# Race, Wealth, and Unemployment Insurance

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**Abstract**

This study examines the effects of labor market discrimination on employment, wage disparities, and wealth accumulation among black and white workers in the United States. Utilizing a search-and-matching model that integrates race-specific differences in job separation rates, job finding rates, and idiosyncratic productivity processes, we uncover that racial disparities in both search and matching and productivity processes contribute to unemployment and wage gaps. These gaps are notably larger for high-productivity workers and give rise to wealth disparities, with black workers predominantly concentrated at the lower end of the wealth distribution. We further explore the role of unemployment insurance (UI) in shaping labor market outcomes, demonstrating that a more expansive UI policy raises median wages. Specifically, a longer UI coverage period effectively narrows the racial wage gap, while higher UI replacement rates consistently enhance welfare for black workers. In contrast, the maximum UI coverage cap has a marginal impact on welfare improvement but a stronger effect in reducing the racial wealth gap. Our findings suggest that extending coverage periods and increasing replacement rates can mitigate the wage gap arising from racial discrimination in the search-and-matching process in the context of labor market discrimination.

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*Keywords:* heterogeneous agent, search-and-matching, racial inequality, labor market, unemployment, wealth distribution, business cycle

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# 1 Introduction

Researchers have long studied the labor market differentials between black and white workers since Becker (1957). A growing body of recent empirical studies extend it into business cycle patterns. Black workers are the first fired and last hired during recessions, have much higher unemployment volatility, higher wage volatility and receive persistent discriminatory wage and employment differentials over the business cycle (Couch and Fairlie, 2010; Biddle and Hamermesh, 2013; Cajner, Radler, Ratner, and Vidangos, 2017; Daly, Hobijn, and Pedtke, 2020; Bartscher, Kuhn, Schularick, and Wachtel, 2021). Though black workers are disproportionately affected in the recession, conventional unemployment insurance policies do not take into consideration of these racial gaps. This paper fills this void by examining the disparate consequences of unemployment insurance between black and white workers.

This paper provides three key findings. First, racial discrimination on black workers in the labor market search-and-matching process serves as an inefficient labor market friction. It transmits to racial gaps in the labor market outcomes, and generates differences in wealth accumulation between black and white workers. Second, wealth differences further exacerbates the discrimination frictions, and aggregate the labor market outcome gaps between black and white workers. Lastly, a strong public unemployment insurance program, though racially blind, decreases the impact of discriminatory frictions, and reduces the racial gaps in the labor market.

In this paper, we construct a heterogeneous agent labor market search-and-matching model that incorporates black-white racial gap in the labor market institution. Individuals are *ex-ante* different on race. Unemployed workers can search for jobs and firms post vacancies. Workers and firms bargain for a wage rate to maximize joined matched surplus. Aggregate fluctuation comes from the factor productivity shocks to production technology.

Importantly, firms cannot discriminate based on race at the vacancy posting stage. Hence, our model features a single labor market for both kinds of workers and not the segmented markets usually featured in models of skill heterogeneity. In our case, even when firms cannot

specify race in their vacancy postings, the firms exhibit differential hiring behaviour based on race in the equilibrium. This endogenously generates lower job-finding rate and higher unemployment rate for black workers.

We model the racial difference in our model through different search frictions and bargaining power black and white workers are facing. We calibrate the matching process for white and black workers separately using monthly CPS data, in addition to standard aggregate labor market index. We choose the efficiency of matching, elasticity of unemployment in the matching function, and bargaining power by targeting the volatilities of wage and unemployment, as well as job finding and separation rates by race in the US. Daly et al. (2020) document a 10-15% average wage gap between black and white men, and that black men have monthly job separation rate of 6.3%, twice of the white men, while job finding rate is 7.7%, compared to 7.3% of white men. Racial difference in labor market institutions can be a result of explicit labor market discrimination and pre-market discrimination[1]. This paper shows how such institution contributes to the large business cycle labor market racial differences.

Upon calibration, we evaluate the aggregate and individual labor market consequences, focusing on wealth accumulation, unemployment rate, and wage rate. Without further financial frictions, our model generates significant difference in wealth accumulation between black and white workers. Advantageous labor market conditions allows white workers with much lower job separation and higher job finding rates. With more favorable employment opportunities, white workers are able to perform wealth accumulation with less likelihood for interruptions from negative labor market shocks. As a result, white workers hold 82% of wealth in the model.

Black workers face higher job separation rate and lower job finding rate, with lower wealth positions compared to white workers. As a consequence, black workers have lower reservation value in the wage bargaining process. The disadvantage of black workers in the overall labor

[1]Such as education preparation (e.g. Arcidiacono, Aucejo, and Hotz, 2016), process associated with housing and wealth accumulation (e.g. Shertzer, Twinam, and Walsh, 2016), among many other dimensions.

market is further exemplified in their bargained wage. On average, black workers receive 87% of the wage rate of white workers. Such wage gap increases in wealth. Higher bargaining power and favorable labor market conditions give wealthy white workers more bargaining power for higher wage, but less so for black workers.

Similarly, the labor market outcomes differ in the unemployment rate between black and white workers. Higher job separation rate and lower finding rate for black workers create additional job search frictions for them. It leads to higher unemployment rate for black workers than for white workers through the wealth spectrum. The unemployment rate gap is the highest in the middle wealth region. However, the unemployment insurance take-up rate is higher for white workers in the upper-middle wealth region.

Lastly, we find that higher unemployment insurance replacement rate and longer eligibility duration reduce the racial unemployment rate and wage rate gaps between black and white workers. Although the policy provides equal subsidy and duration to all claimers, it disproportionately raises the reservation values for black workers, and reduces the additional layer of frictions that unemployed black people are facing.

This paper contribute to the rising discussion on distributional impact of business cycle by focusing on the disparate outcomes of white and black workers. It joins Caballero and Hammour (1994), Jaimovich and Siu (2020), and Heathcote, Perri, and Violante (2020) in providing evidence that recessions disproportionately hurt disadvantaged individuals, leading to widening earnings gap over time. Borella, De Nardi, and Yang (2018) show that introducing gender difference in an OLG model provides better model fit. This paper will provide insights into how racial difference allows better fit for search models over business cycle. Theoretically, Krusell and Smith (1998) conclude that heterogeneity in wealth does not alter business cycle fluctuations. Jang, Sunakawa, Yum, et al. (2020) show that heterogeneity passes to large aggregate fluctuations when introducing non-convexity in budget constraint through progressive tax. This paper identifies that, racial wedge in labor search transmits individual risk and heterogeneity to aggregate fluctuations.

Germane to our paper, Nakajima (2012) and Nakajima (2021) have a similar model structure. Different from Nakajima (2021), we introduce an additional layer of institutional friction in the labor market, and do not allow firms screening candidates based on racial differences. Setty and Yedid-Levi (2021) introduces heterogeneity in labor search-and-matching based on skills. We show that racial difference persists across all skill levels. We further build upon Mitman and Rabinovich (2015) and evaluate the distribution of wealth and labour market outcomes due to various business cycle policies.

The rest of the paper proceeds as follows. Section 2 lays out theoretical framework. Section 3 discusses the calibration strategy. Section 4 examines the racial differences in wealth and labor markets. Section 5 discusses counterfactual unemployment insurance policies in changing racial gaps in labor market. Section 7 concludes the paper.

# 2 Model

We construct a search and matching model with two types of firms that post vacancies in a unified labor market to hire workers. Prejudiced firms ($p$) discriminate against Black workers and only hire White workers. Non-prejudiced firms ($np$) hire black and white workers without discrimination.

Individual workers are heterogeneous on race (black or white, $Ra = [bl, wh]$), wealth (continuous as $a \in A$), current employment status (working for $p$ or $np$ firms, and unemployed, $e = [p, np, 0]$), current unemployment insurance eligibility status (eligible or not, $el = [1, 0]$), and idiosyncratic matched productivity shocks ($s \in S$). For continuing matched workers, the idiosyncratic productivity evolves as AR(1): $s' = \rho_{s,Ra} s + \epsilon_{s,Ra}$, with $\epsilon_{s,Ra} \overset{iid}{\sim} N(0, \sigma_{s,Ra})$. The AR(1) shocks are race-specific, suggesting the exogenously differential labor market risks perturbing black and white workers. Individual workers are distributed on the $\mu \in \{Ra, e, el, s, a\}$. We set the model period to be quarterly.

## 2.1 Labor market search and matching

The total number of unemployed workers $u$ is the sum of unemployed black ($u_{bl}$) and white ($u_{wh}$) workers. The number of $np$ vacancies available is $v_{np}$, and number of $p$ firm vacancies is $v_p$. We define the non-prejudiced market tightness as $\theta_{np} = v_{np}/u$, and the prejudiced market tightness as $\theta_p = v_p/u_{wh}$.

Firms post vacancies to find workers and unemployed persons actively search for jobs. All agents face the same matching function:

$$m = M(u, v) = \gamma u^{\alpha} v^{(1-\alpha)} \tag{1}$$

A unemployed person finding $np$ jobs has job finding probability $f_{np}(\theta_{np}) = M(u, v_{np})/u = \theta_{np}^{(1-\alpha)}$. The vacancy filling probability is: $q(\theta_{np}) = M(u, v_{np})/v_{np} = \gamma\theta_{np}^{-\alpha}$. Similarly, an unemployed white person finding $p$ job has job finding probability $f_p(\theta_p) = M(u_{wh}, v_p)/u_{wh} = \theta_p^{(1-\alpha)}$. The $p$ job vacancy filling probability is: $q(\theta_p) = M(u_{wh}, v_p)/v_p = \gamma\theta_p^{-\alpha}$.

## 2.2 Unemployment insurance

If a worker loses their job, they may be eligible to receive unemployment insurance. Unemployment insurance is characterized by the benefit $b$ and eligibility $el$. To avoid tracking a worker's individual history, we model the unemployment insurance as a fraction of the average wage $\overline{w}(z, Ra, s, a)$ of the same type of worker in the current state of the economy, and the eligibility as a random receiving probability $Pe(z)$, following Setty and Yedid-Levi (2021) and Mitman and Rabinovich (2015).

We set the replacement rate $h$ and maximum benefit level $\chi$. The benefit a person can receive $b(Ra, s, a) = min\{h\overline{w}(Ra, s, a), \chi\}$. The eligibility criteria is set such that a newly unemployed person is guaranteed to receive unemployment insurance. A current unemployed person receiving the insurance faces a probability $Pe(z)$ of receiving unemployment insurance next period. If the person is currently unemployed and ineligible, they will continue to be

ineligible.

## 2.3 Worker's problem

A non-prejudiced firm can employ any worker ($W_{np}$). Only white workers can work at a prejudiced firm ($W_p$). Since the unemployment benefit depends on a worker's last employment situation, unemployed workers eligible for unemployment benefits are differentiated on whether a prejudiced ($U_p^I$) or non-prejudiced ($U_{np}^I$) firm previously employed them. If a worker loses their benefit, their value becomes $U^N$.

Each worker has race-dependent subjective discounting $\beta_{Ra}$ and survival probability $\eta$. If one receives the survival shock $1-\eta$, one is replaced by a new person with zero asset holdings to unemployment without insurance state. Following Krueger, Mitman, and Perri (2016), we assume the deceased's assets pay extra returns to survivors. The adjusted asset returns becomes $(1+r_\mu)/\eta$.

### 2.3.1 Employed with $np$ firm

$$\begin{aligned} W_{np}(\mu; Ra, s, a) = \max_{c,a'>0} \Big\{ & u(c) + \eta\beta_{Ra} \sum_{s'} \Pi_{ss'} [\lambda_{np} U_{np}^I(\mu'; Ra, s', a') \\ & + (1-\lambda_{np}) W_{np}(\mu'; Ra, s', a')] \Big\} \\ & \text{s.t.} \\ & c + a' = \omega_{np}(\mu; Ra, s, a)(1-\tau_\mu) + (1+r_\mu)a/\eta + d_\mu \end{aligned} \tag{2}$$

Each employed person has value function $W_{np}$, which is given by the current utility from consumption, $u(c)$, and discounted future value by $\beta_{Ra}$ adjusted by survival rate $\eta$. The person's income is split into consumption $c$ and savings for future $a'$. Their income comes from savings from before $(1+r)a/\eta$, dividend $d$, and after-tax labor income $w(\mu; Ra, s, a)(1-\tau_{Ra})$, at labor income tax rate $\tau_\mu$.

A working person may receive a job destruction shock, specific to the $np$ firms, at probability $\lambda_{np}$. Hence, their possibility of remaining employed next period is $1-\lambda_{np}$.

### 2.3.2 Employed with $p$ firm

Prejudiced firms $p$ only hire white workers ($Ra = 2$). The matched worker receives job destruction shock $\lambda_p$, specific to $p$ firms. If one loses a job in the next period, one moves to the $U_p^I$ state, where one is unemployed with eligibility for UI. The rest of the model structure is the same as $W_{np}$.

$$\begin{aligned} W_p(\mu; 2, s, a) = \max_{c,a'>0} \Big\{ u(c) + \eta\beta_2 \sum_{s'} \Pi_{ss'} [\lambda_p U_p^I(\mu'; 2, s', a') \\ +(1-\lambda_p) W_p(\mu'; 2, s', a')] \Big\} \\ \text{s.t.} \\ c + a' = \omega_p(\mu; 2, s, a)(1-\tau_\mu) + (1+r_\mu)a/\eta + d_\mu \end{aligned} \tag{3}$$

### 2.3.3 Unemployed and eligible workers

Since unemployment insurance depends on past wages, the value of a worker's state of UI qualifying state, $U^I$, depends on $p$ or $np$ history.

**White worker from a $np$ firm**:

$$\begin{aligned} U_{np}^I(\mu; 2, s, a) = \max_{c,a'>0} \Big\{ u(c) + \eta\beta_2 \sum_{s'} \Pi_{ss'} [(1 - f_{np}(\theta_{np})) f_p(\theta_p) W_p(\mu'; 2, s', a') \\ +f_{np}(\theta_{np})(1 - f_p(\theta_p)) W_{np}(\mu'; 2, s', a') \\ +(1 - f_p(\theta_p))(1 - f_{np}(\theta_{np}))[P e U_{np}^I(\mu'; 2, s', a') + (1 - Pe) U^N(\mu'; 2, s', a')] \\ +f_{np}(\theta_{np}) f_p(\theta_p) max[W_p(\mu'; 2, s', a'), W_{np}(\mu'; 2, s', a')]] \Big\} \\ \text{s.t.} \\ c + a' = b_{np}(2, s, a)(1-\tau_\mu) + (1+r_\mu)a/\eta + d_\mu \end{aligned} \tag{4}$$

If a white worker is unemployed from a $np$ firm and is eligible for unemployment insurance, one has value function $U_{np}^I$. The person has current utility from consumption, $u(c)$, and discounted future survival value. The person's income is similar to an employed person's, except one receives after-tax unemployment benefits $b(1-\tau)$ than labor income.

An unemployed person actively searches for a job. They have the probability $(1 - f_{np}(\theta_{np}))f_p(\theta_p)$ to find only a $p$ job, probability $f_{np}(\theta_{np})(1 - f_p(\theta_p))$ to find only a $np$ job, probability $(1 - f_p(\theta_p))(1 - f_{np}(\theta_{np}))$ finding no jobs, and probability $f_{np}(\theta_{np})f_p(\theta_p)$ finding job offers from both $np$ and $p$ firms.

If the worker finds no job, they have a probability $Pe$ chance of continuing to receive unemployment benefits and $1 - Pe$ probability of losing it. If a worker finds job offers from both $np$ and $p$ firms, they choose whichever offer provides the larger expected returns.

**White worker from a $p$ firm**:

Like $U^I_{np}$, a UI-eligible white worker from a $p$ firm has the value function $U^I_p$. Since the unemployment benefit for this worker is related to their worker history at the $p$ firm, we track the notation separately rather than mixing it with $U^I_{np}$.

$$\begin{aligned} U^I_p(\mu; 2, s, a) = \max_{c,a'>0} \Big\{ u(c) + \eta\beta_2 \sum_{s'} \Pi_{ss'} [(1 - f_{np}(\theta_{np}))f_p(\theta_p)W_p(\mu'; 2, s', a') \\ + f_{np}(\theta_{np})(1 - f_p(\theta_p))W_{np}(\mu'; 2, s', a') \\ + (1 - f_p(\theta_p))(1 - f_{np}(\theta_{np}))[PeU^I_p(\mu'; 2, s', a') + (1 - Pe)U^N(\mu'; 2, s', a')] \\ + f_{np}(\theta_{np})f_p(\theta_p)max[W_p(\mu'; 2, s', a'), W_{np}(\mu'; 2, s', a')]] \Big\} \\ \text{s.t.} \\ c + a' = b_p(2, s, a)(1 - \tau_\mu) + (1 + r_\mu)a/\eta + d_\mu \end{aligned} \tag{5}$$

**Black worker from a $np$ firm**:

Given the firm structure, an unemployed black worker with UI eligible status can only be linked to work history from $np$ firm. They have the value $U^I_{np}(\mu; 1, s, a)$.

$$\begin{aligned} U^I_{np}(\mu; 1, s, a) = \max_{c,a'>0} \Big\{ u(c) + \eta\beta_1 \sum_{s'} \Pi_{ss'} [f_{np}(\theta_{np})W_{np}(\mu'; 1, s', a') \\ + (1 - f_{np}(\theta_{np}))[PeU^I_{np}(\mu'; 1, s', a') + (1 - Pe)U^N(\mu'; 1, s', a')] \Big\} \\ \text{s.t.} \\ c + a' = b_{np}(1, s, a)(1 - \tau_\mu) + (1 + r_\mu)a/\eta + d_\mu \end{aligned} \tag{6}$$

These workers look for jobs in the $np$ sector while unemployed. They have the probability $f_{np}(\theta_{np})$ finding a job and $1 - f_{np}(\theta_{np})$ remain unemployed. One has a $(1 - Pe)$ probability of losing the unemployment benefit if unemployed.

### 2.3.4 Unemployed and not eligible worker

If an unemployed eligible worker loses their UI, they move to the not-eligible state. One's work history doesn't matter, as past wages don't enter these equations. However, white workers can find jobs at $np$ and $p$ firms, and black workers can only find jobs at $np$ firms.

**White worker**:

$$\begin{aligned} U^N(\mu; 2, s, a) = \max_{c,a'>0} \Big\{ u(c) + \eta\beta_2 \sum_{s'} \Pi_{ss'} [ & (1 - f_{np}(\theta_{np})) f_p(\theta_p) W_p(\mu'; 2, s', a') \\ & + f_{np}(\theta_{np})(1 - f_p(\theta_p)) W_{np}(\mu'; 2, s', a') \\ & + (1 - f_p(\theta_p))(1 - f_{np}(\theta_{np})) U^N(\mu'; 2, s', a') \\ & + f_p(\theta_p) f_{np}(\theta_{np}) max[W_p(\mu'; 2, s', a'), W_{np}(\mu'; 2, s', a')] ] \Big\} \\ & \text{s.t.} \\ & c + a' = (1 + r_\mu) a/\eta + d_\mu \end{aligned} \tag{7}$$

The white worker in $U^N(\mu; 2, s, a)$ state has their income only comes from previous savings and lump-sum transfers. Similar to white worker in $U^I$ states, they have a probability $(1 - f_{np}(\theta_{np}))f_p(\theta_p)$ finding only a $p$ firm job, probability $f_{np}(\theta_{np})(1 - f_p(\theta_p))$ finding only a $np$ firm job, probability $(1 - f_p(\theta_p))(1 - f_{np}(\theta_{np}))$ remain unemployed, and probability $f_p(\theta_p) f_{np}(\theta_{np})$ finding jobs in both $np$ and $p$ firms. They choose the higher return one if they find both jobs.

**Black worker**:

Like a black worker in $U^I_{np}(\mu; 1, s, a)$ state, an unemployed and ineligible black worker can find jobs in $np$ firms with probability $f_{np}(\theta_{np})$. If they fail to find a job, they remain unemployed and ineligible.

$$
\begin{aligned}
U^N(\mu;1,s,a) = \max_{c,a'>0} \Big\{ u(c) + \eta\beta_1 \sum_{s'} \Pi_{ss'} [ f_{np}(\theta_{np}) W_{np}(\mu';1,s',a') \\
+ (1 - f_{np}(\theta_{np})) U^N(\mu';1,s',a') ] \Big\} \\
\text{s.t.} \\
c + a' = (1+r_\mu)a/\eta + d_\mu
\end{aligned} \tag{8}
$$

## 2.4 Firm's problem

Firms post vacancies to attract workers for production purposes. Vacant firms have a value of $J_0$, and producing firms have a value of $J$. In addition to contemporary values, firms stochastically discount future value using $\frac{\eta}{1+r_\mu}$.

### 2.4.1 Vacant $np$ firm

A vacant $np$ firm pays posting cost $\kappa_{np}$ and searches for all unemployed workers. With probability $q_{np}(\theta_{np})$, they match with a currently unemployed worker.

$$
\begin{aligned}
J_{0,np} = -\kappa_{np} + \Big(\frac{\eta}{1+r}\Big) \eta q_{np}(\theta_{np}) \sum_{s'} \Pi_{ss'} \int_a \Big[ J(1,s',a') \frac{\phi_u(1,s,a)}{u} \\
+ 1_{\{W_p(\mu';2,s',a') \le W_{np}(\mu';2,s',a')\}} (J(2,s',a') \frac{\phi_u(2,s,a)}{u}) \\
+ 1_{\{W_p(\mu';2,s',a') > W_{np}(\mu';2,s',a')\}} (J(2,s',a') \frac{\phi_u(2,s,a)}{u}) (1 - f_p(\theta_p)) \Big] da
\end{aligned} \tag{9}
$$

Upon matching with a worker, the firm has probability $\frac{\phi_u(1,s,a)}{u}$ working with a black worker of specific $(s,a)$ status and proceeding with production in the next period. The firm has an additional probability $\frac{\phi_u(2,s,a)}{u}$) matched with a white worker of $(s,a)$ status. The production only happens if the white worker receives a more favorable offer from $np$ firm than $p$ firm, or if the worker does not receive a $p$ firm offer.

### 2.4.2 Vacant $p$ firm

A vacant $p$ firm only searches for unemployed white workers. The firm has probably $q_p(\theta_p)$ matching with a worker. And the worker with specific $(s,a)$ status has probability $\frac{\phi_u(2,s,a)}{u_{wh}}$. Symmetric to the $np$ firm matching with a white worker, production only happens when the worker receives a favorable offer from $p$ firm, or does not receive a $np$ firm offer.

$$J_{0,p} = -\kappa_p + \Big(\frac{\eta}{1+r}\Big)\eta q_p(\theta_p)\sum_{s'}\Pi_{ss'}\int_a \Big[1_{\{W_{np}(\mu';2,s',a')<W_p(\mu';2,s',a')\}}(J_p(2,s',a')\frac{\phi_u(2,s,a)}{u_{wh}}) \\ +1_{\{W_p(\mu';2,s',a')\geq W_{np}(\mu';2,s',a')\}}(J_p(2,s',a')\frac{\phi_u(2,s,a)}{u_{wh}})(1-f_{np}(\theta_{np}))\Big]da \tag{10}$$

We impose free entry conditions for both $np$ and $p$ firms. Therefore, $J_{0,np} = 0$ and $J_{0,p} = 0$.

### 2.4.3 Producing $np$ firm

If a $np$ firm enters production, it earns contemporaneous profit $j$ and discounts future values adjusted by the job destruction rate $\lambda^{np}$ and the worker's survival rate $\eta$.

$$J_{np}(\mu;Ra,s,a) = \max_k \Big\{j(\mu;Ra,s,a) + \Big(\frac{\eta}{1+r}\Big)\eta(1-\lambda^{np})\sum_{s'}\Pi_{ss'}J_{np}(\mu';Ra,s',a')\Big\} \\ \text{where} \\ j(\mu;Ra,s,a) = sf(k) - (r_\mu+\delta)k - \omega_{np}(\mu;Ra,s,a) \tag{11}$$

The matched firm produces output $sf(k)$, pays capital cost $(r_\mu+\delta)k$ and labor cost $w$. We assume that the capital market is frictionless, so all firms pay the same rental rate $r$, adjusted by the survival probability $\eta$. The marginal product equalizes across firms. Capital $k$ depreciates according to $\delta$.

## 2.5 Producing $p$ firm

Symmetric to the producing $np$ firm, the producing $p$ firm pays capital and labor costs and discounts future production value adjusted by the worker's survival ($\eta$) and job destruction ($\lambda^p$) rates.

$$J_p(\mu; Ra, s, a) = \max_k \Big\{ j(\mu; Ra, s, a) + \Big(\frac{\eta}{1+r}\Big)\eta(1-\lambda^p) \sum_{s'} \Pi_{ss'} J_p(\mu'; Ra, s', a') \Big\}$$

where (12)

$$j(\mu; Ra, s, a) = sf(k) - (r_\mu + \delta)k - \omega_p(\mu; Ra, s, a)$$

## 2.6 Bargaining

Firms and workers bargain for wage period-by-period that maximizes the joint outcome. Workers have bargaining power $\xi_{Ra}$, differentiated by race. The bargaining solution has:

$$\omega_{np}(\mu; Ra, s, a) = argmax_\omega (W_{np}(\mu; Ra, s, a) - U^I_{np}(\mu; Ra, s, a))^{\xi_{Ra}} J_{np}(\mu; Ra, s, a)^{(1-\xi_{Ra})} \tag{13}$$

$$\omega_p(\mu; 2, s, a) = argmax_\omega (W_p(\mu; 2, s, a) - U^I_p(\mu; 2, s, a))^{\xi_2} J_{np}(\mu; 2, s, a)^{(1-\xi_2)} \tag{14}$$

## 2.7 Equilibrium

In equilibrium, all net savings supply to the firm's capital demand. All contemporaneous profits are distributed back to individuals equally as dividends. The government balances tax revenue and unemployment insurance outgo, by imposing additional lump-sum tax or transfers on individuals equally.

# 3 Calibration

We have two categories of parameters for this model. One set is externally chosen, and the other is internally calibrated to match the relevant data moments. Table 1 reports the parameters and the choice rationale.

Table 1: Calibration and targeted statistics

| Parameter | Value | Description | Target statistics | data | model |
|---|---|---|---|---|---|
| *Chosen internally* | | | | | |
| $\beta_{wh}$ | 0.9866 | subjective discounting - white | quarterly interest | 0.01 | 0.01 |
| $\beta_{bl}$ | | subjective discounting - black | median black-white wealth ratio | | |
| $\gamma$ | 0.5259 | matching efficiency | job finding rate - white | 0.6599 | 0.6598 |
| $\kappa_p$ | 8.8232 | p sector vacancy posting cost | job finding rate - black | 0.4946 | 0.4946 |
| $\lambda_p$ | 0.0268 | p sector job destruction shock | job separation rate - white | 0.03795 | 0.03795 |
| $\lambda_{np}$ | 0.0644 | np sector job destruction shock | job separation rate - black | 0.0644 | 0.0644 |
| $\xi_{wh}$ | 0.1584 | bargaining power - white | firm profit share | 0.033 | 0.033 |
| $\xi_{bl}$ | 0.0723 | bargaining power - black | racial wage ratio | 0.6196 | 0.6196 |
| $\kappa_{\text{np}}$ | 3.2081 | np sector vacancy posting cost | market tightness | 1 | 1 |
| $Pe$ | 0.5385 | probability of UI eligibility | maximum months of eligibility | 6.5 | 6.5 |
| *Chosen externally* | | | | | |
| $\eta$ | | individual survival rate | Setty and Yedid-Levi (2021) | | |
| $\alpha$ | 0.6600 | elasticity of labor matching | Nakajima (2012) | | |
| $\theta_n$ | 0.2890 | capital share of output | Nakajima (2012) | | |
| $\delta$ | 0.0150 | quarterly depreciation rate | Nakajima (2012) | | |
| $\rho_{wh}$ | 0.9395 | persistence of shock - white | PSID | | |
| $\sigma_{wh}$ | 0.1633 | innovation of shock - white | PSID | | |
| $\rho_{bl}$ | 0.9198 | persistence of shock - black | PSID | | |
| $\sigma_{bl}$ | 0.1650 | innovation of shock - black | PSID | | |
| $h$ | 0.4 | UI replacement rate | Mitman and Rabinovich (2015) | | |
| $\xi$ | 0.8714 | maximum UI coverage | Setty and Yedid-Levi (2021) 48% median wage | | |

Notes: This table reports the parameters, their values, and descriptions. The top panel presents the parameters chosen internally through minimizing the distance between model generated moments and data. The last two columns of the top panel compare the targeted moments between data and model simulated values. The bottom panel reports the parameters chosen externally of the model, their values and descriptions.

We set individual production function $y = k^{\theta}$. The capital share of output, $\theta$, is set to be 0.289, following Nakajima (2012). The capital depreciation rate, $\delta$, is set to be 0.015 to match the quarterly depreciation rate, reported by Nakajima (2012). The idiosyncratic labor productivity follows an AR(1) process. We set the persistence $\rho$ and innovation $\sigma$ to be 0.9956 and 0.0032 from Nakajima (2012). The benchmark unemployment insurance replacement rate is set to be 64% of the counterfactual wage rate, following Mitman and Rabinovich (2015). Marginal labor income tax rate, $\tau$, is set to be 0.023, from Mitman and

Rabinovich (2015).

The remaining parameters are chosen internally by solving and simulating the model to match relevant data moments. We set the subjective discounting, $\beta$ to be 0.9977. It is chosen to match monthly interest rate of 0.1%. $\gamma$ is the matching efficiency for white workers, set to be 0.18 to match their job findings rate. The matching efficiency for black workers is $\omega\gamma$. The level of reduction from the efficiency term for white workers $\omega$ is 0.8, set to match the black workers' job findings rate. Related, $\lambda_{wh}$ and $\lambda_{bl}$ are set with values 0.012 and 0.021, to match the job separation rate for white and black workers. $\mu_{wh}$ and $\mu_{bl}$ represent the bargaining power for white and black workers (0.43 and 0.25). Vacancy posting cost, $\kappa$, is 1.08 to match the labor market tightness, between 1 to 2.5 (Wolcott, 2021). $Pe$ takes the value 0.8, following Setty and Yedid-Levi (2021) to match the 6.5 months maximum duration of UI eligibility.

# 4 Results

In this section, we explore the heterogeneous impact of racial discrimination on the labor market. We particularly focus on the endogenously generated wealth distribution by race, and the heterogeneous labor market outcomes between black and white workers.

## 4.1 Racial difference in wealth distribution

Numerous research has documented the racial wealth disparaty in the US (e.g. Kuhn, Schularick, and Steins, 2020; Barsky, Bound, Charles, and Lupton, 2002; McIntosh, Moss, Nunn, and Shambaugh, 2020). Ganong, Jones, Noel, Greig, Farrell, and Wheat (2020) shows that income shocks transmit to individuals of different racial groups differently. This subsection examines the transmission of institutional discrimination from the labor market to disparate wealth distribution between black and white workers.

Without further frictions on the financial market, and with the same idiosyncratic labor

productivity process, the model still generates a wealth holding of 82% by white workers, similar to the reporting from McIntosh et al. (2020).

Figure 1 presents the distribution of black and white workers on wealth, by each labor market status. Panel (a) presents the wealth distribution by race for employed workers. Panel (b) presents it for unemployed workers who are eligible for unemployment insurance, and Panel (c) reports the distribution for workers not qualifying for UI. Panel (d) reports the distributions for all individuals. All distributions are normalized by the population size of the respective racial group.

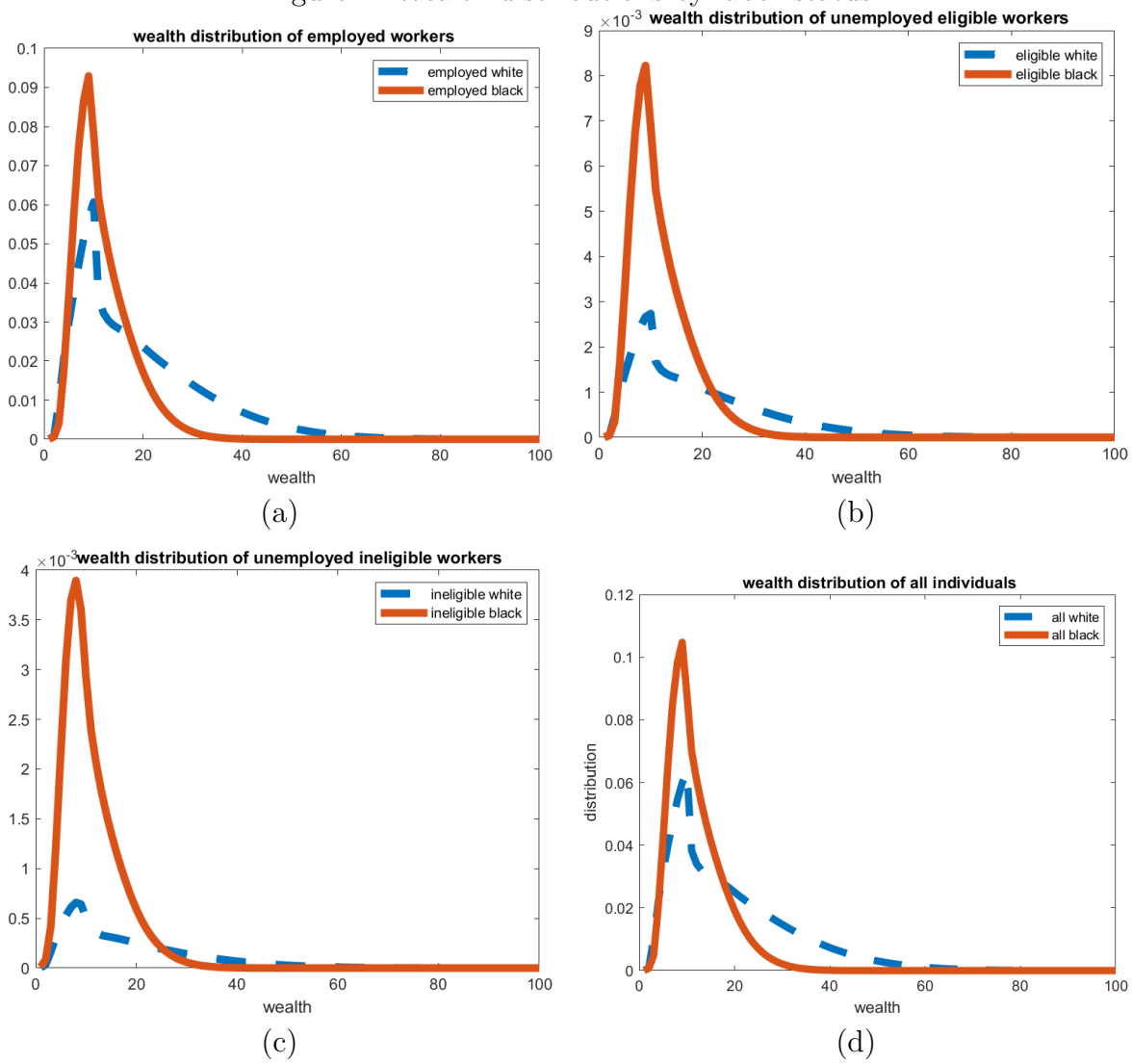
Overall, white workers are more likely to engage in savings, hence distributed to the higher end of the wealth dimension than black workers. Black workers have twice the job separation rate, half the job finding rate, and 87% wage rate to the white workers. Given labor market risk, black workers are much disadvantaged in accumulating wealth. Even without additional financial fictions, institutional labor market discrimination transmits to difference in wealth accumulations on black individuals.

## 4.2 Racial difference in labor market by wealth

In this subsection, we further decompose the differences in labor market outcomes from the discrimination in labor market matching process.

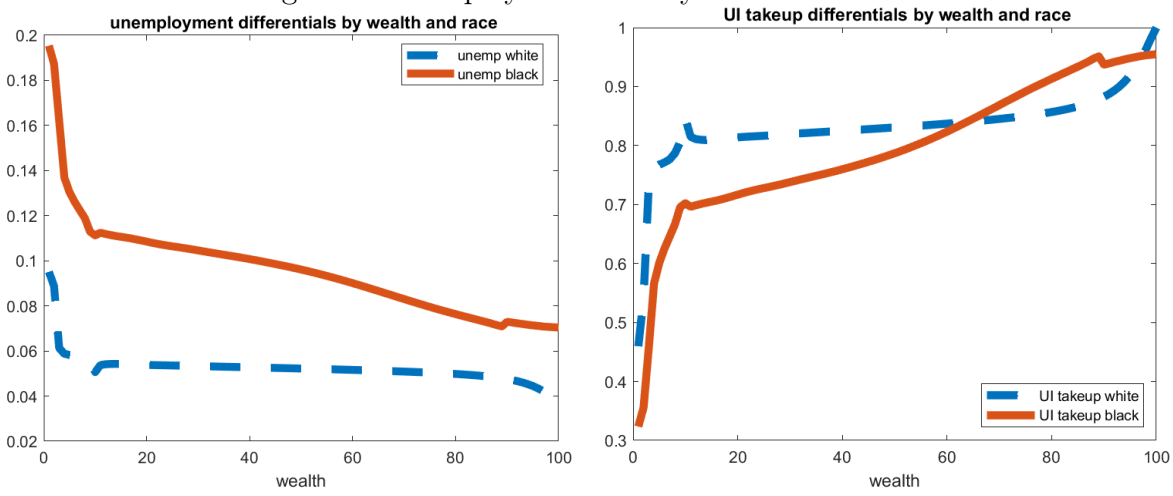
Figure 2 describes the racial differences in unemployment rate and UI take-up rate along the wealth dimension. Panel (a) shows that black workers have higher unemployment rate across the wealth spectrum. Interestingly, the unemployment rate gap is higher for individuals in the middle wealth region. Panel (b) shows the unemployment insurance take-up rate by race across wealth. Overall, as wealth increases, more individuals take up unemployment insurance. However, white people have higher UI take-up rate. This reflects the disproportionate labor market risk between black and white workers. With higher unemployment risk and lower job-findings rate, black workers need more support from UI, but are less likely to stay with its benefit, due to their more prolonged unemployment spell.

Figure 1: Wealth distributions by labor status




Notes: This figure compares model simulated distribution of workers on wealth dimension by employment status and race

Figure 2: unemployment rate by wealth and race




(a) (b)

Notes: This figure compares model simulated unemployment rate and UI take-up rate of workers on wealth dimension by race

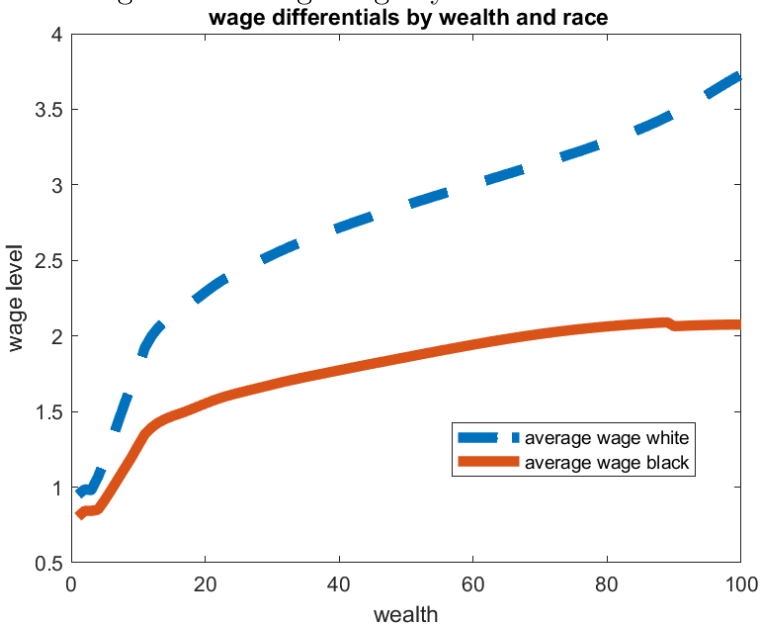
Figure 3 shows the wage differentials between black and white workers. As wealth increases, individuals have higher bargaining power in negotiating wages. The racial wage gap, however, exacerbates as wealth increases. The wage rates are similar between black and white workers at the lower end of wealth. Black workers' wage rate is about 90% of white workers. But the differences increases to be over 20% at the upper end.

# 5 Racial impact of unemployment insurance

The benchmark model shows that labor market discrimination is reflected stronger in black workers in upper-middle wealth regions, as a higher unemployment rate gap and wage rate gap. However, the public unemployment insurance program favors white workers in the upper-middle-wealth region. In this section, we experiment with counterfactual UI policies and examine their impacts on the unemployment rate and wage rate racial gaps.

In the benchmark model, we have the UI replacement covering 40% of the counterfactual wage level, coverage periods of 2.16 quarters, and maximum benefit as 48% of the median wage. Figure 4 presents the impacts of changing unemployment insurance dimensions on

Figure 3: average wage by wealth and race




Notes: This figure compares model simulated wage of workers on wealth dimension by race

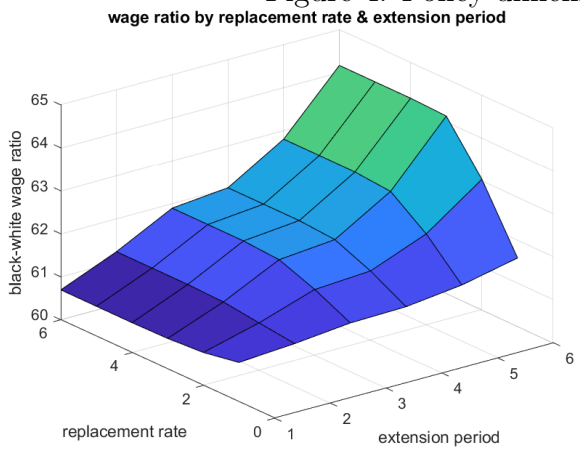
the racial wage gap. We fix one dimension at the benchmark level and vary the other two to explore their joint impact on the black-white wage ratio.

Panel (a) explores the impact of varying replacement rates and coverage periods while fixing the maximum payout. The higher replacement rate and the longer coverage period reduce the average black-white wage gap. Panel (b) explores the impacts of replacement rate and maximum coverage. Similarly, as the maximum coverage increases, it further reduces the racial wage gap. Panel (c) examines the joint impact between the coverage period and maximum payout. While fixing the replacement rate, interestingly, maximum payout creates a kink in its impact. Therefore, the results in reducing the wage gap are less monotonic.

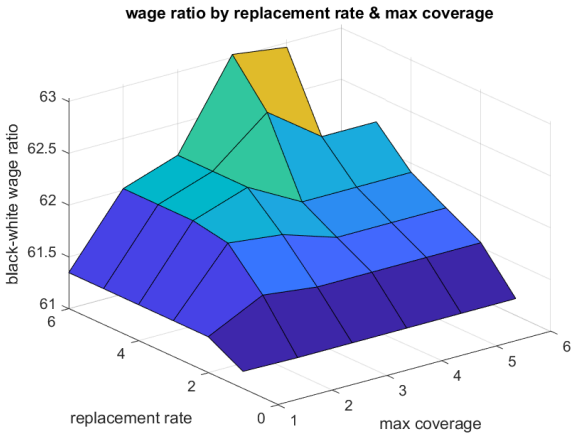
In the benchmark model, black workers hold about 14% of white workers' aggregate wealth. Figure 5 displays the impact of UI policies on the black-white wealth ratio.

Panel (a) explores the impact of varying replacement rates and coverage periods while fixing the maximum payout. Unlike the impact on wages, a lower replacement rate reduces the ratio wealth gap. Panel (b) explores the impacts of replacement rate and maximum coverage.

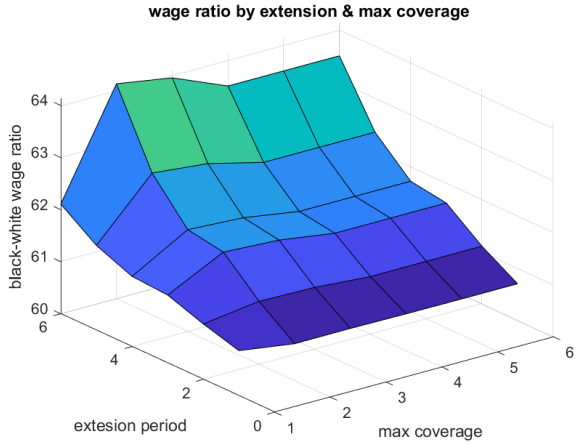
Figure 4: Policy dimensions and racial wage gap




(a)

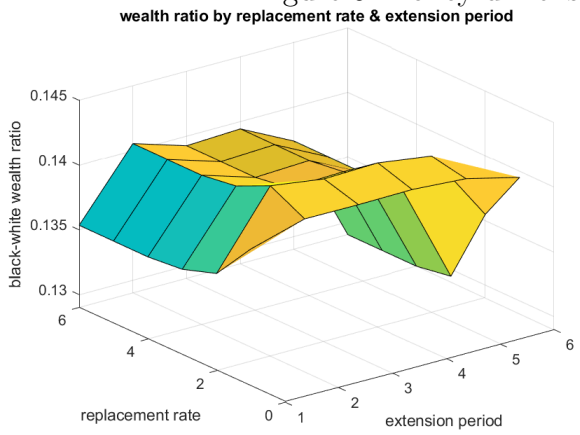



(b)

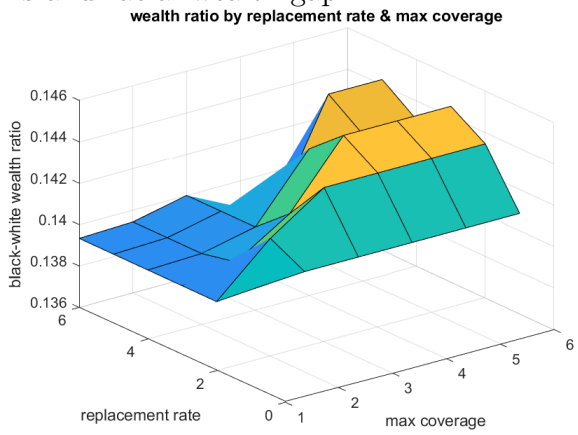



(c)

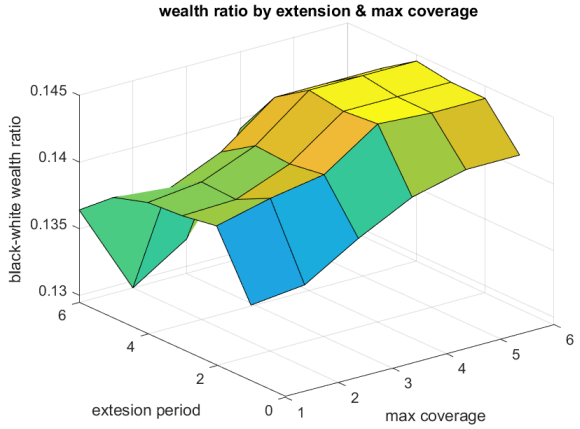
Figure 5: Policy dimensions and racial wealth gap




(a)




(b)




(c)

Similarly, increasing the maximum coverage further reduces the racial wealth gap. Panel (c) examines the joint impact between the coverage period and maximum payout. While fixing the replacement rate, interestingly, maximum payout creates a kink in its impact. Its combination with a shorter extension period reduces the wealth gap the most.

# 6 Optimal Unemployment Insurance

In this section, we examine the optimal Unemployment Insurance across the three dimensions: replacement rate ($h$), eligibility probability ($Pe$), max payout ($\chi$). Following Krusell, Mukoyama, and Şahin (2010) and Setty and Yedid-Levi (2021), we solve for optimal policy choice that maximizes the aggregate consumer welfare.

Under benchmark policy, we let $V(e, R, s, a)$ be the maximal value of the individual with employment status $e$, race $R$, productivity $s$, and asset $a$. For any given state realization:

$$V = \mathrm{E}_0 \sum_{t=0}^{\infty} \beta^t \frac{c_t^{1-\sigma}}{1-\sigma}$$

Under an alternate policy, let $\tilde{V}(e, R, s, a)$ be the maximal value.

$$\tilde{V} = \mathrm{E}_0 \sum_{t=0}^{\infty} \beta^t \frac{\tilde{c}_t^{1-\sigma}}{1-\sigma}$$

We examine the welfare change between the two policies through consumption equivalence $\Omega$, following the equation:

$$\mathrm{E}_0 \sum_{t=0}^{\infty} \beta^t \frac{((1+\Omega)c_t)^{1-\sigma}}{1-\sigma} = \mathrm{E}_0 \sum_{t=0}^{\infty} \beta^t \frac{\tilde{c}_t^{1-\sigma}}{1-\sigma}$$

Given, the CRRA utility function, we derive $\Omega$ as:

$$\Omega = \Big(\frac{\tilde{V}}{V}\Big)^{\frac{1}{1-\sigma}} - 1$$

This expression is similar to Krusell et al. (2010), which derives this for log utility where $\Omega = \exp((\tilde{V} - V)(1-\beta)) - 1$. For each alternate policy choice, we sum over all individual level consumption equivalence, $\Omega$s, using the distribution of the benchmark economy to calculate the aggregate welfare gain. The policy choice that maximizes the welfare gain is our optimal policy.

We find that the optimal policy has replacement rate ($h$) as 0.7675, eligibility probability ($Pe$) as 0.77, and max payout ($\chi$) as 0.575. This translates to an increase of coverage to 75.75%, an increase of extension periods to 4.3 quarters, and an increase of maximum payout by 7.2%. AS a result, overall welfare improve by 11.69% from the benchmark, and the racial wage ratio increases to 65.92%, a reduction by 33.54 percentage points. However, the racial unemployment rate gap increased by 0.44 percentage points to 6.85%.

Figure 6: Optimal UI and racial wage/unemployment outcomes

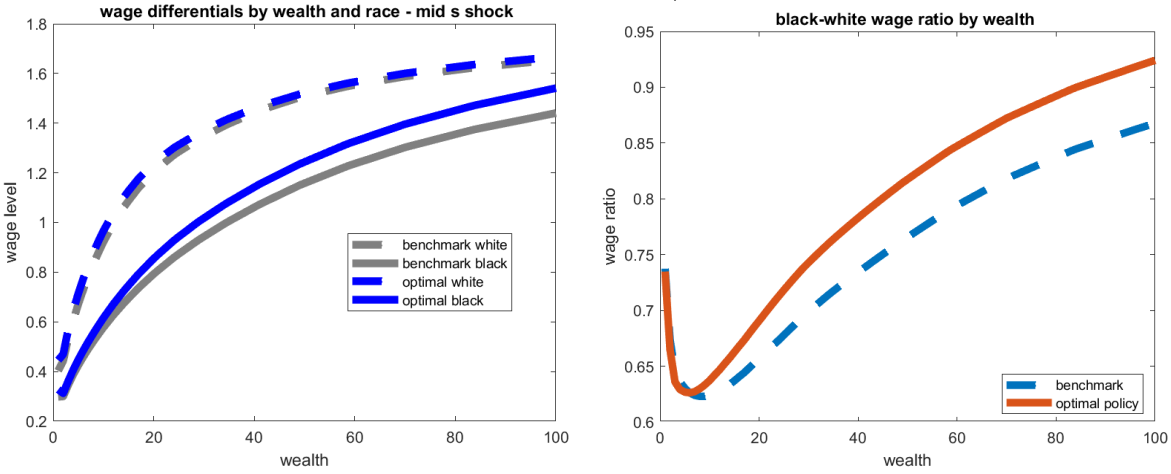
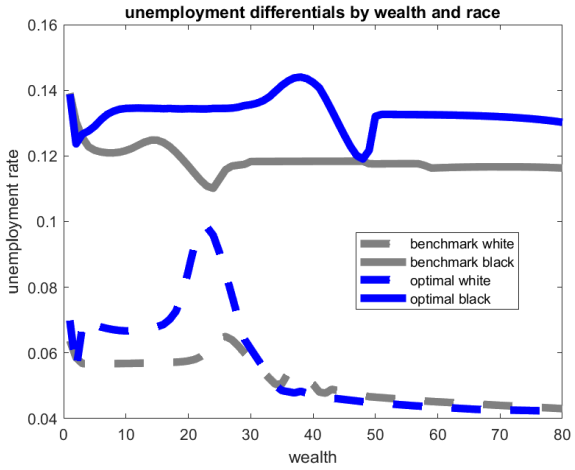
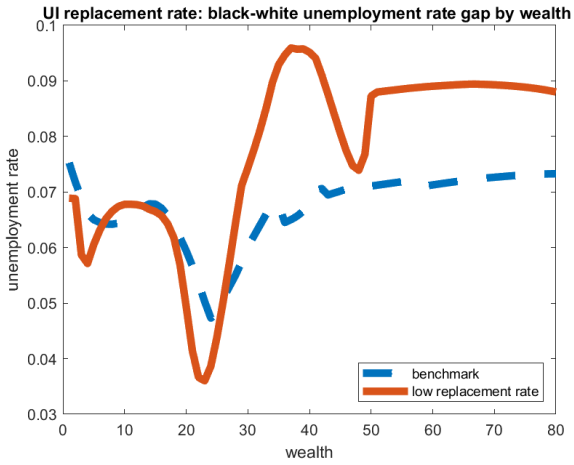



Figure 6 plots the change of racial wage gap between the optimal policy and the benchmark policy. The right panel shows that the optimal policy largely raises average wage for black workers, especially for those with higher wealth, but less impact on the white workers. As a result, the left panel shows that the wage gap shrinks as wealth increases, under the optimal policy.

Section 6 plots the change of racial unemployment rate gap from the optimal policy. The right panel shows that black workers suffer higher unemployment rate across the wealth




spectrum with the optimal policy, while the lower wealth white workers have adverse unemployment rate. Consequently, the left panel shows that the optimal policy increases the racial unemployment rate for middle to higher wealth workers.

# 7 Conclusion

We construct a heterogeneous agent search-and-matching model to examine the impact of institutional racial discrimination on wealth accumulation and labor market outcomes between black and white workers. We find that labor market discrimination on black workers exacerbates the labor market frictions for black workers. As a result, black workers have higher unemployment rate, lower wage rate, and more difficulty in accumulating wealth compared to the white workers. In general equilibrium, wealth disparity further exacerbates the labor market outcome gaps between black and white workers. Unemployment insurance policies, though racially blind, provides disproportionate assistance to black workers, and reduces the negative employment and wage outcomes due to racial discrimination.

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