The Allocation of Talent

and U.S.Economic Growth

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Introduction

- In 1960, 94 percent of doctors and lawyers were white men. By 2010, the fraction was just 62 percent. Similar changes in other highly-skilled occupations have occurred throughout the U.S. economy during the last fifty years.
- Given that the innate talent for these professions is unlikely to have changed differently across groups, the change in the occupational distribution since 1960 suggests that a substantial pool of women and black men in 1960 were not pursuing their comparative advantage.

Introduction

- We examine the effect on aggregate productivity of the convergence in the occupational distribution between 1960 and 2010 through the prism of a Roy model.
- Across our various specifications, between 20 and 40% of growth in aggregate market output per person can be explained by the improved allocation of talents.
- Within the model, every person is born with a range of talents or preferences across occupations. Each individual chooses the occupation where she obtains the highest utility given her talents and preferences.

Discrimination

- First, we allow for discrimination in the labor. We model labor market discrimination as an occupation-specific wedge between wages and marginal products. This "tax" is a proxy for many common formulations of discrimination in the literature.
- Second, the misallocation of talent can be due to barriers to forming human capital. We model these barriers as increased monetary costs associated with accumulating occupation-specific human capital market.
- Finally, we allow for differences in preferences or social norms to drive occupation differences across groups.

Model

- Roy (1951) model
- workers are heterogeneous in either their talent or their preferences over occupations
- forces that distort the allocation of workers across occupations: discrimination in the labor market, barriers to human capital accumulation, and group-specific social norms.
- Individuals invest in human capital and choose an occupation in an initial "preperiod." They then work in their chosen market occupation or in the home sector for three working life cycle periods ("young", "middle" and "old").

Utility Function

- Lifetime utility of a worker from group g and cohort c who chooses occupation i:

$$\log U = \beta \left[\sum_{t=c}^{c+2} \log C(c,t) \right] + \log \left[1 - s(c) \right] + \log z_{ig}(c) + \log \mu$$

- $C(c,t)$: consumption of cohort c in year t
- $S(c)$: time allocated to human capital acquisition in the pre-period
- $z_i g(c)$: the common utility benefit of all members of group g from working in occupation i
- μ: idiosyncratic utility benefit of the individual from the occupation

Model

- Individuals acquire human capital in the initial period, and this human capital remains fixed over their lifetime

$$h_{ig}(c,t) = \bar{h}_{ig}\,\gamma(t-c)\,s_i(c)^{\phi_i}\,e_{ig}(c)^{\eta}.$$

- h_{ig}: permanent differences in human capital endowments
- γ: the return to experience
- ϕ_i: occupation-specific return to time investments in human capital
- η: elasticity of human capital with respect to human capital expenditures

Model

- Consumption equals "after-tax" earnings net of expenditures on education

$$C(c,t) = \left[1 - \tau_{ig}^{w}(t)\right] \, w_i(t) \, \epsilon \, h_{ig}(c,t) - e_{ig}(c,t) \left[1 + \tau_{ig}^{h}(c)\right].$$

- $_i$: person's efficiency units of labor
- ϵ: the worker's idiosyncratic talent in their chosen occupation
- $\tau_{i}{}_{g}^{w}$: Labor market discrimination
- $\tau_{i}{}_{g}^{h}$: Barriers to human capital attainment

Model Results

- Given an occupational choice, a wage w_i, and idiosyncratic ability ϵ in the occupation, the individual chooses consumption in each period and e and s in the initial pre-period to maximize lifetime utility

$$s_i^* = \frac{1}{1 + \frac{1-\eta}{3\beta\phi_i}}$$

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

Utility Function

$$U_{ig}^{*} = \mu_i \left[\bar{\gamma}\widetilde{w}_{ig}\epsilon_i\right]^{\frac{3\beta}{1-\eta}}$$

- where

$$\widetilde{w}_{ig} \equiv w_i s_i^{\phi_i} \left(1 - s_i\right)^{\frac{1-\eta}{3\beta}} \cdot \frac{\bar{h}_{ig}\, \tilde{z}_{ig}}{\tau_{ig}},$$

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

$$\tilde{z}_{ig} \equiv z_{ig}^{\frac{1-\eta}{3\beta}}.$$

Model Results

- The effect of labor market discrimination and human capital barriers is summarized by the "composite" τ_{ig}^{w}.
- More human capital barriers or labor market discrimination increase τ_{ig}^{w}, which lowers indirect utility for an individual from group g when choosing occupation i.
- Group-specific disutility from working in occupation i is represented as a low value of $z_{ig}(c)$.
- Higher innate talent ϵ or preferences μ also increases the rewards for choosing an occupation.

Results

- Occupational choice
  - the fraction of people from cohort c and group g who choose occupation i
  - the occupational choice problem thus reduces to picking the occupation that delivers the highest value of U_{ig}
- Occupational Wages
- Relative Propensities
  - The fraction of a group working in an occupation—relative to white men
- Relative Labor Force Participation

Firms and Equilibrium

- A representative firm produces final output Y from workers in M occupations:

$$Y = \left[\sum_{i=1}^{M} (A_i \cdot H_i)^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}}$$

- We endogenize (τ^w) and (τ^h) as a function of the discriminatory preferences of firm owners.
- We define general equilibrium of the model and contains a proposition describing how the equilibrium allocation and prices can be solved for.

Inference with Selection Only on Ability

- We now explain how we identify the driving forces of our model given data on wages and occupational shares for different groups of workers.
- Assumptions
  - First, we assume the relative mean occupational talent of a group relative to white men is constant over time. It implies that the change in the occupational distribution of women and black men relative to white men since 1960 must be driven by changes in labor market or human capital frictions or by changes in common occupational preferences.
  - Second,we assume that idiosyncratic occupational abilities or preferences are distributed iid Frechet.

Data

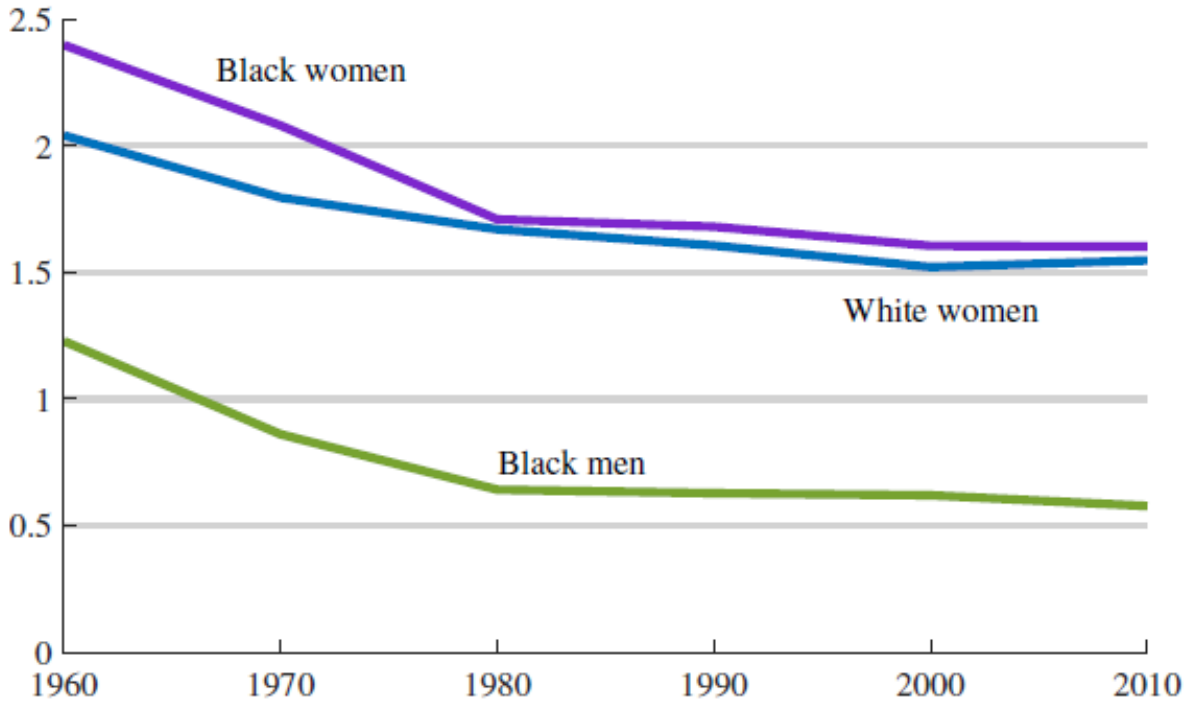
- We use data from the 1960, 1970, ... 2000 decennial Censuses and the 2010-2012 American Community Surveys (ACS).
- We restrict the sample to four groups: white men, white women, black men and black women.
- We include individuals between the ages of 25 and 54. This restriction focuses the analysis on individuals after they finish schooling and prior to retirement.

Composite Frictions vs. Occupational Preferences

- differences in occupational choice between women and black men relative to white men are driven by differences in the ratio of occupational preferences to occupational frictions z/τ
- The sorting of women and blacks has converged toward that of white men over time.
- This fact indicates that the τ and/or z of women and black men must have converged toward that of men.
- This is one key fact behind our finding that the allocation of talent has improved over the last five decades.

Composite Frictions vs. Occupational Preferences

Figure 1: Standard Deviation of Relative Occupational Shares



Note: Figure shows the standard deviation of $\ln\left(\frac{p_{ig}}{p_{wm}}\right)$ across occupations for each group weighting each occupation by the share of earnings in that occupation. Specifically, we show the data for young white women (middle line), young black men (bottom line), and young black women (top line) relative to young white men.

Composite Frictions vs. Occupational Preferences

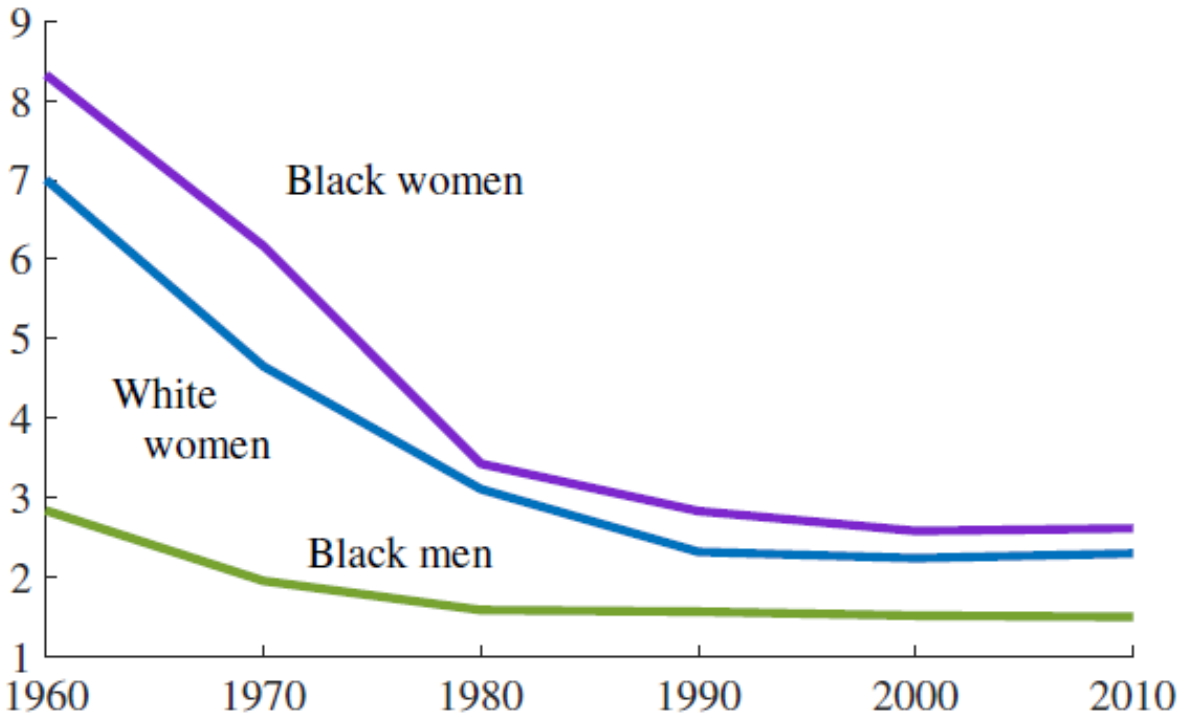
- wage gaps across occupations for the young are proportional to gaps in $z^{-1/1-\eta}$
- For example, if white women are poorly compensated (relative to white men) as lawyers compared to secretaries, it must be the case that women receive higher utility from working as secretaries compared to lawyers.
- For a given estimate of η we can infer relative z across groups by fitting the occupational wage gaps across groups and occupations for the young.

Composite Frictions vs. Occupational Preferences

- Conditional on having an estimate of the parameters θ and η, the composite friction τ can be recovered from data on relative occupational shares after controlling for the average wage gap.
- Intuitively, the wage gap controls for the effect of preferences on occupational choice. The "residual" occupational choice is therefore only driven by the effect of τ.

Composite Frictions vs. Occupational Preferences

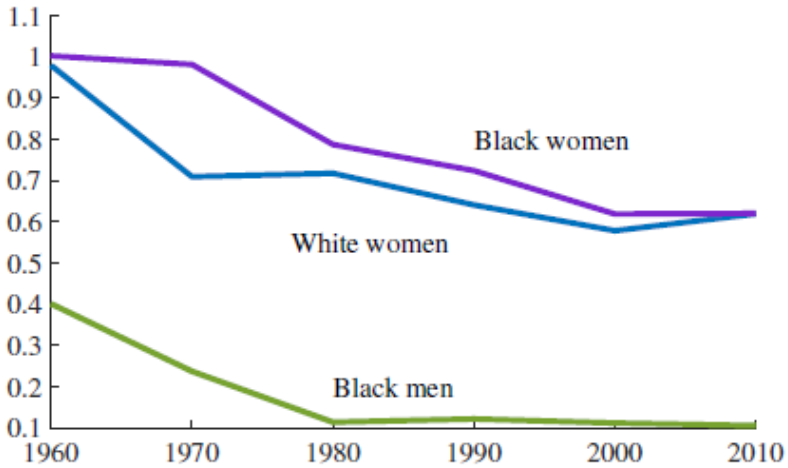
Figure 2: Mean of Composite Occupational Frictions



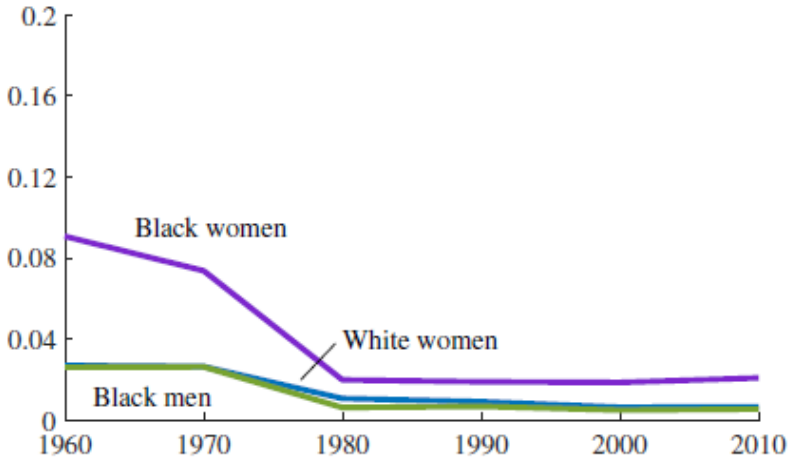
Note: Figure shows earnings-weighted mean of τ for each group.

Composite Frictions vs. Occupational Preferences

Figure 3: Variance of Composite Frictions and Occupational Preferences



COMPOSITE FRICTIONS (τ)

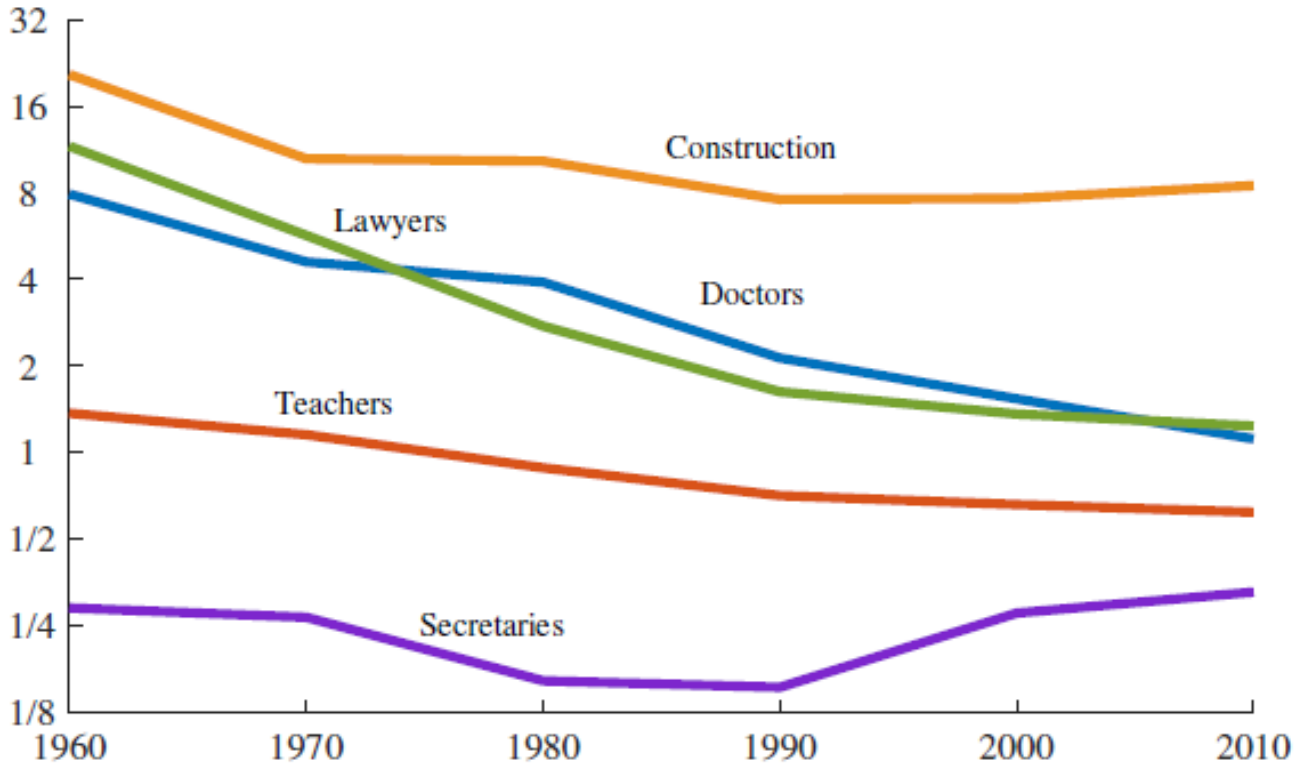


OCCUPATIONAL PREFERENCES ($\tilde{Z}$)

Note: Figure shows the earnings-weighted variance of $\ln \tau$ (left panel) and $\ln \tilde{z}$ (right panel).

Composite Frictions vs. Occupational Preferences

Figure 4: Occupational Barriers (τ_{ig}) for White Women



Note: Author's calculations based on equation (7) using Census data and imposing $\theta = 2$ and $\eta = 0.103$.

Labor Market vs. Human Capital Discrimination

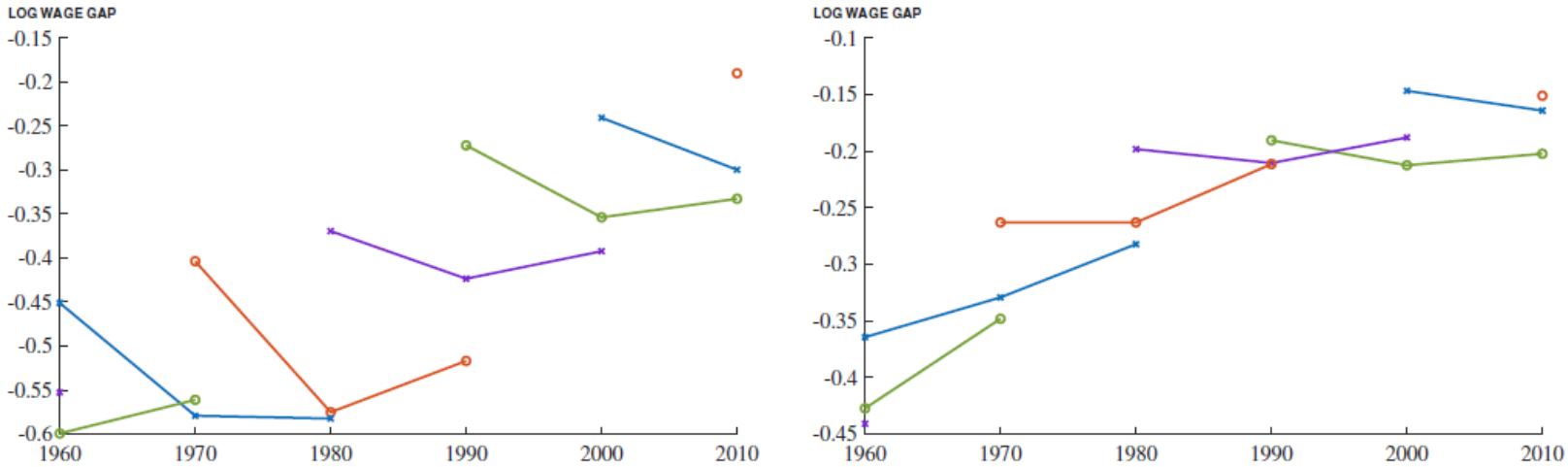
- The occupational frictions shown in Figures 3 and 4 are a composite of labor market discrimination (τ^w) and human capital barriers (τ^h).
- The key assumption is that individuals make an active choice to obtain human capital prior to entering the labor market. This assumption implies that human capital discrimination is akin to a cohort effect, whereas labor market discrimination affects all cohorts in the labor market at the same point in time and thus is like a time effect.

Labor Market vs. Human Capital Discrimination

- The change in the wage gap over the lifecycle depends on the change in τ^w over time. If labor market discrimination diminishes over time, this raises the average wage (relative to white men) in occupations where the group previously faced discrimination. We therefore use the change in the wage gap over a cohort-group's lifecycle to infer the change in τ^w over time. We then use $\tau_{ig} = (1 + \tau_{ig}^h)^\eta / (1 - \tau_{ig}^w)$to infer the change in τ^h from the change in τ after controlling for the change in τ^w.
- Intuitively, the change in τ^h is calculated as the difference in the wage gap of the young between successive cohorts after controlling for the slope of the life-cycle wage gap for a given cohort.

Labor Market vs. Human Capital Discrimination

Figure 5: Wage Gaps Relative to White Men by Time and Cohort



WHITE WOMEN

BLACK MEN

Note: Log wage gaps are shown for the life cycle of each cohort by connected line segments for young, middle-aged, and old periods.

Recap and Model Fit

- Table 1 summarizes the identifying assumptions and normalizations for our base parameterization of the model

Table 1: Identifying Assumptions and Normalizations

Parameter	Definition	Determination	Value
$\tau^h_{i,wm}$	Human capital barriers (white men)	Assumption	0
$\tau^w_{i,wm}$	Labor market barriers (white men)	Assumption	0
$\bar{h}_{i,g}$	Talent in each occupation (all groups)	Assumption	1
$\tau^h_{home,g}$	Home human capital barriers (all groups)	Assumption	0
$\tau^w_{home,g}$	Home labor market barriers (all groups)	Assumption	0
$\tilde{z}_{home,g}$	Home occupational preference (all groups)	Normalization	1

Recap and Model Fit

- Table 2 summarizes the key parameters.

Table 2: Baseline Parameter Values

Parameter	Definition	Determination	Value
θ	Fréchet shape	Wage dispersion, Frisch elasticity	2
η	Goods elasticity of human capital	Education spending	0.103
σ	EoS across occupations	Arbitrary	3
β	Consumption weight in utility	Mincerian return to education	0.231

Recap and Model Fit

- Table 3 summarizes the endogenous variables and the target data for their indirect inference.

Table 3: Forcing Variables and Empirical Targets when $\delta = 0$

Parameter	Definition	Empirical Target
$A_i(t)$	Technology by occupation	Occupations of young white men
$\phi_i(t)$	Time elasticity of human capital	Education by occupation, young white men
$\tau^h_{ig}(c)$	Human capital barriers	Occupations of the young, by group
$\tau^w_{ig}(t)$	Labor market barriers	Life-cycle wage growth, by group
$\tilde{z}_{ig}(c)$	Occupational preferences	Wages by occupation for the young
$\gamma(1), \gamma(2)$	Experience terms	Age earnings profile of white men

Note: The variable values are chosen jointly to match the empirical targets. $\delta = 0$ refers to the polar case where individuals draw idiosyncratic ability for each occupation (but not idiosyncratic tastes).

Recap and Model Fit

- Finally, Table 4 compares the data and the model's predictions for aggregate earnings per worker and labor force participation by year.

Table 4: Model versus Data: Earnings and Labor Force Participation

Year	Earnings Data	Earnings Model	LFP Data	LFP Model
1960	18,383	18,615	0.599	0.599
1970	24,645	25,000	0.636	0.614
1980	27,088	27,900	0.702	0.653
1990	33,953	34,265	0.764	0.720
2000	39,419	41,134	0.747	0.743
2010	41,541	42,717	0.759	0.748

Note: This table shows average market earnings per worker in 2009 dollars and labor force participation in the Census/ACS data alongside the corresponding model values by year.

Results with Selection Only on Ability ($\delta = 0$)

- Given the discussion of inference above, we can now answer the key question of the paper: **how much of the overall growth from 1960 to 2010 can be explained by the changing labor market outcomes of women and black men during this time period?**

Results with Selection Only on Ability ($\delta = 0$)

- Real earnings per person in our census sample grew by 1.8 percent per year between 1960 and 2010. According to our model, this observed earnings growth can come from five sources:
  - General occupational productivity growth (changing A's).
  - Growth in the returns to schooling, which results in more human capital attainment (changing ϕ's).
  - Changing preferences can reallocate labor across occupations and generate earnings growth (changing z's).
  - Growth in the relative share of each group in the working age population can also mechanically change earnings per capita (changing q's).
  - Changing gender- and race specific barriers to occupational choice can result in economic growth (changing τ's).

Results with Selection Only on Ability ($\delta = 0$)

- To assess how much the changing τ's contributed to economic growth, we hold the τ's fixed while allowing the A's, ϕ's, z's and q's to evolve.
- We then use the difference between the actual path in the data and the counterfactual "no change in τ's" path to measure the contribution of changing τ 's.

Income and Productivity Gains

- The results of our baseline counterfactual are shown in the first column of Table 5. The changes in τ 's account for 41.5% of growth from 1960 to 2010 in market GDP per person (row 1) and 38.4% in market earnings per person (row 2).

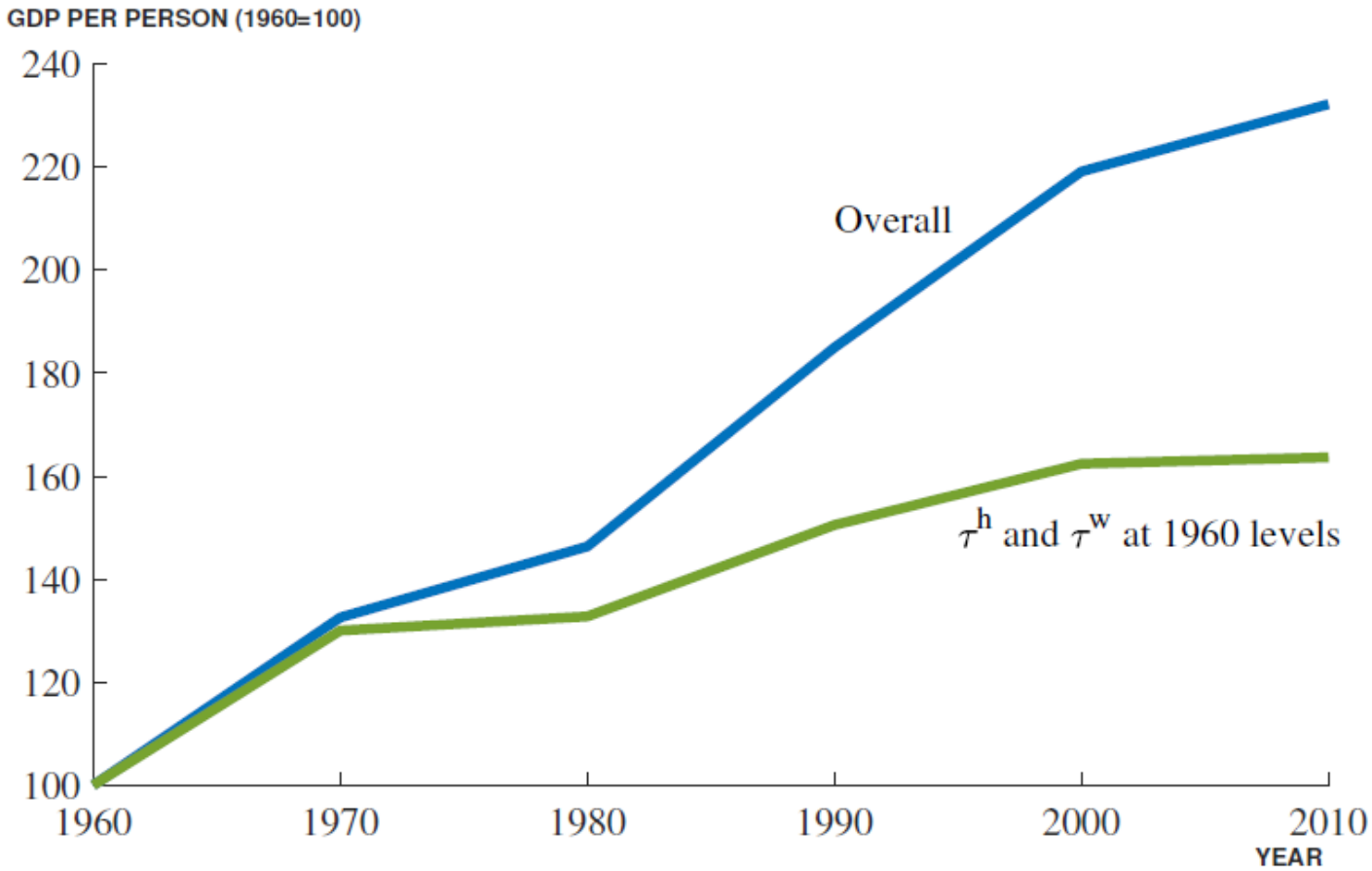
Table 5: Share of Growth due to Changing Frictions (all ages)

	Share of growth accounted for by			
	τ^h and τ^w	τ^h, τ^w, $\tilde{z}$	τ_h only	τ_w only
Market GDP per person	41.5%	40.8%	36.0%	7.7%
Market earnings per person	38.4%	37.5%	18.9%	26.0%
Labor force participation	90.4%	112.7%	24.9%	56.2%
Market GDP per worker	24.0%	15.0%	40.0%	-9.8%
Home+market GDP per person	32.7%	32.1%	30.6%	4.4%

Note: Entries in the table show the share of growth in the model attributable to changing frictions under various assumptions. The variables are τ^h (human capital frictions), τ^w (labor market frictions), and $\tilde{z}$ (occupational preferences).

Income and Productivity Gains

Figure 7: GDP per person, Data and Model Counterfactual



Note: The graph shows the cumulative growth in GDP per person (market), in the data (overall) and in the model with no changes in τ's as in Table 5.

Conclusion

- We then used a general equilibrium setup to isolate the aggregate effects of the reduction in occupational barriers facing women and black men in the U.S. from 1960 to 2010. Our baseline calculations suggest that falling barriers explain roughly 40% of aggregate growth in market GDP per person.