The Allocation of Talent and U.S. Economic Growth

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Occupational sorting in the U.S.

In 1960:

- White men were 94% of Doctors, 96% of Lawyers, and 86% of Managers
- 20% of men worked in one of these professions or as Executives, Architects, Engineers, Math/Computer Scientists, Natural Scientists.
- 2% of blacks, 6% of white women worked in these professions (conditional on working).

Occupational sorting in the U.S.

In 1960:

- 58% of working white women in Nursing, Teaching, Sales, Secretarial and Office Assistances, and Food Prep/Service (vs. 17% for white men, mostly Sales)
  - 68% of white women stayed at home
  - Versus just 9% of white men
- 64% of working black men were Freight/Stock Handlers, Motor Vehicle Operators, Machine Operators, Farm Laborers, and Janitorial and Personal Services (vs. 29% for white men).
- 51% of working black women in Household Services, Personal Services, and Food Prep/Services (vs. 2% of white men).

Occupational sorting in the U.S.

By 2008:

- White men down to 63% of doctors, 61% of lawyers, and 57% of managers
- 15 to 20% of women and blacks now working in the higher-skilled professions (vs. 25% for white men)

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

Households

4 groups: white men, white women, black men, black women.

Individuals draw iid talent ϵ in each of I occupations.

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

Individuals choose their human capital (s, e) and an occupation to maximize their utility.

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

$\tau^w_{ig} =$ labor market barrier facing group g in occupation i

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

Some Possible Barriers

Acting like τ^w

- Discrimination in the labor market.
- Less time/flexibility for reported hours worked.

Acting like τ^h

- Quality of public schools available.
- Nutrition, family background.
- Discrimination in school admissions.

Identification Problem (currently)

Empirically, we will be able to identify:

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

But not τ_{ig}^w and τ_{ig}^h separately.

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

- All differences are from τ_{ig}^h barriers to human capital accumulation ($\tau_{ig}^w = 0$)
- Or all differences are due to τ_{ig}^w labor market barriers ($\tau_{ig}^h = 0$).

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

In this case, T_i is observationally equivalent to production technology parameters (to be described later), so we normalize $T_i = 1$.

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:

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

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

Occupational Choice

Therefore:

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

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

Wages and Wage Gaps

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

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

Therefore, the occupational wage gap between any two groups is the **same** across all occupations:

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

- 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.

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* of the τ's by assuming "zero profits" by occupation (in the labor market and in the human capital market).

Data

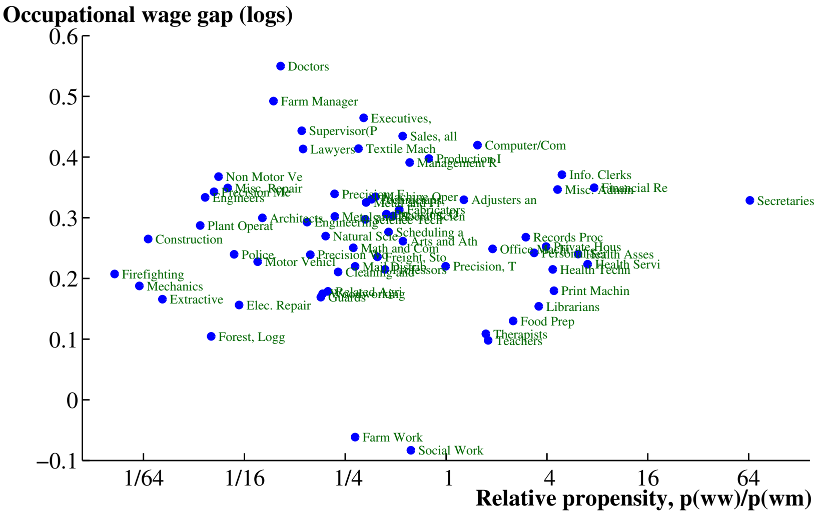
- U.S. Census for 1960, 1970, 1980, 1990, and 2000
- American Community Survey for 2006-2008

70 consistent occupations, one of which is the “home” sector.

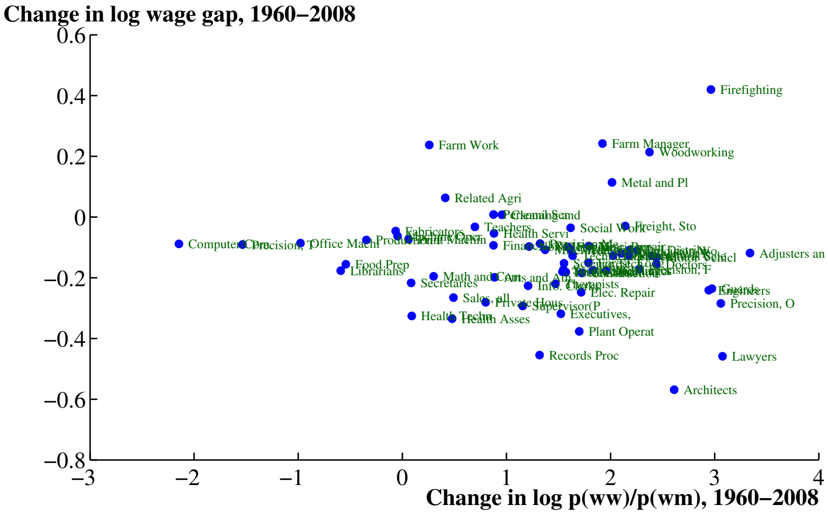
Look at full-time and part-time workers, hourly wages.

Prime-age workers (age 25-55).

Occupational Wage Gaps for White Women in 1980



Change in Wage Gaps for White Women, 1960–2008



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, the wage distribution within an occupation satisfies

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

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

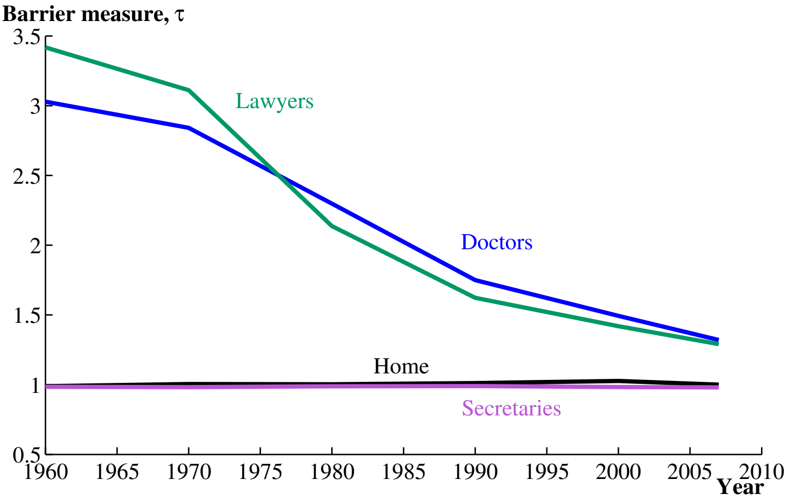
Estimating $\theta(1-\eta)$ (continued)

Adjustments to Wages	**Estimates of $\theta(1-\eta)$**
Base controls	3.11
Base controls + Adjustments	**3.44**
Assumptions about wage variation due to Absolute Advantage	
25%	**3.44**
50%	4.16
75%	5.61
90%	8.41

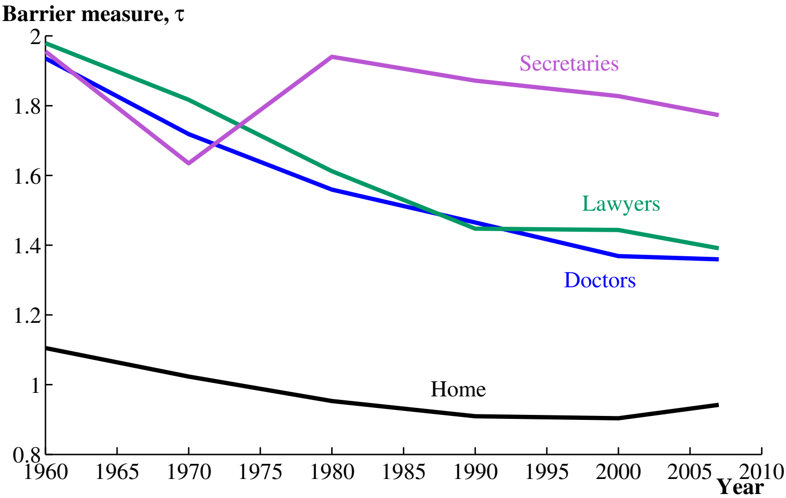
Base controls: potential experience, hours worked, occupation dummies, group dummies

Adjustments: transitory variation in wages, AFQT score, education

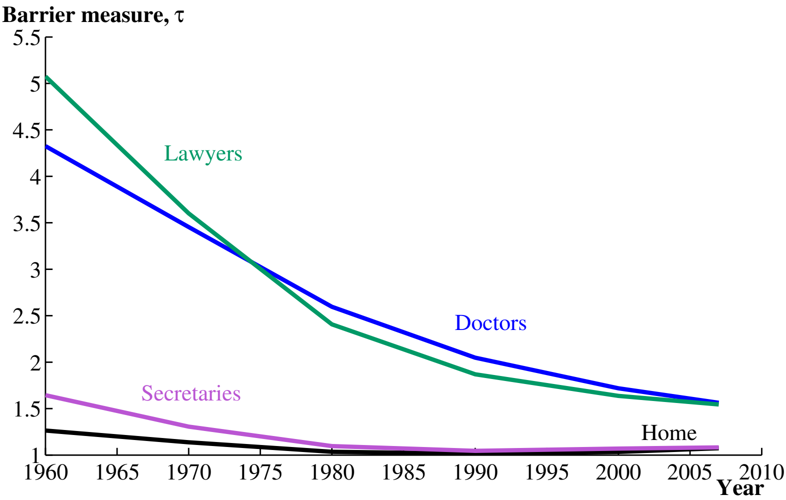
τ_{ig}^{h} for White Women over Time



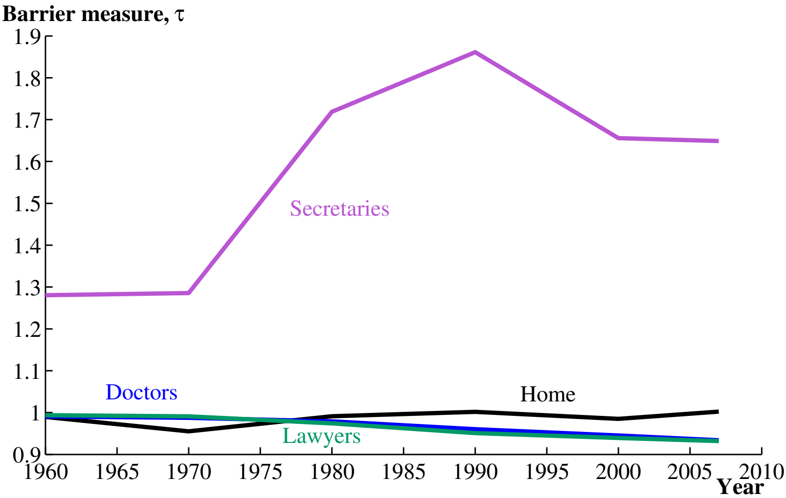
τ_{ig}^h for Black Men over Time



τ_{ig}^{h} for Black Women over Time



τ_{ig}^{h} for White Men over Time



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.

Driving Forces

Allow A_i, ϕ_i, τ_{ig}, and population to vary across time to fit observed employment and wages by occupation-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

Level pinned down by zero revenue in each occupation

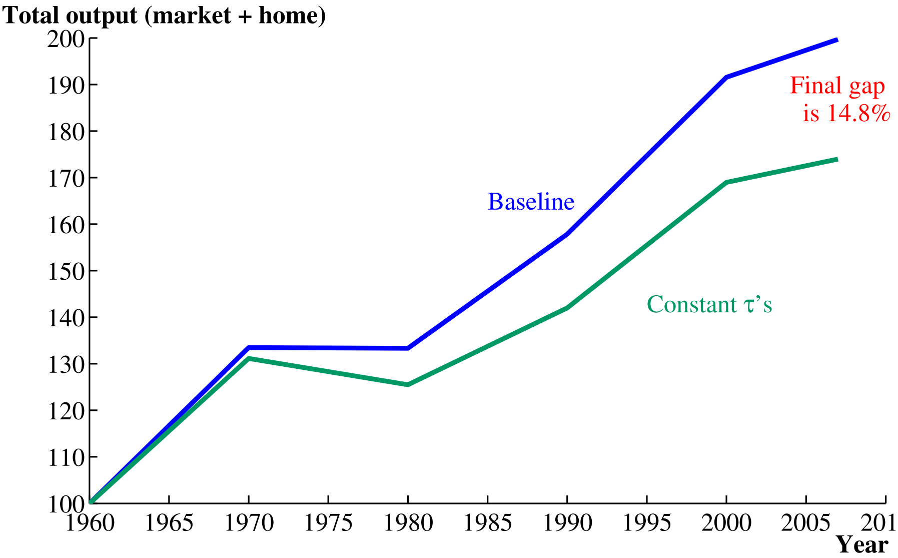
Trends in A_i could be skill-biased and/or market-sector-biased.

Baseline Parameter Values

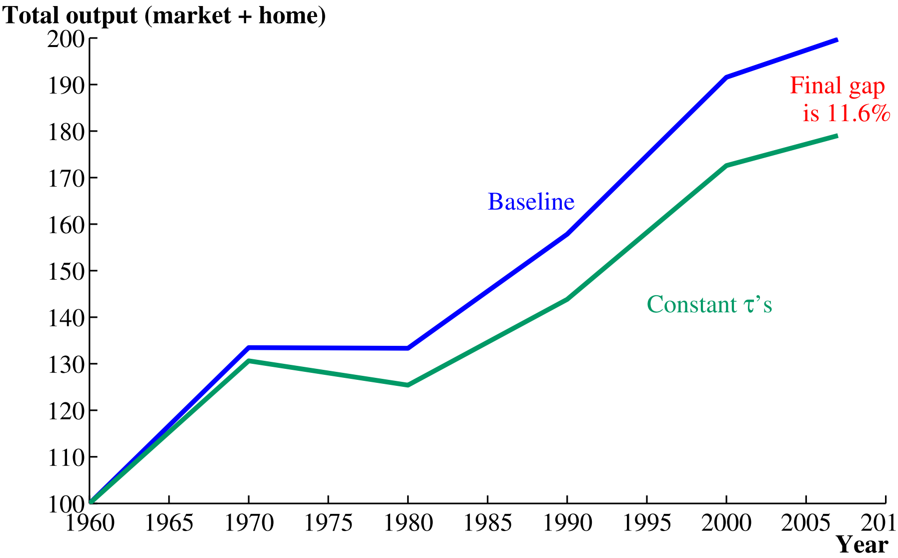
Parameter	Value	Target
$\theta(1-\eta)$	3.44	wage dispersion within occupation-groups
η	0.25	midpoint of range from 0 to 0.5
β	0.693	Mincerian return across occupations
ρ	2/3	elasticity of substitution b/w occupations of 3
ϕ_{min}	by year	schooling in the lowest-wage occupation

How much of growth
is due to changing frictions?

Counterfactuals in the τ^h Case



Counterfactuals in the τ^w Case



Productivity Gains

	τ^h case	τ^w case
Average annual wage growth	1.47	
Frictions in all occupations		
Growth due to changing frictions	0.294	0.233
(Percent of total)	(20.0%)	(15.8%)
No frictions in "brawny" occupations		
Growth due to changing frictions	0.262	0.197
(Percent of total)	(17.8%)	(13.4%)

Potential Remaining Output Gains from Zero Barriers

	τ^h case	τ^w case
Frictions in all occupations		
Cumulative gain, 1960–2008	14.8%	11.6%
Remaining gain from zero barriers	9.3%	4.3%
No frictions in "brawny" occupations		
Cumulative gain, 1960–2008	13.1%	9.7%
Remaining gain from zero barriers	7.2%	3.0%

Sources of productivity gains in the model

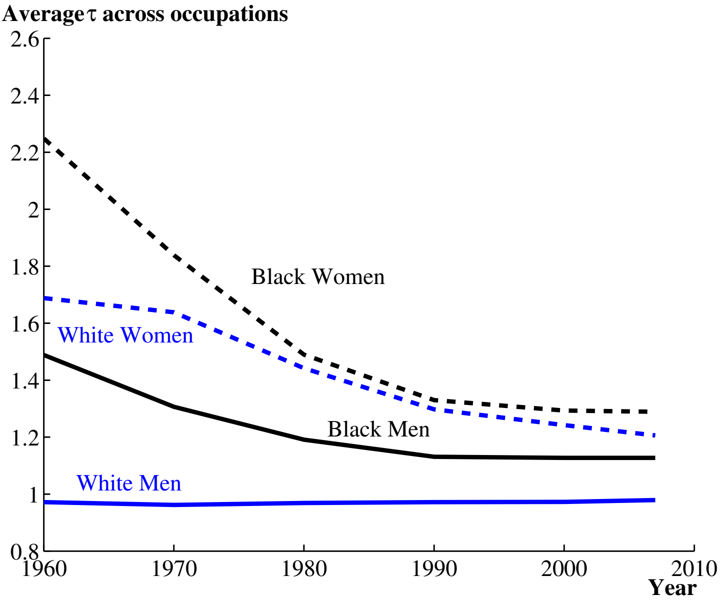
Better allocation of human capital investment:

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

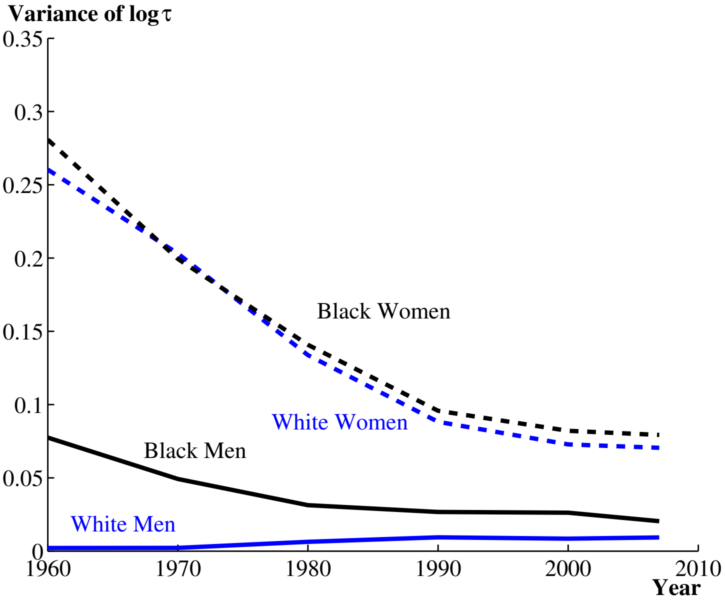
Better allocation of talent to occupations:

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

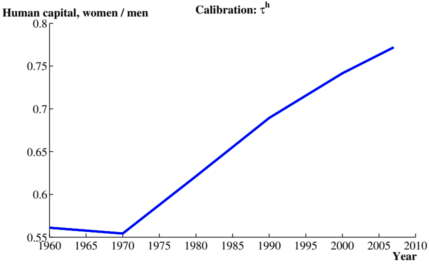
Average Values of τ_{ig} over Time

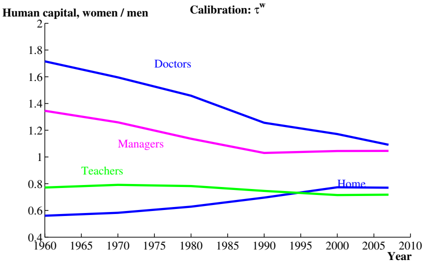


Variance of log τ_{ig} over Time



Human capital of white women vs. white men





Back-of-the-envelope calculation

Take wages of white men as exogenous.

Growth from faster wage growth for white women and blacks?

Answer: 26.6% (market), 12.8% (including home).

Vs. 20.0% gains in our τ^h case, 15.8% in our τ^w case.

Why do these figures differ?

- We are isolating the contribution of τ's.
- We take into account GE effects on all worker wages.
  - Wages of white men fall with fading reverse-discrimination.
  - But comparative advantage lifts all worker wages.
- In an extreme case, can match back-of-the-envelope with no productivity gains (τ^w, $\theta \to \infty$ and $\eta = 0$).

Wage Growth Due to Changing τ's

	Actual Growth	Due to τ^h's	Due to τ^w's
White men	77.0 percent	-4.3%	-10.2%
White women	126.3 percent	39.4%	33.6%
Black men	143.0 percent	44.3%	40.2%
Black women	143.0 percent	57.0%	52.7%

Note: τ columns are % of growth explained.

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)
- Average wage gaps
  - E.g. Cut gaps in half in every period: changing τ^h accounts for 17.0% of growth instead of 20.0%

Are we overstating dispersion of talent?

We looked at the variance of wages across workers within occupation-groups controlling for:

- Years of education
- Years of potential experience
- Hours worked
- AFQT variation (based on NLSY)
- Transitory wage movements (based on CPS)

Our baseline $\theta = 3.44$ attributes 75% of wage dispersion to comparative advantage (rest to absolute advantage).

If comparative advantage explains only 50%, 25% or 10% of wage dispersion within occupations, gains fall modestly (robustness table).

Robustness: τ^h calibration

	Baseline				
	$\rho = 2/3$	$\rho = -90$	$\rho = -1$	$\rho = 1/3$	$\rho = .95$
Changing ρ	20.0%	15.9%	17.0%	18.6%	23.1%

Changing	3.44	4.16	5.61	8.41
$\theta(1-\eta)$	20.0%	18.8%	17.8%	17.0%

	$\eta = 1/4$	$\eta = 0$	$\eta = .05$	$\eta = .1$	$\eta = .5$
Changing η	20.0%	14.3%	18.1%	19.3%	18.5%

	Full	1/2	Zero
Wage gaps	20.0%	17.0%	12.8%

Entries in the table are the percent of wage growth explained by changing frictions.

Robustness: τ^w calibration

	Baseline $\rho = 2/3$	$\rho = -90$	$\rho = -1$	$\rho = 1/3$	$\rho = .95$
Changing ρ	15.8%	10.0%	11.7%	13.9%	19.9%

Changing	3.44	4.16	5.61	8.41
$\theta(1-\eta)$	15.8%	15.2%	14.4%	13.6%

	$\eta = 1/4$	$\eta = 0$	$\eta = .05$	$\eta = .1$	$\eta = .5$
Changing η	15.8%	15.6%	15.6%	15.6%	15.8%

	Full	1/2	Zero
Wage gaps	15.8%	13.1%	10.1%

Entries in the table are the percent of wage growth explained by changing frictions.

Female Labor Force Participation

	τ^h case	τ^w case
Women's LF participation	1960 = 0.329	2008 = 0.692
Change, 1960 – 2008	0.364	
Due to changing τ's	0.106	0.116
(Percent of total)	(29.1%)	(31.8%)

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	0.60
Black men	8.56	12.73	4.17	1.81	0.62
Black women	9.24	13.15	3.90	1.55	1.10

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

	1960–1980	1980–2008	1960–2008
All groups	21.1%	19.2%	20.0%
White women	8.7%	15.4%	12.6%
Black men	3.4%	0.8%	1.9%
Black women	4.7%	1.4%	2.8%

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	2.9%	0.2%	3.3%
Due to black τ's changing	3.3%	1.6%	5.0%

Note: Entries are percentage points. "North" is the Northeast.

Work in Progress

Distinguishing between τ^h and τ^w empirically:

- Look at cohort vs. time effects.
- 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.