The Allocation of Talent  
and U.S. Economic Growth

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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).
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:


**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 $\epsilon$ 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)

\( \phi_i \) = the elasticity of human capital wrt time invested for occupation \( i \)

\( \tau_{ig}^w \) = labor market barrier facing group \( g \) in occupation \( i \)

\( \tau_{ig}^h \) = barrier to building human capital facing group \( g \) for \( i \)
Some Possible Barriers

**Acting like $\tau^w$**

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

**Acting like $\tau^h$**

- Quality of public schools available.
- Nutrition, family background.
- Discrimination in school admissions.
Empirically, we will be able to identify:

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

But not \( \tau_{ig}^w \) and \( \tau_{ig}^h \) separately.

For now we analyze the composite \( \tau_{ig} \) or one of two polar cases:

- All differences are from \( \tau_{ig}^h \) barriers to human capital accumulation (\( \tau_{ig}^w = 0 \))

- Or all differences are due to \( \tau_{ig}^w \) labor market barriers (\( \tau_{ig}^h = 0 \)).
The solution to an individual’s utility maximization problem, given an occupational choice:

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

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

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

\[ U(\tau_{ig}, w_i, \epsilon_i) = \bar{\eta}^{\beta} \left( \frac{w_i s_i^* (1 - s_i)^{\frac{1 - \eta}{\beta}} \epsilon_i}{\tau_{ig}} \right)^{\frac{\beta}{1 - \eta}} \]
The Distribution of Talent

We assume Fréchet for analytical convenience:

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

- \( \theta \) 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

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

**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 \( i \):

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

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

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

Misallocation of talent comes from dispersion of \(\tau\)’s across occupation-groups.
Wages and Wage Gaps

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

$$\bar{\text{wage}}_{ig} \equiv \frac{(1 - \tau_{ig}^w)w_iH_{ig}}{q_gP_{ig}} = (1 - s_i)^{-1/\beta} \gamma \bar{\eta} \left( \sum_s \tilde{w}^\theta_{sg} \right)^{\frac{1}{\theta} \cdot \frac{1}{1-\eta}}.$$

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

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

- Selection exactly offsets $\tau_{ig}$ differences across occupations because of the Fréchet assumption.
- Higher $\tau_{ig}$ barriers in one occupation reduce a group’s wages proportionately in all occupations.
Inferring Barriers

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

We infer high $\tau$ 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 $\tau$’s by assuming “zero profits” by occupation (in the labor market and in the human capital market).
Data

- 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

Relative propensity, $p(ww)/p(wm)$

Occupational wage gap (logs)
Change in Wage Gaps for White Women, 1960–2008

Change in log wage gap, 1960–2008

Change in log p(ww)/p(wm), 1960–2008
Estimating $\theta(1 - \eta)$

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

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 $\theta$.
- Attempt to control for “absolute advantage” as well (next slide)
### Adjustments to Wages

<table>
<thead>
<tr>
<th>Base controls</th>
<th>3.11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base controls + Adjustments</td>
<td>3.44</td>
</tr>
</tbody>
</table>

### 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
$\tau_{ig}^h$ for White Women over Time

**Barrier measure, $\tau$**

- **Lawyers**
- **Doctors**
- **Home**
- **Secretaries**

Year:
- 1960
- 1965
- 1970
- 1975
- 1980
- 1985
- 1990
- 1995
- 2000
- 2005
- 2010
Barrier measure, $\tau$

- Home
- Doctors
- Lawyers
- Secretaries

Year

$\tau_{ig}^h$ for White Men over Time

Barrier measure, $\tau$

- Doctors
- Lawyers
- Home
- Secretaries

Year

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

\[ Y = \sum_{i=1}^{I} \sum_{g=1}^{G} \int (c_{jgi} + e_{jgi}) \, dj \]
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.
Allow $A_i$, $\phi_i$, $\tau_{ig}$, 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

$\phi_i$: Occupation-specific return to education

- Wage differences across occupations

$\tau_{ig}$: 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

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\theta(1 - \eta)$</td>
<td>3.44</td>
<td>wage dispersion within occupation-groups</td>
</tr>
<tr>
<td>$\eta$</td>
<td>0.25</td>
<td>midpoint of range from 0 to 0.5</td>
</tr>
<tr>
<td>$\beta$</td>
<td>0.693</td>
<td>Mincerian return across occupations</td>
</tr>
<tr>
<td>$\rho$</td>
<td>2/3</td>
<td>elasticity of substitution b/w occupations of 3</td>
</tr>
<tr>
<td>$\phi_{min}$</td>
<td>by year</td>
<td>schooling in the lowest-wage occupation</td>
</tr>
</tbody>
</table>
How much of growth is due to changing frictions?
Counterfactuals in the $\tau^h$ Case

Total output (market + home)

Baseline
Constant $\tau$’s

Final gap is 14.8%
Counterfactuals in the $\tau^w$ Case

Total output (market + home)

- Baseline
- Constant $\tau$'s

Final gap is 11.6%
## Productivity Gains

<table>
<thead>
<tr>
<th></th>
<th>$\tau^h$ case</th>
<th>$\tau^w$ case</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Average annual wage growth</strong></td>
<td>1.47</td>
<td></td>
</tr>
<tr>
<td><strong>Frictions in all occupations</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Growth due to changing frictions</td>
<td>0.294</td>
<td>0.233</td>
</tr>
<tr>
<td>(Percent of total)</td>
<td>(20.0%)</td>
<td>(15.8%)</td>
</tr>
<tr>
<td><strong>No frictions in “brawny” occupations</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Growth due to changing frictions</td>
<td>0.262</td>
<td>0.197</td>
</tr>
<tr>
<td>(Percent of total)</td>
<td>(17.8%)</td>
<td>(13.4%)</td>
</tr>
</tbody>
</table>
## Potential Remaining Output Gains from Zero Barriers

<table>
<thead>
<tr>
<th>Frictions in all occupations</th>
<th>$\tau^h$ case</th>
<th>$\tau^w$ case</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cumulative gain, 1960–2008</td>
<td>14.8%</td>
<td>11.6%</td>
</tr>
<tr>
<td>Remaining gain from zero barriers</td>
<td>9.3%</td>
<td>4.3%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No frictions in “brawny” occupations</th>
<th>$\tau^h$ case</th>
<th>$\tau^w$ case</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cumulative gain, 1960–2008</td>
<td>13.1%</td>
<td>9.7%</td>
</tr>
<tr>
<td>Remaining gain from zero barriers</td>
<td>7.2%</td>
<td>3.0%</td>
</tr>
</tbody>
</table>
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 $\tau$’s for women, blacks in 1960
- Less in 2008
Average Values of $\tau_{ig}$ over Time

Average $\tau$ across occupations

White Men
White Women
Black Women
Black Men

Year
Variance of log $\tau_{ig}$ over Time

- White Men
- White Women
- Black Women
- Black Men

Year

Variance of log $\tau$

0.35
0.3
0.25
0.2
0.15
0.1
0.05
0

Human capital of white women vs. white men

Graph showing the human capital of white women and men over the years from 1960 to 2010. The calibration parameters are denoted as $\tau^h$ and $\tau^w$.

Human capital, women / men

Calibration: $\tau^h$

Year

Human capital, women / men

Calibration: $\tau^w$

Year

Jobs represented:
- Doctors
- Teachers
- Managers
- Home
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 $\tau^h$ case, 15.8% in our $\tau^w$ case.

**Why do these figures differ?**

- We are isolating the contribution of $\tau$’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 ($\tau^w$, $\theta \to \infty$ and $\eta = 0$).
## Wage Growth Due to Changing $\tau$’s

<table>
<thead>
<tr>
<th></th>
<th>Actual Growth</th>
<th>Due to $\tau^h$’s</th>
<th>Due to $\tau^w$’s</th>
</tr>
</thead>
<tbody>
<tr>
<td>White men</td>
<td>77.0 percent</td>
<td>-4.3%</td>
<td>-10.2%</td>
</tr>
<tr>
<td>White women</td>
<td>126.3 percent</td>
<td>39.4%</td>
<td>33.6%</td>
</tr>
<tr>
<td>Black men</td>
<td>143.0 percent</td>
<td>44.3%</td>
<td>40.2%</td>
</tr>
<tr>
<td>Black women</td>
<td>143.0 percent</td>
<td>57.0%</td>
<td>52.7%</td>
</tr>
</tbody>
</table>

Note: $\tau$ columns are % of growth explained.
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 ($\beta$)
- Average wage gaps
  - E.g. Cut gaps in half in every period: changing $\tau^h$ accounts for 17.0% of growth instead of 20.0%
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: $\tau^h$ calibration

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>ρ = 2/3</th>
<th>ρ = −90</th>
<th>ρ = −1</th>
<th>ρ = 1/3</th>
<th>ρ = .95</th>
</tr>
</thead>
<tbody>
<tr>
<td>Changing ρ</td>
<td></td>
<td>20.0%</td>
<td>15.9%</td>
<td>17.0%</td>
<td>18.6%</td>
<td>23.1%</td>
</tr>
<tr>
<td>Changing θ(1 − η)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Changing η</td>
<td></td>
<td>3.44</td>
<td>4.16</td>
<td>5.61</td>
<td>8.41</td>
<td></td>
</tr>
<tr>
<td>θ(1 − η)</td>
<td></td>
<td>20.0%</td>
<td>18.8%</td>
<td>17.8%</td>
<td>17.0%</td>
<td></td>
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<tr>
<td></td>
<td>η = 1/4</td>
<td></td>
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<td></td>
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<tr>
<td></td>
<td>η = 0</td>
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<tr>
<td></td>
<td>η = .05</td>
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<tr>
<td></td>
<td>η = .1</td>
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<tr>
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<td></td>
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</tr>
<tr>
<td>Changing ρ</td>
<td></td>
<td>20.0%</td>
<td>14.3%</td>
<td>18.1%</td>
<td>19.3%</td>
<td>18.5%</td>
</tr>
<tr>
<td>Wage gaps</td>
<td></td>
<td>20.0%</td>
<td>17.0%</td>
<td>12.8%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Entries in the table are the percent of wage growth explained by changing frictions.
Robustness: $\tau^w$ calibration

<table>
<thead>
<tr>
<th>Baseline</th>
<th>$\rho = 2/3$</th>
<th>$\rho = -90$</th>
<th>$\rho = -1$</th>
<th>$\rho = 1/3$</th>
<th>$\rho = .95$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Changing $\rho$</td>
<td>15.8%</td>
<td>10.0%</td>
<td>11.7%</td>
<td>13.9%</td>
<td>19.9%</td>
</tr>
<tr>
<td>Changing</td>
<td>3.44</td>
<td>4.16</td>
<td>5.61</td>
<td>8.41</td>
<td></td>
</tr>
<tr>
<td>$\theta(1 - \eta)$</td>
<td>15.8%</td>
<td>15.2%</td>
<td>14.4%</td>
<td>13.6%</td>
<td></td>
</tr>
<tr>
<td>$\eta = 1/4$</td>
<td>15.8%</td>
<td>15.6%</td>
<td>15.6%</td>
<td>15.6%</td>
<td>15.8%</td>
</tr>
<tr>
<td>Changed $\eta$</td>
<td>Full</td>
<td>1/2</td>
<td>Zero</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wage gaps</td>
<td>15.8%</td>
<td>13.1%</td>
<td>10.1%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Entries in the table are the percent of wage growth explained by changing frictions.
<table>
<thead>
<tr>
<th></th>
<th>$\tau^h$ case</th>
<th>$\tau^w$ case</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Women’s LF participation</strong></td>
<td>1960 = 0.329</td>
<td>2008 = 0.692</td>
</tr>
<tr>
<td><strong>Change, 1960 – 2008</strong></td>
<td></td>
<td>0.364</td>
</tr>
<tr>
<td>Due to changing $\tau$’s</td>
<td>0.106</td>
<td>0.116</td>
</tr>
<tr>
<td>(Percent of total)</td>
<td>(29.1%)</td>
<td>(31.8%)</td>
</tr>
</tbody>
</table>
## Education Predictions, $\tau^h$ case

<table>
<thead>
<tr>
<th></th>
<th>Actual 1960</th>
<th>Actual 2008</th>
<th>Actual Change</th>
<th>Change vs. WM</th>
<th>Due to $\tau$’s</th>
</tr>
</thead>
<tbody>
<tr>
<td>White men</td>
<td>11.11</td>
<td>13.47</td>
<td>2.35</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White women</td>
<td>10.98</td>
<td>13.75</td>
<td>2.77</td>
<td>0.41</td>
<td>0.60</td>
</tr>
<tr>
<td>Black men</td>
<td>8.56</td>
<td>12.73</td>
<td>4.17</td>
<td>1.81</td>
<td>0.62</td>
</tr>
<tr>
<td>Black women</td>
<td>9.24</td>
<td>13.15</td>
<td>3.90</td>
<td>1.55</td>
<td>1.10</td>
</tr>
<tr>
<td>--------------------------</td>
<td>-----------</td>
<td>-----------</td>
<td>-----------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All groups</td>
<td>21.1%</td>
<td>19.2%</td>
<td>20.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White women</td>
<td>8.7%</td>
<td>15.4%</td>
<td>12.6%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black men</td>
<td>3.4%</td>
<td>0.8%</td>
<td>1.9%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black women</td>
<td>4.7%</td>
<td>1.4%</td>
<td>2.8%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Entries are % of growth explained. “All” includes white men.
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual wage convergence</td>
<td>20.7%</td>
<td>-16.5%</td>
<td>10.0%</td>
</tr>
<tr>
<td>Due to all $\tau$’s changing</td>
<td>2.9%</td>
<td>0.2%</td>
<td>3.3%</td>
</tr>
<tr>
<td>Due to black $\tau$’s changing</td>
<td>3.3%</td>
<td>1.6%</td>
<td>5.0%</td>
</tr>
</tbody>
</table>

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

Distinguishing between $\tau^h$ and $\tau^w$ empirically:

- Look at cohort vs. time effects.
- Assume $\tau^h$ is a cohort effect, $\tau^w$ a time effect.
- Early finding: mostly $\tau^h$ 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?