Parameter	Value	Target
$\theta(1-\eta)$	3.44	wage dispersion within occupation-groups
η	0.25	midpoint of range from 0 to 0.5
β	0.693	Mincerian return across occupations
ρ	2/3	elasticity of substitution b/w occupations of 3
ϕ_{min}	by year	schooling in the lowest-wage occupation

Outline

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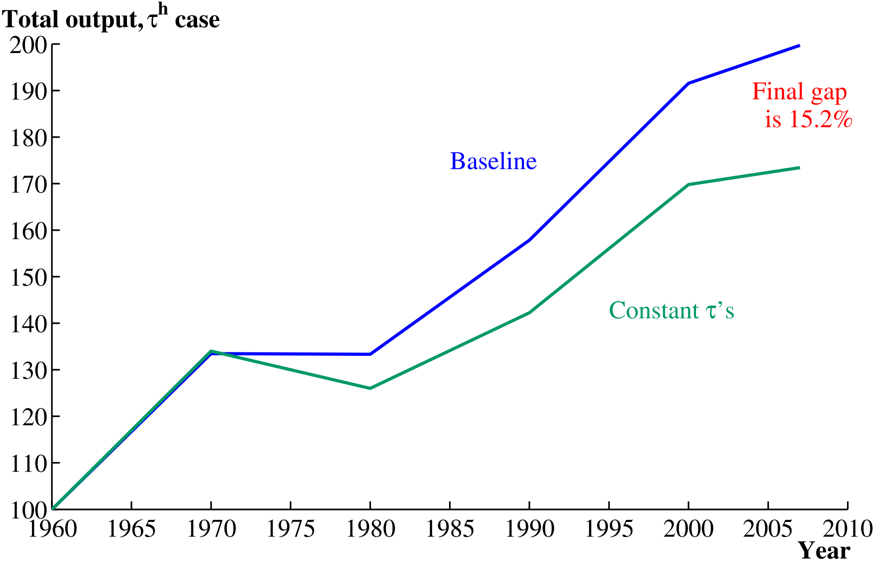
Main Finding

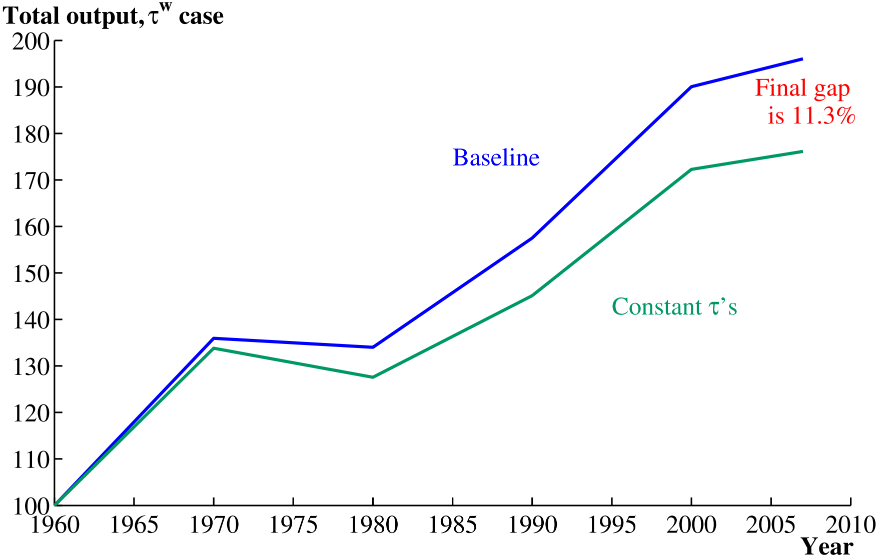
What share of labor productivity growth is explained by changing barriers?

	τ^h case	τ^w case
Frictions in all occupations	20.4%	15.9%
No frictions in "brawny" occupations	18.9%	14.1%
No frictions in 2008	20.4%	12.3%
Market sector only	26.9%	23.5%
Ages 25 to 35 only	28.7%	23.6%

Counterfactuals in the τ^h Case



Counterfactuals in the τ^w Case



Potential Remaining Productivity Gains

	τ^h case	τ^w case
Cumulative gain, 1960–2008	15.2%	11.3%
Remaining gain from zero barriers	14.3%	10.0%

Sources of productivity gains in the model

Better allocation of human capital investment:

- White men over-invested in 1960
- Women, blacks under-invested in 1960
- Less so in 2008

Better allocation of talent to occupations:

- Dispersion in τ's for women, blacks in 1960
- Less in 2008

Back-of-the-envelope calculation

The calculation:

- Take wages of white men as exogenous.
- Growth from faster wage growth for women and blacks?

Answer = 12.8%

Versus 20.4% gains in our τ^h case, 15.9% in our τ^w case.

Why do these figures differ?

- We are isolating the contribution of τ's.
- We take into account GE effects.

Sensitivity of Gains to the Wage Gaps

	τ^h case	τ^w case
Baseline	20.4%	15.9%
Counterfactual: wage gaps halved	12.5%	13.7%
Counterfactual: zero wage gaps	2.9%	11.8%

Wage Growth Due to Changing τ's

	Actual Growth	Due to τ^h's	Due to τ^w's
White men	77.0%	-5.8%	-7.1%
White women	126.3%	41.9%	43.0%
Black men	143.0%	44.6%	44.3%
Black women	198.1%	58.8%	59.5%

Note: τ columns are % of growth explained.

Decomposing the Gains: Dispersion vs. Mean Barriers

	τ^h case	τ^w case
1960 Eliminating Dispersion	22.2%	14.9%
1960 Eliminating Mean and Variance	26.9%	18.6%
2008 Eliminating Dispersion	16.6%	7.8%
2008 Eliminating Mean and Variance	14.3%	10.0%

Robustness: τ^h case

	Baseline				
	$\rho = 2/3$	$\rho = -90$	$\rho = -1$	$\rho = 1/3$	$\rho = .95$
Changing ρ	20.4%	19.7%	19.9%	20.2%	21.0%
	3.44	4.16	5.61	8.41	
Changing θ	20.4%	20.7%	21.0%	21.3%	
	$\eta = 1/4$	$\eta = 0.01$	$\eta = .05$	$\eta = .1$	$\eta = .5$
Changing η	20.4%	20.5%	20.5%	20.5%	20.3%

Note: Entries are % of output growth explained.

Robustness: τ^w case

	Baseline				
	$\rho = 2/3$	$\rho = -90$	$\rho = -1$	$\rho = 1/3$	$\rho = .95$
Changing ρ	15.9%	12.3%	13.3%	14.7%	18.4%
	3.44	4.16	5.61	8.41	
Changing θ	15.9%	14.6%	12.9%	11.2%	
	$\eta = 1/4$	$\eta = 0$	$\eta = .05$	$\eta = .1$	$\eta = .5$
Changing η	15.9%	13.9%	14.4%	14.8%	17.5%

Note: Entries are % of output growth explained.

More robustness

Gains are not sensitive to:

- More detailed occupations (331 for 1980 onward)
- A broader set of occupations (20)
- Weight on consumption vs. time in utility (β)

Gains when changing only the dispersion of ability

Value of $\theta(1-\eta)$	τ^h case	τ^w case
3.44	20.4%	15.9%
4.16	18.6%	15.1%
5.61	9.5%	8.0%
8.41	8.4%	3.9%

Summary of other findings

Changing barriers also led to:

- 40+ percent of WW, BM, BW wage growth
- A 6 percent reduction in WM wages
- Essentially all of the narrowing of wage gaps
- 70+ percent of the rise in female LF participation
- Substantial wage convergence between North and South

Extensive range of robustness checks in paper...

Female Labor Force Participation

	Data	
Women's LF participation	1960 = 0.329	2008 = 0.692
Change, 1960 – 2008	0.364	

	Model
Due to changing τ^h's	0.235
Due to changing τ^w's	0.262

Education Predictions, τ^h case

	Actual 1960	Actual 2008	Actual Change	Change vs. WM	Due to τ's
White men	11.11	13.47	2.35		
White women	10.98	13.75	2.77	0.41	0.63
Black men	8.56	12.73	4.17	1.81	0.65
Black women	9.24	13.15	3.90	1.55	1.17

Note: Entries are years of schooling attainment.

Gains from white women vs. blacks, τ^h case

	1960–1980	1980–2008	1960–2008
All groups	19.7%	20.9%	20.4%
White women	11.3%	18.2%	15.3%
Black men	3.3%	0.9%	1.9%
Black women	5.1%	1.9%	3.2%

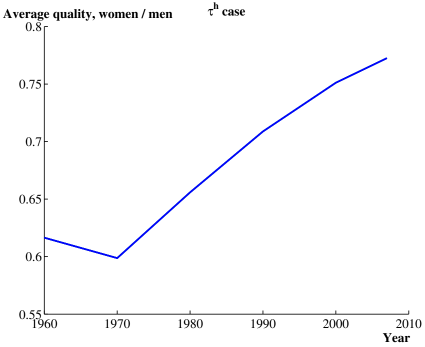
Note: Entries are % of growth explained. “All” includes white men.

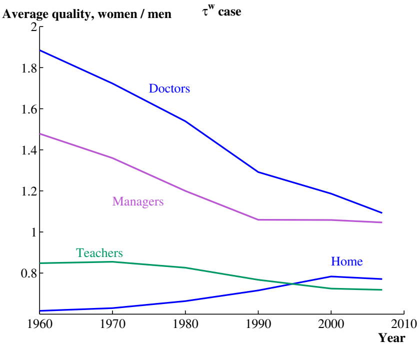
North-South wage convergence, τ^h case

	1960–1980	1980–2008	1960–2008
Actual wage convergence	20.7%	-16.5%	10.0%
Due to all τ's changing	4.9%	1.5%	6.9%
Due to black τ's changing	3.6%	1.9%	5.6%

Note: Entries are percentage points. “North” is the Northeast.

Average quality of white women vs. white men





Future

Distinguishing between τ^h and τ^w empirically:

- Assume τ^h is a cohort effect, τ^w a time effect.
- Early finding: mostly τ^h for white women, a mix for blacks.

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?