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Abstract.- In this paper I inquire about the effects initial wealth has on black-white differences in early employment careers. I set up a dynamic model in which individuals simultaneously search for a job and accumulate wealth, and fit it to data from the National Longitudinal Survey (1979-cohort). The estimates show that borrowing constraints are tight for both race groups. Regime changes reveal that differences in initial wealth account almost fully for the racial gap in wealth and wages at the beginning of employment careers, but their effect tapers off and completely dissapears several years after graduation. In contrast, differences in the labor market environment and in preferences are shown to account fully for both racial gaps, in wealth and in wages, persisting several years after High School graduation.

Keywords: Job search, wealth, racial differences, borrowing constraints, consumption, unemployment, estimation of dynamic structural models.

JEL Classification: C33, E21, E24, J64.

1 Introduction

The last decade has witnessed a growing interest in the black-white wealth gap. Whereas historically income disparity between blacks and whites has narrowed down (Smith and Welch 1989), wealth disparity remains large. Thus, while blacks earn between 50% and 64% of whites' income, blacks' wealth is only between 12% and 20% of whites' wealth (Blau and Graham 1990, Wolff 1994, Menchik and Jianakoplos 1997, Oliver and Shapiro 1997, Scholz and Levine 2003). Recent studies have focused on the role of differences in income, education, and patterns of marriage and fertility to explain racial gaps in wealth levels and growth rates (Gittleman and Wolff 2004, Altonji and Doraszelski 2005). I, on the other hand, examine whether causality may be also working in the opposite direction, that is, whether initial wealth disparity explains black-white differences in employed wages and employment rates for High School graduates Therefore, throughout this paper I report differences in wages (the income of the employed) and in the unemployment rate rather than total differences in income, as in other studies. In order to abstract from wage differences caused by skill gaps (Neal and Johnson 1996, Neal 2005), I restrict the analysis to individuals with the same level of schooling. Subsequently, I estimate a dynamic model of wealth accumulation and job search and find that initial wealth has essentially no influence in explaining racial disparities several years after High School graduation in comparison with labor market variables. Initial wealth only accounts for the racial gap in wealth and wages at the *beginning* of employment careers. By contrast, differences in the labor market environment and in preferences are shown to account fully for both racial gaps, in wealth and in wages, persisting several years after High School graduation.

Imperfect capital markets allow wealth to affect job search outcomes: wealthier agents can search longer and obtain higher wages. This effect is formalized in a utility-maximizing job search model where agents' reservation wages depend positively on their wealth levels. Thus, wealth accumulation becomes part of the optimal job search strategy in which unemployed agents run down their wealth to maintain consumption levels, and employed agents accumulate wealth to hedge against future unemployment spells, which also allows them to move to better paying jobs.

Utility-maximizing job search models are based on the seminal work of Danforth (1979), who analyzed in detail the role of wealth on an individual's optimal job search strategy. In his framework, only the unemployed look for a job and receive wage offers from a non-degenerate distribution; the employed do not search and do not become unemployed and there is no decision about search intensity. In recent years several empirical studies have attempted to test utility-maximizing search models inspired in Danforth's basic framework. In this paper I generalize Danforth's model to allow for on-the-job search, wage growth, variations of arrival and layoff rates as a function of age, retirement age, and a parametric limit on borrowing. In particular, I assume a parametric initial wealth distribution and unobserved heterogeneity with different types of individuals who differ in their labor market environments, initial wealth distributions, borrowing constraints, and preferences. These features allow my model to generate predicted life-cycle trajectories and distributions of employment status, wealth, and wages that match the observed ones.

The behavioral parameters of the model are recovered using the method surveyed by Rust (1988) and Eckstein and Wolpin (1989). I use the numerical solution to the joint job search and consumption problem to construct a distance function between the observed and the predicted paths of wealth, wages, and employment transitions, which is minimized over the behavioral parameters. This approach has been used by Wolpin (1992), Eckstein and Wolpin (1999), Keane and Wolpin (2000), and Bowlus and Eckstein (2002) to study black-white labor market differences and to conduct policy experiments. I study the effects on wealth accumulation and labor market outcomes of regime changes consisting of assigning blacks the labor market conditions, initial wealth distribution and access to credit, and preferences of whites.

A regime change that gives blacks the labor market conditions of whites is able to generate full convergence in labor market outcomes both in the short and in the long run. If, additionally, there is a switch in taste parameters, this regime change can also eliminate long run wealth disparity, although not the initial wealth gap. On the contrary, a shift in initial wealth and access to credit fails to substantially narrow down the long run racial wealth and wage gaps, but it is the only regime change that accomplishes the elimination of both race gaps at the beginning of employment careers.

The remainder of the paper is organized as follows. The next section explains the data source, the National Longitudinal Survey of Labor Market Experience - Youth Cohort (NLSY), the selection of the sample, and the descriptive statistics; Section 3 describes the theoretical model; Section 4 explains the simulated method of moments estimation procedure; Section 5 analyzes the estimation results; Section 6 assesses, both formally and graphically, the performance of the model in replicating the main trends of the data, and Section 7 presents regime changes based on the estimated parameters of the model. The main conclusions of the paper are summarized in Section 7.

2 Data

The National Longitudinal Survey of Labor Market Experience - Youth Cohort (NLSY) contains data on household composition, military experience, school enrollment, and a week by week account of employment status, hourly wages, hours worked, and employers. An individual's complete weekly work history can be constructed from 1978 until 1993. Respondents whose employment histories started before 1978, i.e., those born before 1961, and for whom it is impossible to construct a complete employment history, are dropped from the sample. The final sample contains 158 black and 212 white High School male graduates born after December 31, 1960, who neither went to college nor had any type of military experience. Black males were selected from the core and from the supplemental sample, whereas white males were taken from the core sample. Wolpin (1992) and Rendon (2006) also use this selection of individuals whose behavior is well described by a search-theoretic framework that excludes the decision to join the military.

Given that blacks exhibit higher High School dropout rates and whites are more likely to continue studying after High School, it is possible that this sample selection leads to an underestimation of the differences in labor market outcomes by race. As pointed out by Heckman, Lyons and Todd (2000) the definition of the sample is crucial in making inferences about black-white differentials. In this article, the lower tail of the income distribution of blacks and the upper tail of the income distribution of whites could be underrepresented. In spite of this, it will be shown that wage and wealth differences by race remain important.

To make the estimation tractable I aggregate the data into quarters. Each individual's reported last week of school enrollment is assigned to its corresponding calendar quarter; employment history starts in the quarter thereafter. An individual is employed if he works twenty or more hours during the first week of the quarter; any other job held during the quarter is ignored. Otherwise, he is recorded as unemployed for that quarter. Reasons for leaving a given employer are classed as layoffs or quits. Individuals returning to work for their old employers are recorded as having new jobs. The quarterly wage is the wage of the first week of the quarter in 1985 dollars times 13. The Consumer Price Index is used to deflate nominal values into real amounts.

Annual data on the market value of wealth are only available for years 1985 until 1993, with the exception of year 1991; this information is assigned to the calendar quarter in which the interview took place, leaving all other quarters blank.

Wealth consists of financial assets, vehicles and other assets (like jewelry or furniture), all net of debts and all computed at their "market value", defined by the NLSY as the amount the respondent would reasonably expect someone to pay if the particular asset were sold in its current condition at any point in time. Other less liquid types of wealth, such as residential property and business assets, are excluded as I assume that agents will only use the most liquid wealth to finance their job search. Jianakoplos, Menchik and Irvine (1989), Blau and Graham (1990), and Smith (1995) show that, as individuals of both race groups become wealthier, they increase the proportion of their wealth in the form of residential property, business, farms or other property, and decrease the proportion of their wealth in the form of vehicles. Notably, at the same wealth level blacks systematically have a lower percentage of their wealth in business property than whites, denoting a relative absence of black-owned businesses (Fairlie 1999, Fairlie and Meyer 2000). Thus, racial inequality in terms of the most liquid wealth will be lower than racial inequality measured with total wealth. In Rendon (2006) I estimate a similar version of this model for one race group using *total* wealth.

[Table 1 here]

Table 1 shows the evolution of employment rates and transitions, wealth and wages three, six, and nine years after High School graduation. From year 3 to year 9, the fraction of blacks who are unemployed decreases from 34% to 20%, while the corresponding percentage for whites decreases from 18% to 9%. In the same period, blacks increase their wealth from $1,393 to $3,702, whereas whites increase their wealth from $4,921 to $8,780, that is, the black-white ratio of average wealth increases from 28% to 42%. The percentage of individuals with more than $10,000 increases from 1% to 11% for blacks, and from 15% to 29% for whites. Average wage, income of the employed, for blacks increases from $3,104 to $3,739 and from $3,363 to $4,552 for whites, meaning that the black-white ratio of average wage decreases from 92% to 82%. It is clear that wealth accumulation does accompany the increase in employment rates and wages that occurs after graduation from High School, and that a reduction in the racial wealth gap is associated with a widening of the racial wage gap.

[Table 2 here]

Table 2 reports average wealth by wage level, number of years since graduation and race group. Wages measure the quarterly income of the employed only; the unemployed are not included in this table. It is shown that agents with higher wages tend to have a higher level of wealth. No more than 6 years after graduation, blacks with wages below $2,000 have an average wealth of $724, whereas blacks with wages above $6,000 have an average wealth of $5,634. The corresponding wealth of whites for the same wage brackets is, respectively, $1,396 and $8,511. These descriptive statistics show the existence of a link between labor market progress and wealth accumulation for both race groups.

[Table 3 here]

Table 3 relates saving behavior to employment transitions between two periods for which wealth data are available. As the interviews were conducted in different quarters for different individuals, this time interval does not necessarily correspond to four quarters. For both race groups becoming or staying unemployed is associated with wealth decumulation, while becoming employed or changing employer is associated with increases in wealth. Staying with the same employer is associated with wealth accumulation for whites, and with wealth decumulation for blacks. Black individuals who are unemployed and become employed save on average $1,740 between two quarters; the corresponding amount for whites is $365. White individuals who are employed and become unemployed decrease their wealth in $1,515; the corresponding amount for blacks is $953. Explaining these related trends requires a theoretical model that will account jointly for wealth accumulation and employment transitions.

3 Model

In this section I describe a model of wealth accumulation and job search under borrowing constraints. It is an extension of Danforth's (1979) model to allow for on-the-job search, wage growth, variations in arrival and layoff rates as a function of age, retirement age, and a parametric borrowing limit.

An individual maximizes expected utility of consumption over his life, T_F quarters. He can be employed or unemployed during his active life, T quarters, after which he retires and lives off his savings. Each period he faces a utility function $U(\cdot)$ over consumption and, when employed, he suffers a constant utility loss captured by $\psi \geq 0$, which represents the disutility of working.

While unemployed at period t he receives, with probability λ_t, one wage offer x drawn from the known base wage offer distribution $F(\cdot)$, $x \in (\underline{w}, \overline{w})$, $0 < \underline{w} < \overline{w} < \infty$. An unemployed individual becomes employed if he receives and accepts a wage offer; otherwise he remains unemployed. Transitions from unemployment are illustrated in the following scheme:

[Figure 1 here]

While employed at period t, an individual can be laid off with probability θ_t and receive a new wage offer with probability π_t, drawn from the same base distribution $F(\cdot)$. If he is not laid off and receives a job offer, he can accept it and switch to a new job, reject it and stay in the current job, or reject it and quit to unemployment. If he is not laid off and does not receive a job offer, he has to decide between staying in his current job or quitting to unemployment. If he is laid off, he can still receive a job offer; accepting it means switching to a new job; rejecting it means becoming unemployed. If a person is laid off and does not receive an offer, his only option is to become unemployed. The possible transitions from being employed are shown below.

[Figure 2 here]

When unemployed, the agent receives transfers b, which are non-labor income such as family transfers and unemployment compensation net of search costs. When employed, the agent experiences wage growth as a function of age, that is, his current wage w_t depends on the initial wage draw ω and age t. Similarly, both the probability of receiving an offer while unemployed and while employed, λ_t and π_t respectively, as well as the layoff rate θ_t, depend on the agent's age t. Modelling wage and arrival rates as functions of experience would have been preferable, but would also increase drastically the computation burden to solve and estimate this model.

At each period t, given his employment state and his wealth A_t, the agent determines his consumption C_t^u and C_t^e, and thereby his wealth for the next period A_{t+1}^u and A_{t+1}^e. Initial wealth is inherited and final wealth is zero. The rate of return r is constant; the subjective discount factor is $\beta \in (0,1)$. Agents can save freely, but borrowing is restricted so that current wealth cannot be lower than an age-dependent level B_t. In a free capital market with fully risk-averse lenders individuals can borrow up to the level they can pay back with certainty, that is, the 'natural borrowing limit' (Ljungqvist and Sargent 2000), which is the present discounted value of the lowest possible income level b: $\widetilde{B}_t = -\sum_{\tau=t}^{T} b \frac{1}{(1+r)^{T-\tau}}$. Wealth levels below this limit imply non-positive consumption, $C = \widetilde{B}_t + b - \widetilde{B}_{t+1}/(1+r) = 0$, which is not admissible for utility functions that satisfy the Inada condition $\lim_{C \to 0} U(C) = \infty$. Hence, the only non-redundant constraint is $B_t > \widetilde{B}_t$, which allows us to express and parameterize the borrowing constraint as a fraction of the natural constraint. Let s measure the tightness of the borrowing constraint as a fraction of $\widetilde{B}_t$, then the lower bound on wealth is $B_t = s\widetilde{B}_t$, $s \in [0,1]$.

The expected lifetime utility of a retired agent of age t, V_t^R, depends on wealth A_t:

$$V_t^R(A_t) = \max_{\{A\}_{\tau=t+1}^{T_F}} \sum_{\tau=t}^{T_F} \beta^{\tau-t} U\left(A_\tau - \frac{A_{\tau+1}}{1+r}\right),$$

where $A_{T_F+1}=0$. This agent saves voluntarily for retirement with full control over his pension funds, so that the dynamic problem becomes 'a cake-eating problem.' A possible extension of this model is to allow for a pension system with realistic contribution schemes during the working lifetime and pensions during retirement with an increasing mortality. However, since the estimation will only contain a young labor force, this extension should not affect the main results substantially. Accordingly, it is left for future research.

When unemployed, expected lifetime utility at age t, V_t^u, depends on wealth A_t:

$$\begin{aligned} V_t^u(A_t) &= \max_{A_{t+1}^u \geq B_{t+1}} \left\{ U\left(A_t + b - \frac{A_{t+1}^u}{1+r}\right) \right. \\ &\left. +\beta\left[\lambda_{t+1}\int \max\left[V_{t+1}^e(A_{t+1}^u, x), V_{t+1}^u(A_{t+1}^u)\right] dF(x) + (1-\lambda_{t+1})V_{t+1}^u(A_{t+1}^u)\right]\right\}. \end{aligned}$$

When employed, expected lifetime utility at age t, V_t^e, depends on wealth A_t and wage w:

$$\begin{aligned} V_t^e(A_t,\omega) = &\max_{A^e \geq B_{t+1}} \left\{ U\left(A_t + w_t(\omega) - \frac{A_{t+1}^e}{1+r}\right) - \psi \right. \\ &+ \beta\left[(1-\theta_{t+1})\left(\pi_{t+1}\int \max\left[V_{t+1}^e(A_{t+1}^e, x), V_{t+1}^e(A_{t+1}^e, \omega), V_{t+1}^u(A_{t+1}^e)\right] dF(x)\right.\right. \\ &\left. + (1-\pi_{t+1})\max\left[V_{t+1}^e(A_{t+1}^e,\omega), V_{t+1}^u(A_{t+1}^e)\right]\right) \\ &\left.\left. +\theta_{t+1}\left(\pi_{t+1}\int \max\left[V_{t+1}^e(A_{t+1}^e, x), V_{t+1}^u(A_{t+1}^e)\right] dF(x) + (1-\pi_{t+1})V_{t+1}^u(A_{t+1}^e)\right)\right]\right\}. \end{aligned}$$

This dynamic programming (DP) problem has a finite horizon T and a 'salvage value' which is the present discounted utility at retirement age, that is, at $t=T+1$: $V_t^u(A_t)=V_t^R(A_t)$, and $V_t^e(A_t,\omega)=V_t^R(A_t)$. The solution to this problem includes two policy rules for wealth accumulation, $A_{t+1}^u(A_t)$ and $A_{t+1}^e(A_t,\omega)$, and a reservation wage $\omega_t^*(A_t)=\{\omega|\ V_t^u(A_t)=V_t^e(A_t,\omega)\}$. In this model, under certain conditions nobody will work for a wage below b, that is:

Proposition 1 *If* $\lambda_{t+1}\geq\pi_{t+1}$ *and* $\psi\geq 0$*, then* $w_t\left(\omega_t^*(A_t)\right)\geq b$, $t=1,...,T$.

Proof: *In Appendix A1.*

Notice requiring the arrival rate while unemployed to be higher than while employed is a sufficient but not necessary condition for reservation wages to be greater or equal than unemployment transfers. Even if this condition is not fulfilled, high disutility levels associated to working can generate reservation wages that exceed unemployment transfers.

In the absence of analytical solutions for this problem, and in order to solve it numerically one needs to assume specific functional forms:

- a constant relative risk aversion (CRRA) utility function $U(C) = \frac{C^{1-\gamma}-1}{1-\gamma}$, where $\gamma > 0$ is the coefficient of risk-aversion that satisfies the Inada conditions;

- a truncated log-normal wage offer distribution $\ln x \sim N(\mu, \sigma^2 | \ln \underline{\omega}, \ln \overline{\omega})$;

- a wage growth function $w_t(\omega) = \omega \exp(\alpha_1 t + \alpha_2 t^2)$; and

- age-dependent arrival and layoff rates given by the logistic function

$$q_t = \frac{q_0 \exp(\alpha_q t)}{1 + q_0 [\exp(\alpha_q t) - 1]}, \text{ where } q = \{\lambda, \pi, \theta\}.$$

  and q_0 are the initial arrival and layoff rates. This expression comes from $q_t = \frac{\exp(\alpha_q^0 + \alpha_q t)}{1+\exp(\alpha_q^0 + \alpha_q t)}$ and letting $\alpha_q^0 = \ln\left(\frac{q_0}{1-q_0}\right)$.

Then the model is solved recursively on a discretized state space. Using longer period lengths for the more distant future value functions in the DP problem makes the estimation more tractable (Wolpin 1992). Appendix A2 describes in detail the discretization and the numerical solution technique.

As shown in Rendon (2006), this model produces policy rules with the following features:

- The unemployed decumulate wealth. That is, they maintain their consumption while searching for a job by decreasing their wealth monotonically until reaching the borrowing limit.

- The employed can accumulate or decumulate wealth, depending on their wages and current wealth, so that wealth converges to some age-dependent desired level. They keep this wealth as a precaution to cushion future unemployment spells that may follow, if the layoff rate is not zero. As retirement age approaches they increase their wealth accumulation.

- The reservation wage is increasing in wealth. This means that wealthier agents are more selective and end up with higher accepted wages.

These policy rules imply a close interaction between labor market turnover and saving decisions. During unemployment spells, longer for wealthier people, reservation wages decline and hazard rates increase. In contrast, during employment spells, and for some combinations of current wealth and wages, wealth and reservation wage increase. It may occur that the reservation wage exceeds the current wage, in which case the current job is no longer preferable to unemployment. Barring a better wage offer from a new employer, the agent will quit his current job to search for a better one while unemployed with higher arrival rates. Thus, wealth accumulation underlies quits to unemployment, which reflect the agent's permanent desire to move to better paying jobs.

As explained in Rendon (2006), quits to unemployment can only happen in this framework if arrival rates are higher while unemployed than while employed. Although this difference is not assumed in the model and is not a restriction imposed in the estimation, observed quits will yield estimated parameters that satisfy this difference. Notice that the incentive to quit is there in spite of age wage growth.

With these features the policy rules will be able to generate realistic employment transitions and trajectories and distributions of wealth and wages over the life cycle.

4 Estimation

The estimation strategy is designed to recover the behavioral parameters of the theoretical model. I assume that individuals start off their careers with a wealth level drawn from a parametric initial wealth distribution and, for each parameter set, I compute the policy rules that solve the DP problem and use them to generate simulated careers paths. Then, at each iteration of the parameters I construct a measure of distance between the observed and the simulated moments, namely the distributions of employment status and transitions, wages, and assets. The estimation is thus a simulated method of moments (SMM) procedure in which the parameter estimates of the theoretical model are the minimizers of this function.

All individuals start off their careers being unemployed, with a wealth level A_0 drawn from a displaced lognormal distribution, $\ln(A_0 - B_0) \sim N(\mu_0, \sigma_0^2)$. I add the lowest admissible wealth level B_0 to each unobservable initial value of wealth to make the term inside the logarithm positive. The identification of the parameters of this function is not only given by wealth data, which are scarce for the first quarters after graduation, but also, in the presence of persistence in observed wealth values over time, by employment transitions and wages over time. The parameters to estimate are then the following:

1. Labor Market Parameters: $\Theta^1 = \{\lambda_0,\ \pi_0,\ \theta_0,\ \mu,\ \sigma,\ \alpha_1, \alpha_2, \alpha_\lambda, \alpha_\pi, \alpha_\theta\}$.

2. Wealth Parameters: $\Theta^2 = \{s, \mu_0, \sigma_0\}$.

3. Taste Parameters: $\Theta^3 = \{b, \gamma, \psi\}$.

The parameters of the standard search model, b, λ_0, π_0, θ_0, μ, and σ, extended by $\alpha_1, \alpha_2, \alpha_\lambda, \alpha_\pi$, α_θ, and ψ are identified from the reservation wage rule by the observed transitions, accepted wages, and wealth level at each quarter after graduation . The interest rate r and the discount factor β are not identified separately from the arrival rates, so they are fixed at 0.015 and 0.98, respectively. The other parameters, namely

γ and s are specific of a utility-maximizing job search model, which generates rules for wealth accumulation, and are pinned down by the observed evolution of wealth by employment status and wages.

Individuals do not only differ in their initial wealth, but also in other characteristics that have permanent effects in their work history. Assuming there is only one type of agent would, therefore, lead to making wrong inferences, in particular with regards to the estimation of wage offer distributions and arrival rates (Lazear 1979, Orazem 1987). To prevent this I introduce unobserved heterogeneity in the estimation and assume eight types of agents within each race group, which requires solving the DP problem eight times, one for each type of agent.

I assume two types for each of the three subsets of parameters, indexed by 1 and 2. Therefore, there are $8 = 2^3$ types of individuals characterized by each possible combination of the three subsets: $\Theta_{ijk} = \{\Theta_i^1, \Theta_j^2, \Theta_k^3\}$, $i, j, k = 1, 2$. The proportion for each type in the subsample is $p_{ijk}, i, j, k = 1, 2$, restricted by $\sum_i \sum_j \sum_k p_{ijk} = 1$. Accordingly, the vector for all parameters of the model is defined as $\Theta = \{\Theta_1^1, \Theta_1^2, \Theta_1^3, \Theta_2^1, \Theta_2^2, \Theta_2^3, p_{111}, p_{112}, p_{121}, p_{122}, p_{211}, p_{212}, p_{221}\}$ and contains the two types of the three subsets of parameters and only seven proportions.

I generate simulated career paths for 8000 individuals, that is, 1000 draws for each type of agent in each subsample. The moments used in this estimation are the cell-by-cell probability masses for the following distributions:

1. wealth distribution (10 years $\times$ 5 moments),
2. wage distribution (10 years $\times$ 4 moments),
3. employment status (10 years $\times$ 2 moments),
4. employment transitions from unemployment (10 years $\times$ 2 moments),
5. employment transitions from employment (10 years $\times$ 3 moments),
6. layoffs from employment to unemployment (10 years $\times$ 2 moments), and
7. layoffs when changing employer (10 years $\times$ 2 moments).

Thus, there are 200 moments to estimate 32 parameters, 16 for each type of agent plus 7 proportions of types for each race group. These simulated moments are computed for each year and without excluding actually missing observations (these moments barely change when they are computed excluding simulated individual and quarterly observations when the observed counterpart is missing). The SMM procedure relates a parameter set to a weighted measure of distance between sample and simulated moments:

$$S(\Theta) = \Delta m' W^{-1} \Delta m,$$

where Δm is the distance between each sample and simulated moment and W is a weighting matrix. As shown in Appendix A3, the matrix W can be chosen so that this weighted distance equals the sum of the χ^2-statistics of the selected distributions. In that case, minimizing this function is equivalent to minimizing a goodness of fit measure: $\Delta m' W^{-1} \Delta m = \chi^2_{130}$. Hence, fit measured by this criterion is the best that can be attained. The estimated behavioral parameters are thus $\Theta^* = \arg\min S(\Theta)$.

The function is minimized using Powell's method (Press, Teutolsky, Vetterling and Flannery 1992), which requires only function evaluations, not derivatives. This algorithm first calculates function values for the whole parameter space and then searches for the optimal parameter direction in the next iteration for function minimization. Underlying the computation of this optimal direction there is an implicit model of the derivative structure of the objective function. Once a new set of parameters is obtained, the algorithm goes back to calculate a new function value f_t, and the process is repeated until a convergence criterion is satisfied, namely that the percentage variation of this value falls below a certain value: $2\frac{|f_t - f_{t-1}|}{|f_t| + |f_{t-1}|} \leq 10^{-10}$. Asymptotic standard errors are calculated using the outer-product gradient estimator; their computation is explained in greater detail in Appendix A4.

5 Estimation Results

In this section, I discuss the parameter estimates for the two race groups and compare graphically and numerically actual and fitted moments: hazard rates at the first unemployment spell, trajectories for all observed variables and wealth variations by employment transitions.

The parameter estimates by race and type and their corresponding asymptotic standard errors are reported in Table 4.

[Table 4 here]

The first set of parameters, which characterize the labor market environment, are reported in the upper part of the table. The probabilities of receiving an offer while unemployed are initially lower but grow faster for blacks than for whites. In the first period out of school these are 55% for Type 1 and 30% for Type 2 of blacks. However, forty quarters after graduation they have grown substantially to 73% and 98% respectively. For whites these probabilities are initially 84% for Type 1 and 58% for Type 2; forty quarters later they have not grown much: 99% and 68%, respectively.

On the other hand, the probability of receiving an offer while employed is higher for blacks than for whites: it is initially 17% for Type 1 and 78% for Type 2 of blacks and 10% for Type 1 and 53% for Type 2 of whites. For both race groups these probabilities do not grow much with age: forty quarters after graduation they become 23% and 79% for blacks and 28% and 55% for whites. The relatively slow growth of offer rates while employed in contrast to the fast growth of offer rates while unemployed, captures the observed trend of decreasing job-to-job transitions over time that is simultaneous to exit rates from unemployment remaining pretty constant. To match increasing reservation wages, a result of wealth accumulation, arrival rates while unemployed have to go up so that exit rates remain more or less constant. Similarly, if agents are becoming more selective in their job acceptance decisions and are moving up to better paying jobs, matching observed decreasing job-to-job transitions requires offer rates while employed not grow too fast.

Finally, the layoff rate is initially higher but decreases faster for blacks. While it is 22% for Type 1 and 17% for Type 2 of blacks, it is 7% for Type 1 and 13% for Type 2 of whites. Forty quarters after graduation these parameters become, respectively, 3% and 9% for blacks and 5% and 3% for whites, which means that there is relatively fast convergence in layoff rates. Only for blacks of Type 2 these arrival and layoff rates, both the initial values and the associated variation parameters, are not statistically significant; for all other groups they are estimated with small standard errors.

Blacks exhibit lower means but higher standard deviations of the log-wage offer distributions than whites. These parameters imply an estimated initial mean quarterly wage offer for Type 1 and Type 2 of $1,964 and $1,590 for blacks and $1,575 and $2,511 for whites, respectively. Wages grow at a declining rate for both races, but they grow higher for whites, who also reach a maximum level later in their working life: at 264.3 and 29.9 quarters for Type 1 and Type 2, respectively, of whites. The equivalent for blacks is 94.6 and 19.1 quarters. The highest attainable mean wage offers are $2,759 for Type 1 and $1,785 for Type 2 of blacks, and $3,457 for Type 1 and $3,051 for Type 2 of whites. Asymptotic standard errors for these parameters are in general small, with the exception of the quadratic term of wage growth for Type 2 of blacks, which is found to be non-significant.

While these implications are useful in providing a first glance on the evolution of wages, they do not consider wealth-dependent labor turnover (agents switching jobs and employment states depending on their wealth position) and therefore do not imply that wages for a given individual wages will peak at the above age. Simulation of the model over the individuals' life cycle yields wages that peak at $7,838 for blacks and $9,132 for whites. The interested reader will find further insights on the maximum attainable wages over an individual's life cycle in Appendix A5.

These parameters are characteristic of the standard search model and represent a labor market environment that is more favorable for whites than for blacks. As in Wolpin (1992), whites have a better wage offer distribution and more wage growth. However, here the differences in arrival rates are much larger for both race groups: arrival rates while unemployed are higher, arrival rates while employed are lower, and layoff rates are higher. Accounting for the evolution of wealth and the reason for leaving the current employer, particularly voluntary quits from employment to unemployment, require larger differences between arrival rates by employment status and larger layoff rates.

The second set of parameters are specific of a utility-maximizing search model: the tightness of the borrowing constraint and the parameters characterizing the initial wealth distribution. Borrowing constraints are tight for both race groups, especially for both types of blacks. The parameter s capturing the tightness of the borrowing constraints is 0.4% and 1.3% for Type 1 and Type 2 of blacks and almost the same for the two types of whites: 4.85% and 4.90%. Their standard errors are small, except for Type 2 of whites.

The means and standard deviations of the displaced log-wealth distribution are higher for whites than for blacks. However, standard deviations are consistently non-significant. Notice that this distribution is identified mainly from initial wealth observations that start only in 1985. A larger number of early observations would certainly yield a more precise estimation of these parameter.

Whereas initial average wealth of blacks is between -$549 and $0 for Type 1 and between $5,216 and $5,765 for Type 2, for whites it is $8,467 for Type 1 and between $16,520 and $16,937 for Type 2. There is no unique initial average wealth level, because the support of the initial wealth distribution depends also on the amount of transfers while unemployed.

The third set of parameters reveals that blacks tend to have more transfers while unemployed, less risk-aversion, and more disutility of working than whites. Transfers while unemployed for Type 1 and Type 2 are respectively $1,049 and $389 for blacks and \$515 and \$326 for whites. The estimated coefficient of risk-aversion γ is 1.08 and 0.26 for Type 1 and Type 2 of blacks, respectively, and accounts for lower saving rates. It is 1.07 and 1.31 for Type I and 2 of whites. The disutility of working is 0.20 and 0.86 for blacks and 0.11 and 0.21 for whites. Together with transfers while unemployed, this parameter is pinned down by the higher unemployment rates and lower exit rates from unemployment of blacks. All these parameters exhibit small standard errors, with the exception of the disutility of working of Type 2 of blacks and transfers of Type 2 of whites.

These parameter estimates are similar to those of Rendon (2006) despite the differences in the model specification and the estimation method. In Rendon (2006) wage growth depends on specific human capital accumulation, not age, and the estimation method of choice is maximum likelihood. The most notable differences in parameter estimates are for borrowing constraints and the coefficient of risk aversion, respectively tighter and higher in that article, which may stem from using liquid wealth rather than total wealth here.

These subsets of parameters produce only five types of black agents and six types of white agents. However, three of these types alone represent 91% of blacks and 92% of whites while some of the remaining types are estimated to have zero proportion in their respective sample. Minority types exhibit also high standard errors and may, therefore, not be representative in their own sample. For a better understanding of these types I also report unemployment rates, average quarterly wages, and wealth by race group and type for years 3, 6, and 9 in Table 5.

[Table 5 here]

Type p_{111} is the largest for both race groups: 44% of blacks and 39% of whites belong to this type. For both race groups this type faces a labor market environment that is comparable to previous estimates (see Wolpin 1992 and Rendon 2006), with higher arrival rates while unemployed, and relatively low layoff rates. These parameters generate reservation wages that are increasing in wealth.

Type p_{121} of blacks represent 26% of its group, the second largest. It exhibits the same relatively favorable labor market environment than the previous type, with almost the same wage path, the same high transfers, high risk aversion, and low disutility of working parameters, but higher initial wealth and more access to credit. As shown in Table 5, looser borrowing constraints imply less wealth at later periods for this type, despite being initially wealthier. On the contrary, Type p_{212}, representing 21% of blacks, faces a labor environment in which it is hard to receive a job offer when unemployed, and easy to receive a job offer and get fired while employed. Accordingly, reservation wages do not depend on wealth. In this labor market environment, the unemployment rate is very low, less than 3% over the sample period. This type is also characterized by low initial wealth, high disutility of working and low risk-aversion, therefore it exhibits low savings and stagnated wealth levels. Type p_{212} and Type p_{221} are altogether 28% of blacks and both face a depressed labor market, with Type p_{221} being the wealthier segment of this subset.

In turn, the second and third largest types among whites, Type p_{221}, 31%, and Type p_{211}, 21%, share the same taste parameters with Type p_{111}, implying higher savings than blacks, medium transfers while unemployed, and low disutility of working. They also receive better wage offers than Type p_{111}; however, since their initial arrival rates while unemployed and employed do not differ much, Type p_{221} and Type p_{211} are characterized by a reservation wage that initially does not depend on the agent's wealth position. In later periods, as the arrival rate while unemployed increases and the arrival rate while employed remains about the same, the reservation wage becomes increasing in wealth. Otherwise, the only difference between them is that Type p_{221} is wealthier than Type p_{211}. In that sense, p_{111}, p_{112}, and p_{122}, the segment with the depressed labor market, relatively high unemployment, no more than $3,600 quarterly wages at year 9, and decreasing wealth levels over time, amounts to 44% of the sample of whites. This segment is larger and enjoys a better labor market environment than the corresponding segment of blacks.

6 Model Fit

To assess how well these parameter estimates mimic the data, I compare the observed and the predicted choice distributions of employment status, employment transitions, wealth, and wages.

[Figure 3 and Figure 4 here]

Figure 3 and Figure 4 show the actual and the predicted hazard rates for the first unemployment spell. For both groups, the model is able to replicate the data closely, especially for whites for whom the predicted hazard rate mimics closely the actual hazard rate and its negative duration dependence. However, for blacks the predicted hazard rate does not exhibit a the pronounced negative duration dependence of its observed counterpart. This may be related to the increase in the observed hazard rate of blacks from quarter 11 until 13. A similar increase, though less abrupt, is also present in the hazard rate of whites from quarter 8 until 13. Since the initial wealth distribution and heterogeneity play a crucial role for reproducing this pattern, the few early wealth observations used in the estimation may be the reason the model does not reproduce closely the negative duration dependence of blacks. Conditional on initial wealth level and type, hazard rates are increasing over time: individuals reduce their wealth position while unemployed, so that reservation wages decline and hazard rates increase. However, because poorer individuals exhibit high hazard rates and are first to exit unemployment, the predicted average hazard rate tends to go down over time. Considering also that the observed hazard rates were not used in the estimation, this comparison can be considered a cross validation, an out-of-sample assessment of the model's success in fitting the data.

[Figure 5 here]

[Table 6 here]

Figure 5 offers a graphical comparison of all actual and predicted variables by quarter since graduation for both race groups. Additionally, Table 6 presents a summary of the actual and predicted distributions of employment status and transitions for years 3, 6, and 9 after graduation for both race groups. It also shows goodness of fit tests to evaluate whether the theoretical model at the estimated parameters can mimic the cell-by-cell distribution of the data. The test statistic across choices j at time t is defined as $\chi_t^2 = \Sigma_{j=1}^{J} \frac{(n_{jt}-\hat{n}_{jt})^2}{\hat{n}_{jt}}$, where n_{jt} is the actual number of observations of choice j at time t, $\hat{n}_{jt}$ is the model predicted counterpart, J is the total number of possible choices and T is the number of years. This statistic has an asymptotic χ^2 distribution with $J-1$ degrees of freedom.

In the graphical comparison, the evolution of predicted employment status and employment transitions replicate the actual paths for both race groups very accurately: unemployment rates in Figures 5a and 5b, transitions from unemployment to employment shown in Figures 5c and 5d, job separations reported in Figures 5e and 5f, and job-to-job transitions, in Figures 5g and 5h. Exits from unemployment and job-to-job transitions are particularly noisy. The χ^2 statistics corroborate this graphical evidence and show that prediction is accurate for both race groups: all of these variables pass the χ^2 tests.

As illustrated by Figures 5i-5l the model overpredicts slightly the percentage of layoffs in job separations, but predicts very accurately the percentage of layoffs in job-to-job transitions. Yet, at the formal level, the choice distributions of these transitions pass the χ^2 tests.

[Table 7 here]

Table 7 presents a similar summary of the actual and predicted wealth and wage distributions, including goodness of fit tests. The corresponding evolution of wealth is illustrated graphically in Figures 5m and 5n. In spite of the noise in the wealth data, the model mimics well the observed pattern of wealth accumulation. As implied by the initially decreasing hazard rate seen above, just after graduation whites decumulate wealth in order to finance their first unemployment spell, but then they accumulate wealth as a result of making progress in their employment careers. Blacks also show initial wealth decumulation, but it is not as pronounced as for whites. The model passes the χ^2 tests for both race groups at all years. Notice that the actual wealth of whites is more noisy than that of blacks. Nevertheless, the model reproduces relatively well the racial wealth ratio at the average, particularly at years 6 and 9, and its first increasing and then decreasing trend over time

As explained above, for most individuals in the sample initial wealth is not observed, as it is only observed from 1985 onwards. This implies that conditioning on initial wealth in simulating the data for the goodness of fit tests is not feasible. Had such data been available, I could certainly have shown a better model fit.

Figures 5o and 5p show that wages are especially well replicated on average, with some overprediction for blacks and some underprediction for whites in later periods. The model also mimics well the observed wage distribution: it passes the χ^2 tests for both race groups in all years, with the exception of whites in year 9. The racial wage ratio and its declining trend over time are partially captured by the model, at year 3 and year 6.

[Table 8 here]

Table 8 shows the actual and predicted first unemployment spell duration and first accepted wage. It is shown that the model is able to replicate these two variables pretty well, though with some underprediction of the unemployment duration of blacks and some overprediction of the first accepted wage of whites. This table also provides a comparison between observed and predicted savings by employment transitions as reported previously in Table 3. Comparing these predicted moments with their observed counterparts, as the hazard rates, is informative about the ability of the model to replicate observables that have not been used in the estimation. This table reveals a relatively good prediction of savings during job separations for both race groups, exits from unemployment and employment retention for whites, and job-to-job transitions for blacks. Other wealth variations by employment transitions are under- or overestimated. By contrast, the employment transitions themselves are very accurately predicted by the model.

In short, both graphically and formally the model is fairly successful in replicating the main features of the data.

7 Regime Changes

After recovering the underlying behavioral parameters, I explore black-white variations in outcomes resulting from changes in the economic environment in the three subsets of parameters: first, assigning blacks the labor market conditions of whites, second, the initial wealth distribution and access to credit of whites, and, third, the taste parameters of whites. Additionally, I evaluate the outcomes of performing two of these changes at a time. Notice that there are several combinations for computing these counterfactuals. For example, one can replace a parameter subset of Types 1 and 2 of blacks respectively by the corresponding parameter subset of Types 1 and 2 of whites or, alternatively, of Types 2 and 1. For simplicity, I only report the counterfactual that yields the highest welfare for blacks. The effects of these experiments, of which labor and wealth changes are welfare-improving, are reported in Table 9, where the first and last columns show selected predicted variables for the black and white subsample, respectively. Once again, average wages only contain the income of the employed.

[Table 9 here]

The first experiment, reported in column 2, addresses the importance of labor market conditions, that is, of the first subset of parameters in blacks' outcomes. While at the beginning of the employment careers this experiment decreases the racial wealth gap very slightly, it practically eliminates the racial wage gap; in the fourth quarter, however, whereas the black-white wealth ratio goes down from 20% to 16%, the black-white wage ratio increases from 89% to 109%. As agents rely more on good labor market conditions, they can initially decumulate faster to finance their job search. These conditions also imply transitions that are very similar to whites and, therefore, the same unemployment rate. In the long run, the better labor market conditions prevail and wealth increases with wages: forty quarters after graduation the racial wealth ratio has increased from 37% to 86% and the racial wage ratio from 94% to 109%.

As shown in column 3, having whites' initial wealth distribution and access to credit increases blacks' average wealth and wages in the fourth quarter after graduation, smoothing out racial differences almost completely: the racial wealth and wage ratio increase to 96% and 93%, respectively. It also improves blacks' welfare considerably, basically by increasing their consumption in the first quarters after graduation. On the other hand, more initial wealth leads to a longer initial unemployment spell and higher rates of unemployment at the start of employment careers, deteriorating blacks' employment situation. None of these changes, however, is persistent: forty quarters after graduation racial disparities reemerge: while blacks' wages remain unchanged, at 94% of whites', the racial wealth ratio diminishes from 37% to 28%. Broader access to credit, unlike the displacement of initial wealth, is a permanent change and undermines the need for holding wealth.

The outcomes for blacks when they are assigned the taste parameters of whites are presented in column 4. With more risk-aversion, less disutility of working, and less transfers while unemployed blacks become less selective in their job search and suffer an initial decline in accepted wages, from 89% to 83% of whites' wages, and the unemployment rate, from 43% to 36%. Wealth, however, increases slightly from 20% to 28% of whites'. Lower wages and more wealth holdings imply a substantial reduction in consumption, from $1,783 to $1,495, the lowest attained by any experiment. Forty quarters after graduation, blacks have accumulated wealth relatively fast, increasing the black-white wealth ratio from 37% to 59%, wages recover from their initial decline, and the unemployment rate increases from 16% to 20%.

The second set of experiments starts in column 5, combining two changes at a time. This column illustrates the results of extending the first experiment by also assigning blacks the initial wealth distribution and borrowing possibilities of whites. This variation increases blacks' welfare and consumption the most, plus having the initial effect of diminishing both the wealth and the wage gap: in the fourth quarter after graduation relative wealth of blacks increases from 20% to 60% of whites' and relative wages go up from 89% to 99%. However, the improved labor market conditions combined with looser borrowing constraints, both permanent changes, undermine the need of precautionary savings, so that forty quarters after graduation wealth goes down and the racial wealth ratio diminishes from 37% to 1%. At the same time, the wage gap disappears fully and unemployment rates fall below those of whites. Consumption is the highest and the saving rate while employed is the lowest of all experiments. Forty quarters after graduation blacks' average consumption has increased from $3,390 to $3,926, overtaking whites', at $3,518.

Had blacks the labor and taste parameters of whites, as reported in column 6, they would experience a modest increase in their initial wealth: the racial wealth ratio rises from 20% to 32%. In this scenario, blacks' first unemployment spell is shorter, their exit rates from unemployment higher, their unemployment rate lower, and their wages higher, almost the same as whites. However, in the fortieth quarter after graduation this experiment has created full long run racial convergence in wealth and wages: all wage and wealth gaps have disappeared. Given that borrowing constraints are the only remaining permanent difference with whites and that these are relatively tight and quite similar across race groups, this combined change is the most successful in eliminating wealth and wage racial differences in the long run, matching thereby the welfare level of blacks and whites. Additionally, this experiment generates both faster wealth accumulation while employed and faster wealth decumulation while unemployed.

The combination of better initial wealth distributions, looser borrowing constraints, and the taste parameters of whites, reported in column 7, does a better job of eliminating initial wealth racial differences, even more than only switching initial wealth distributions and accessibility to credit. Furthermore, the wealth black-white ratio forty quarters after graduation increases from 37% to 60%. However, this experiment has the effect of reducing the relative wage of blacks, initially from 89% to 81% and in the long run from 94% to 82%. Unlike the second experiment, in which only initial wealth distributions and access to credit are increased, the current experiment also reduces de disutility of working and transfers while unemployed, which results in lower reservation wages and, therefore, lower accepted wages. The increase in risk-aversion, which has the effect of increasing reservation wages, does not seem enough to counteract this trend. Consequently, blacks do not only have lower wages, but also, and similarly to whites, lower unemployment rates and employment transitions.

Another variable of interest in these experiments is the saving rate. Compared to blacks, whites save more when employed and dissave more when unemployed. Blacks' savings rates in the long run converge to those of whites only when blacks are assigned the taste parameters of whites.

Summarizing, improving the initial wealth distribution and access to credit of blacks is the only regime change that eliminates both racial wealth and wage gaps at the beginning of employment careers. This change, however, fails to substantially diminish the long run racial wealth and wage gaps. On the other hand, only improving labor market conditions of blacks accomplishes initial and long run convergence of labor market outcomes, that is, of wages, unemployment rates and employment transitions. If this improvement is combined with a switch in preferences, it also eliminates long run, but not initial wealth disparity.

8 Conclusions

The main purpose of this paper has been to determine the extent to which initial wealth disparity is responsible for the observed differences in early employment careers of black and white individuals. I generalize Danforth's (1979) utility-maximizing search model to allow for on-the-job search, wage growth, arrival and layoff rate variations, retirement, and a parametric borrowing limit, and estimate it by a simulated method of moments using data from the NLSY. At the recovered behavioral parameters, the model mimics well the main observables, namely, the hazard rate during the first unemployment spell, first accepted wages, savings by employment transitions, and the cross-sectional distributions of wealth, wages, and employment transitions over time.

Counterfactual experiments reveal that most of the differences in labor market performance between blacks and whites several years after High School graduation are accounted for by differences in their wage offer distributions and arrival and layoff rates, both in levels and growth, as well as preferences. Differences in initial wealth have essentially no role in explaining racial disparities several years after High School graduation; they are able to account for the racial gap both in wealth and wages only at the *beginning* of employment careers.

These results are revealing about racial differences in labor market outcomes stemming from initial wealth, the labor market environment, and preferences. Throughout this paper, I have abstracted from racial differences arising from schooling choices, which also provide insurance for labor risk (Whalley 2005), and general equilibrium effects, that is, regime changes can also affect wage offer distributions and arrival rates. The utility-maximizing job search model proposed here can be extended in these two directions, which may alter the effects of regime changes implemented in this paper. Recent papers by Lee (2005) and Lee and Wolpin (2006) account for schooling decisions in a general equilibrium setting and are thus encouraging about the feasibility of these extensions in future research.

Appendix

A1. Proof of Proposition 1

I proceed inductively, showing $w_{t+1}(\omega) \geq b$ implies $w_t(\omega) \geq b$, for $t < T$. Suppose that $w_{t+1}(\omega) \geq b$ and $w_t(\omega) = b$, for $t < T$, then the value functions become:

$$\begin{aligned} V_t^e(A_t, b) &= \max_{A^e \geq B_{t+1}} \left\{ U\left(A_t + b - \frac{A_{t+1}^e}{1+r}\right) - \psi \right. \\ &\left. + \beta\left[\pi_{t+1} \int \max\left[V_{t+1}^e(A_{t+1}^e, x), V_{t+1}^u(A_{t+1}^e)\right] dF(x) + (1-\pi_{t+1}) V_{t+1}^u(A_{t+1}^e)\right]\right\}, \\ V_t^u(A_t) &= \max_{A_{t+1}^u \geq B_{t+1}} \left\{ U\left(A_t + b - \frac{A_{t+1}^u}{1+r}\right) \right. \\ &\left. + \beta\left[\lambda_{t+1} \int \max\left[V_{t+1}^e(A_{t+1}^u, x), V_{t+1}^u(A_{t+1}^u)\right] dF(x) + (1-\lambda_{t+1}) V_{t+1}^u(A_{t+1}^u)\right]\right\}. \end{aligned}$$

Thus, $V_t^u(A_T) \geq V_t^e(A_t, b)$, if $\lambda_{t+1} \geq \pi_{t+1}$ and $\psi \geq 0$, so that $V_T^e(A_T, \omega) = V_T^u(A_T)$ only when $w_T(\omega) \geq b$.

Now suppose that at period T, $w_T(\omega) = b$, then if $\psi \geq 0$:

$$\begin{aligned} V_T^e(A_T, b) &= \max_{A_{T+1}^e \geq B_{T+1}} \left\{ U\left(A_T + b - \frac{A_{t+1}^e}{1+r}\right) - \psi + \beta V_T^R\left(A_{t+1}^e\right)\right\} \\ V_T^u(A_T) &= \max_{A_{t+1}^u \geq B_{T+1}} \left\{ U\left(A_T + b - \frac{A_{t+1}^u}{1+r}\right) + \beta V_T^R\left(A_{T+1}^u\right)\right\}, \end{aligned}$$

Thus, $V_T^u(A_T) \geq V_T^e(A_T, b)$, if $\psi \geq 0$, so that $V_T^e(A_T, \omega) = V_T^u(A_T)$ only when $w_T(\omega) \geq b$.■

A2. Numerical Solution of the Model

As mentioned in the main body of the paper, the model is solved on a discretized state space. Certainly, the computation of the DP problem and the criterion function are sensitive to the discretization of the state and choice variables, especially of wealth. Few gridpoints for wealth reduce the accuracy of the model in replicating observed quits and savings, and in estimating the borrowing limit. The choice of 201 gridpoints for wealth, almost four times as much as the number of gridpoints for wages, aims to ameliorate this problem. Fewer than 5% of wealth and 3% of wage observations lie outside the admissible range defined by these bounds. The table below gives further details of this discretization, based on Rendon (2006).

Discretization of variables		
	Assets	Wages
Original Variable	A	ω
Discretized Variable	$A(i)$	$\omega(j)$
Gridpoints	$i = 1, ..., N_A$	$j = 1, ..., N_w$
Number of Gridpoints	$N_A = 201$	$N_w = 51$
Lower Bound	$\underline{A} = -10,250$	$\underline{w} = 1,000$
Upper Bound	$\overline{A} = 55,250$	$\overline{w} = 10,000$
Gridsize	$\Delta_A = \frac{\overline{A} - \underline{A}}{N_A}$	$\Delta_w = \frac{\ln \overline{w} - \ln \overline{w}}{N_w}$

The discrete probability for a wage draw $\omega(j)$ is

$$\widehat{f}(j) = \frac{\Phi\left(\frac{\ln \omega(j)+\Delta_w/2-\mu}{\sigma_w}\right) - \Phi\left(\frac{\ln \omega(j)-\Delta_w/2-\mu}{\sigma_w}\right)}{\Phi\left(\frac{\ln \overline{w}-\mu}{\sigma_w}\right) - \Phi\left(\frac{\ln \underline{w}-\mu}{\sigma_w}\right)}.$$

Wage as a function of age $w_t(\omega)$ is also discretized and becomes $w(j,t)=\omega(j)\exp\left(\alpha_1 t+\alpha_2 t^2\right)$. Arrival and layoff rates are $q(t) = \frac{q_0 \exp(\alpha_q t)}{1+q_0[\exp(\alpha_q t)-1]}$, $q = \{\lambda, \pi, \theta\}$.

The entire working lifetime is assumed to be 162 quarters. As in Wolpin (1992), the solution to the model and estimation is made tractable assuming that the individual solves the DP problem using longer period lengths for the more distant future value functions. Let n be the period length measured in quarters and let t_n be age measured in periods of varying length n. The following scheme illustrates the periods' transformation:

	50 quarterly periods	8 annual periods	10 biannual periods
Quarters t:	1, 2,,......, 49, 50	51, 52,...., 81, 82	83, 84,......, 161, 162
Period Length:	$n = 1$	$n = 4$	$n = 8$
Transformed periods t_n	1, 2,......, 49, 50	51, 52,...., 57, 58	59, 60,......, 67, 68

Then, the age in quarters measured in periods of varying length $n = \{1, 4, 8\}$ is

$$t(t_n) = \min(t_n, 50) + 4\min(\max(t_n - 50, 0), 58) + 8\max(t_n - 58, 0).$$

Notice that the transformed number of periods t_n does not indicate the *number* of quarterly, annual, biannual periods. This way, a finite horizon DP problem of originally 162 quarterly periods is transformed into a problem of only $T = 68$ periods. However, one has to make several adjustments in the setup to match these varying period lengths.

The arrival and discount rates for a person of age t_n measured in periods of length n are, thus,

$$q_n(t_n) = 1 - (1 - q(t))^n,\ q = \{\lambda, \pi, \theta\}, \quad \beta_n = \beta^n.$$

And the borrowing constraint is just $B_{t_n} = -s\sum_{\tau=t(t_n)}^{T} b/(1+r)^{T-\tau}$. For annual and biannual period lengths, the quarterly consumption is assumed to be constant during that period. If the agent is unemployed and consumes C_u in each quarter, wealth at the end of a period of length n is

$$A_{t_n+1} = (1+r)^n A_{t_n} + b\sum_{j=1}^{n}(1+r)^j - C_u\sum_{j=1}^{n}(1+r)^j.$$

The utility function for a period of length n from quarterly consumption C_u is then

$$\begin{aligned} U_n(C_u) &= \sum_{t=0}^{n}\beta^t U(C_u) = \frac{1-\beta^n}{1-\beta}U(C_u) = \frac{1-\beta^n}{1-\beta}U\left(g_n A_{t_n} + b - g_n\frac{A_{t_n+1}}{(1+r)^n}\right) \\ \text{where} &: g_n = \frac{(1+r)^n}{\sum_{j=1}^{n}(1+r)^j} = \frac{1-\frac{1}{(1+r)}}{1-\frac{1}{(1+r)^{n+1}}}. \end{aligned}$$

Consumption is also constant during the period when the individual is employed, without any change in the wage offer distribution, but with an adjustment for wage growth. The quarterly wage for a person of age t_n measured in periods of length n is thus

$$w_n(\omega, t_n) = \omega \exp\left(\alpha_1 t(t_n) + \alpha_2 t^2(t_n)\right).$$

Hence, the utility function for a period of length n from a constant quarterly consumption C_e of an employed agent with initial wage ω and age t_n is

$$U_n(C_e) = \sum_{t=0}^{n} \beta^t U(C_e) = \frac{1-\beta^n}{1-\beta}\left[U\left(g_n A_{t_n} + w_n(\omega, t_n) - g_n \frac{A_{t_n+1}}{(1+r)^n}\right) - \psi\right]$$

This way, the DP problem is solved by choosing wealth next period regardless of the period length, just by making the necessary adjustments in the utility function and its arguments during the backward solution. Note that this procedure does not entail aggregating quarterly observations, because the estimation only uses data from period 1 until period 40, for which I use quarterly periods.

The numerical solution proceeds in the following steps:

1. For $t_n = T + 1$ define the discretized value functions:

$$\begin{aligned} \widehat{V}^u[i, t_n] &= V_R(A(i)), \text{ and} \\ \widehat{V}^e[i, j, t_n] &= V_R(A(i)), \end{aligned}$$

where $V_R(A(i))$ is the discretized value of being retired. For a CRRA utility function, this value function admits an analytical expression:

$$V_t^R(A_t) = \max_{\{A\}_{s=t}^{T_F}} \sum_{s=t}^{T_F} \beta^{s-t} \frac{\left(A_s - \frac{A_{s+1}}{1+r}\right)^{\gamma} - 1}{1-\gamma} = \frac{(A_t - A_{T_F+1})^{1-\gamma}}{1-\gamma} c_1^{\gamma} - \frac{1}{1-\gamma} c_2,$$

where $c_1 = \frac{1-\left[\frac{g}{1+r}\right]^{T_F - T+1}}{1-\frac{g}{1+r}}$, $g = [\beta(1+r)]^{\frac{1}{\gamma}}$, $c_2 = \frac{1-\beta^{T_F-T+1}}{1-\beta}$, and $A_{T_F+1} > 0$.

Analytical solutions for consumption and for assets are $C_t = \frac{g^{t-T}}{c_1} A_T$ and $A_t = \frac{g^{t-T}}{c_1} A_T \left(\frac{1-\left(\frac{g}{1+r}\right)^{T_F-t+1}}{1-\frac{g}{1+r}}\right)$, respectively. With $\beta(1+r) < 1$, consumption and assets of the retired decrease monotonically over time. Individuals are assumed to live for 25 years (100 quarters) after retirement. As the value function and the policy rules for retirement admit closed solutions and these functions are only needed at the moment of retirement, their period length is a quarter.

2. Integration. Define the discretized expected values

$$
\begin{aligned}
W^u[i,t_n] &= \lambda_n(t_n)\sum_{j=1}^{N_w}\max\left[\widehat{V}^e[i,j,t_n],\widehat{V}^u[i,t_n]\right]f(j)+[1-\lambda_n(t_n)]\widehat{V}^u[i,t_n];\\
W^e[i,j,t_n] &= [1-\theta_n(t_n)]\left(\pi_n(t_n)\sum_{l=1}^{N_w}\max\left[\widehat{V}^e[i,j,t_n],\widehat{V}^e[i,l,t_n],\widehat{V}^u[i,t_n]\right]f(l)\right.\\
&\quad\left.+[1-\pi_n(t_n)]\max\left[\widehat{V}^e[i,j,t_n],\widehat{V}^u[i,t_n]\right]\right)\\
&\quad+\theta_n(t_n)\left(\pi_n(t_n)\sum_{l=1}^{N_w}\max\left[\widehat{V}^e[i,l,t_n],\widehat{V}^u[i,t_n]\right]f(l)+[1-\pi_n(t_n)])\widehat{V}^u[i,t_n]\right).
\end{aligned}
$$

3. Compute the value function for the previous period

$$
\begin{aligned}
\widehat{V}^u[i,t_n] &= \max_{m\geq i^*(t_n+1)}\left\{U_n\left(g_nA(i)+b-g_n\frac{A(m)}{(1+r)^n}\right)+\beta_nW^u[m,t_n+1]\right\},\\
\widehat{V}^e[i,j,t_n] &= \max_{q\geq i^*(t_n+1)}\left\{U_n\left(g_nA(i)+w_n(j,t_n)-g_n\frac{A(q)}{(1+r)^n}\right)+\beta_nW^e[q,j,t_n+1]\right\},
\end{aligned}
$$

   where $A(i^*(t_n+1))=B_{t_n+1}$. The maximizers to these problems are $q^*=q^*(i,j,t_n)$ and $m^*=m^*(i,t_n)$; the reservation wage is $j^*(i,t_n)=\left\{j\left|\widehat{V}^e[i,j,t_n]\geq\widehat{V}^u[i,t_n]>\widehat{V}^e[i,j-1,t_n]\right.\right\}$.

4. Go to step 2. This process goes backwards and it is repeated until reaching period $t_n=1$.

A3. Simulated Method of Moments

The discrete distribution of an observed variable is characterized by a set of J frequencies m_j, $j=\{1,..,J\}$. Let n be the total number of observations of the actual variable and n_j the number of observations of the actual variable in the jth cell. The predicted counterparts of the frequencies and the number of observations for the jth cell are $\widehat{m}_j$ and $\hat{n}_j$, respectively. Let $\Delta m'=[\Delta m_1,\cdots,\Delta m_J]'$ be a vector in which $\Delta m_j=m_j-\widehat{m}_j$, that is, the difference between the actual and the predicted percentage for each cell. A method of moments estimation minimizes the weighted average distance between the actual and predicted distributions $\Delta m'W^{-1}\Delta m$, where W is a diagonal matrix in which each element of the main diagonal is $\frac{\widehat{m}_j}{n}$. Then, the weighted average distance of a variable, indexed by k, becomes

$$
\Delta m'W^{-1}\Delta m=\sum_{j=1}^{J_k}\Delta m_j^2\left(\frac{\widehat{m}_j}{n}\right)^{-1}=\sum_{j=1}^{J_k}\frac{(m_j-\widehat{m}_j)^2n^2}{\widehat{m}_jn}=\sum_{j=1}^{J_k}\frac{(n_j-\hat{n}_j)^2}{\hat{n}_j}=\chi^2_{J_k-1}.
$$

Since a sum of chi-square random variables follows also a chi-square distribution, with this diagonal weighting matrix the weighted average distance is $\chi^2_{L-K}=\sum_{k=1}^{K}\chi^2_{J_k-1}$, where $L=\sum_{k=1}^{K}J_k=200$ is the number of moments used in the estimation, and $K=70$ (7 variables $\times$10 years). Hence, matching the simulated moments to the moments observed in the actual dataset is equivalent to computing a χ^2-statistic for the selected distributions: $S(\Theta) = \chi^2_{L-K}$.

A4. Asymptotic Standard Errors

The asymptotic standard errors are obtained from the criterion function by the following formula:

$$Asy.\ Var(\Theta) = \left[\frac{\partial^2 S(\Theta)}{\partial\Theta\partial\Theta'}\right]^{-1} \approx \left[\frac{\Delta^2 S(\Theta)}{\Delta\Theta\Delta\Theta'}\right]^{-1}$$

The first numerical derivative is computed by increasing each parameter proportionally by h and smoothing the criterion function, which has many discontinuities, with a quadratic approximation. If a first approximation of the first derivative is $\frac{S(\Theta+h\Theta)-S(\Theta)}{h\Theta}$, the relative step-size in each parameter can be further shrinked by $\varepsilon \in (0,1)$. Let $S(\theta+\varepsilon h\theta) - S(\theta) \approx \varepsilon^2 [S(\theta+h\theta) - S(\theta)]$, then $\frac{S(\theta+\varepsilon h\theta)-S(\theta)}{\varepsilon h\theta} \approx \frac{\varepsilon^2[S(\theta+h\theta)-S(\theta)]}{\varepsilon h\theta}$. For $\varepsilon = h$, we obtain $\frac{\Delta S(\Theta)}{\Delta\Theta} = \frac{S(\theta+h^2\theta)-S(\theta)}{h^2\theta} \approx \frac{S(\theta+h\theta)-S(\theta)}{\theta}$. Alternatively, other methods can be used, such as a kernel approximations for smoothing the computation of these derivatives as in Coppejans and Sieg (2005).

The second derivative is approximated in a similar way, that is, by computing the implied variation in the numerical first derivative implied by a variation of each parameter and smoothing it by the same relative variation:

$$\left[\frac{\Delta^2 S(\Theta)}{\Delta\Theta\Delta\Theta'}\right]_{ij} = \begin{cases} \frac{S(\Theta_{-i,j},\theta_i+h\theta_i,\theta_j+h\theta_j)-S(\Theta_{-i},\theta_i+h\theta_i)-S(\Theta_{-j},\theta_j+h\theta_j)+S(\Theta)}{\theta_i\theta_j}, & \text{if } i \neq j; \\ \frac{S(\Theta_{-i},\theta_i+2h\theta_i)-2S(\Theta_{-i},\theta_i+h\theta_i)+S(\Theta)}{\theta_i^2}, & \text{if } i = j. \end{cases}$$

where $S(\Theta_{-i}, \theta_i + h\theta_i)$ is the criterion function when parameter θ_i is increased by $h\theta_i$ and all the other parameters denoted by Θ_{-i} are unchanged, and $S(\Theta_{-i,j}, \theta_i + h\theta_i, \theta_j + h\theta_j)$ is the criterion function when parameters θ_i and θ_j are increased respectively by $h\theta_i$ and $h\theta_j$ and all of the others, $\Theta_{-i,j}$, are kept fixed.

The parameters' asymptotic standard errors are the square root of the main diagonal of this matrix. I use $h = 0.01$ for the behavioral parameters, and $h = 0.0001$ for the proportions of types.

A5. Wage Peaks by Type

The following table indicates at which quarter wages of each race group reach their maximum level

Maximum Wage by Race, Type and Quarter

Blacks				Whites			
		Wage Peak				Wage Peak	
Types	%	Value	Quarter	Types	%	Value	Quarter
p_{111}	43.59	7838	41	p_{111}	39.33	9132	162
				p_{112}	0.16	7644	143
p_{121}	26.33	7019	126				
p_{122}	1.71	6961	125	p_{122}	4.95	7661	144
				p_{211}	21.38	5270	41
p_{212}	21.21	2570	70	p_{212}	3.22	5749	33
p_{221}	7.16	2950	65	p_{221}	30.96	5272	41

Generally speaking, wages of blacks tend to peak earlier and at lower values than wages of whites. Type p_{111} attains the highest wages if both race groups: \$7,838 quarterly wages at quarter 41 for blacks and \$9,132 at quarter 162 for whites. It is noteworthy that Type p_{111} of whites, which exhibits relatively low wage levels during the sample period, is the type with the highest maximum wage level. In general, individuals belonging to Type 2 of labor market parameters, p_{211}, p_{212}, and p_{221}, have lower initial wages with relatively slow but very persistent wage growth and therefore lower average wages than their corresponding Type 1 individuals. On the contrary, blacks' Type 2 of labor market parameters, p_{212} and p_{221}, exhibit lower average wages than Type 1, that is, for this group there is no overtaking in wages.

References

Altonji, J. G. and Doraszelski, U. (2005), 'The Role of Permanent Income and Demographics in Black/White Differences in Wealth', *Journal of Human Resources* **240**(1), 1–30.

Blau, F. and Graham, J. W. (1990), 'Black-White Differences in Wealth and Asset Composition', *Quarterly Journal of Economics* **105**(2), 321–339.

Bowlus, A. and Eckstein, Z. (2002), 'Dicrimination and Skill Differences in an Equilibrium Search Model', *International Economic Review* **43**(4), 1309–1345.

Coppejans, M. and Sieg, H. (2005), 'Kernel estimation of average derivatives and differences', *Journal of Business and Economic Statistics* **23**(2), 211–225.

Danforth, J. P. (1979), On the role of consumption and decreasing absolute risk aversion in the theory of job search, *in* S. A. Lippman and J. McCall, eds, 'Studies in the Economics of Search', North-Holland, New York, pp. 109–131.

Eckstein, Z. and Wolpin, K. (1989), 'The Specification and Estimation of Dynamic Stochastic Discrete Choice Models', *Journal of Human Resources* **24**, 562–598.

Eckstein, Z. and Wolpin, K. (1999), 'Estimating The Effect of Racial Discrimination On First Job Wage Offers', *Review of Economic Studies* **81**(3), 384–392.

Fairlie, R. W. (1999), 'The Absence of the African-American Owned Business: An Analysis of the Dynamics of Self-Employment', *ei* **17**(1), 80–108.

Fairlie, R. W. and Meyer, B. D. (2000), 'Ethnic and Racial Self-employment Differences and Possible Explanations', *Journal of Human Resources* **35**(4), 543–669.

Flinn, C. and Heckman, J. (1982), 'New methods for analyzing structural models of labor force dynamics', *Journal of Econometrics* **188**, 115–68.

Gittleman, M. and Wolff, E. N. (2004), 'Racial Differences in Patterns of Wealth Accumulation', *Journal of Human Resources* **39**, 193–227.

Heckman, J. J., Lyons, T. M. and Todd, P. E. (2000), 'Understanding Black/White Wage Differencials, 1960-1990', *American Economic Review* **90**(2), 344–349.

Jianakoplos, N. A., Menchik, P. L. and Irvine, F. O. (1989), Using Panel Data to Assess the Bias in Cross-sectional Inferences of Life-Cycle Changes in the Level and Composition of Household Wealth, *in* R. Lipsey and H. S. Tice, eds, 'The Measurement of Saving, Investment and Wealth', The University of Chicago Press, Chicago, pp. 553–644.

Keane, M. and Wolpin, K. (2000), 'Eliminating Race Differences in School Attainment and Labor Market Success', *Journal of Labor Economics* **18**(4), 610–652.

Lazear, E. (1979), 'The Narrowing of Black-White Wage Differentials is Illusory', *American Economic Review* **69**(4), 553–564.

Lee, D. (2005), 'An Estimable Dynamic General Equilibrium Model of Work, Schooling and Occupational Choice', *International Economic Review* **46**(1), 1–34.

Lee, D. and Wolpin, K. (2006), 'Intersectoral Labor Mobiity andthe Growth of the Service Sector', **74**(1), 1–46.

Ljungqvist, L. and Sargent, T. J. (2000), *Recursive Macroeconomics*, The MIT Press, Cambridge. Massachussetts.

Menchik, P. L. and Jianakoplos, N. A. (1997), 'Black-White Wealth Inequality. Is Inheritance the Reason?', *Economic Inquiry* **35**, 428–442.

Neal, D. (2005), Why has black-white skill convergence stopped? NBER Working Paper 11090.

Neal, D. A. and Johnson, W. R. (1996), 'The Role of Pre-market Factors in Black/White Wage Differences', *Journal of Political Economy* **104**(5), 869–895.

Oliver, M. L. and Shapiro, T. M. (1997), *Black Wealth/White Wealth: A New Perspective on Racial Inequality*, Routledge, London.

Orazem, P. (1987), 'Black-White Differences in Schooling Investment and Human Capital Production in Segregated Schools', *American Economic Review* **77**(4), 714–723.

Press, W. H., Teutolsky, S. A., Vetterling, W. T. and Flannery, B. P. (1992), *Numerical Recipes in FORTRAN: The Art of Scientific Computing*, Cambridge University Press, New York.

Rendon, S. (2006), 'Job Search and Asset Accumulation under Borrowing Constraints', *International Economic Review* **47**(1), 233–263.

Rust, J. (1988), 'Maximum Likelihood Estimation of Discrete Control Processes', *SIAM Control and Optimization* **26**(5), 1006–1024.

Scholz, J. K. and Levine, K. (2003), U.S. Black/White Wealth Inequality: A Survey, *in* K. Neckerman, ed., 'Social Inequality', Russel Sage Foundation, pp. 849–929.

Smith, J. P. (1995), 'Racial and Ethnic Differences in Wealth in the Health and Retirement Study', *Journal of Human Resources* **30**(Supplement), S158–S183.

Smith, J. P. and Welch, F. R. (1989), 'Black Economic Progress after Myrdal', *Journal of Economic Literature* **27**(2), 519–564.

Whalley, A. (2005), Racial Differences in the Insurance Value of Human Capital. University of Maryland. Mimeo.

Wolff, E. (1994), 'Trends in Household Wealth in the United States', *Journal of Income and Wealth* **43**(2), 143–174.

Wolpin, K. (1992), 'The Determinants of Black-White Differences in Early Employment Careers: Search, Layoffs, Quits, and Endogeneous Wages', *Journal of Political Economy* **100**, 535–560.

Table 1: Unemployment, Wealth and Wages by Number of Years since Graduation.
Black and White Male High School Graduates (amounts in 1985 dollars)
In small fonts: Number of observations

	Blacks			Whites		
Variable	Year 3	Year 6	Year 9	Year 3	Year 6	Year 9
Employment status and transitions						
% Unemployed	34.2	19.3	19.7	18.3	10.9	8.8
Observations	622	592	569	845	832	804
% Unemployed						
becoming Employed	24.9	22.8	33.0	37.4	45.1	47.9
% Employed						
becoming Unemployed	12.2	5.9	8.3	8.4	6.5	5.6
changing Employer	9.5	8.2	7.4	11.4	8.5	5.2
% Employed Quitting						
to Unemployment	31.1	53.9	47.2	30.6	43.2	37.9
Observations	45	26	36	49	37	29
to Employment	47.2	72.2	58.6	65.7	80.0	66.7
Observations	36	36	29	67	55	33
Wealth						
Average	1393	3381	3702	4921	5664	8780
Black-White Ratio (%)				28	60	42
% with						
$A \leq 0$	2.8	5.7	6.2	7.8	13.8	10.7
$0 < A \leq 10,000$	95.8	86.8	83.2	76.6	68.8	60.0
$10,000 < A \leq 20,000$	0.0	4.7	6.2	10.9	10.9	12.1
$20,000 < A \leq 30,000$	1.4	0.9	2.7	3.1	2.2	10.7
$A > 30,000$	0.0	1.9	1.8	1.6	4.4	6.4
Observations	71	106	113	64	138	140
Wages						
Average Quarterly Wage	3104	3473	3739	3363	4114	4552
Black-White Ratio (%)				92	84	82
% with						
$w \leq 2,000$	20.2	12.7	10.9	16.7	8.5	4.6
$2,000 < w \leq 4,000$	61.3	60.7	56.1	58.2	50.7	38.2
$4,000 < w \leq 6,000$	16.2	19.1	21.6	18.6	27.7	40.7
$w > 6,000$	2.3	7.5	11.4	6.5	13.2	16.5
Observations	346	440	412	598	651	668

Note: Wages are only the labor income of the employed and do not include any income of the unemployed.

Table 2: Average Wealth by Wages and Years after Graduation (in 1985 dollars)
In small fonts: Number of observations

Wages	Blacks		Whites	
	Years ≤ 6	Years > 6	Years ≤ 6	Years > 6
$w \leq 2,000$	724	1674	1396	2338
	38	38	48	27
$2,000 < w \leq 4,000$	1762	2361	4056	6049
	177	202	193	208
$4,000 < w \leq 6,000$	4528	6108	6227	8747
	53	76	94	168
$w > 6,000$	5634	9377	8511	11283
	7	30	34	52

Note: This table only contains observations for employed individuals. Wages are only labor income.

Table 3: Average Quarterly Savings by Employment Transitions:
Blacks' savings/Whites' savings. In small fonts: No. of blacks / No. of whites

Employment Status t	$t + \Delta$			Total
	Un-employment	Same Employment	New Employment	
Unemployment	-103/-2918		1740/365	766/-738
	123/41		109/81	568/122
Employment	-953/-1515	-95/561	244/140	-141/329
	98/68	483/698	150/194	731/960
Total	-484/-2043	-95/561	870/206	77/209
	221/109	483/698	259/275	963/1082

Note: Wealth is only observed annually, at quarter t and quarter $t + \Delta$. Employment transitions and savings are, respectively, the employment and the average quarterly wealth variation between these two quarters.

Table 4: Parameter Estimates and Asymptotic Standard Errors (in small fonts)
($r = 0.015$, $\beta = 0.98$)

Parameter	Θ	Blacks				Whites			
		Type 1		Type 2		Type 1		Type 2	
		Est.	ASE	Est.	ASE	Est.	ASE	Est.	ASE
Θ_1									
Base unemp. arrival rate %:	λ_0	54.82	4.65	29.46	55.38	83.62	21.46	57.55	3.83
Base emp. arrival rate %:	π_0	17.43	0.73	78.17	28.29	9.89	6.19	53.42	11.64
Base layoff rate %:	θ_0	22.44	3.13	17.27	14.08	7.22	0.78	13.25	2.10
Mean base log-wage dbn :	μ	7.17	0.07	6.58	0.16	6.91	0.01	7.71	0.01
St. dev. base log-wage dbn:	σ	0.59	0.05	0.63	0.07	0.50	0.02	0.45	0.03
Unemp. arrival rate growth $\times 10^2$:	α_λ	1.94	0.50	11.86	42.04	7.58	2.31	1.09	0.43
Emp. arrival rate growth $\times 10^2$:	α_π	0.76	0.25	0.16	0.36	3.20	2.00	0.16	0.17
Layoff rate growth $\times 10^2$:	α_θ	-6.10	0.62	-1.87	2.53	-1.06	0.45	-3.65	0.67
Wage growth (linear) $\times 10^3$:	α_1	8.57	1.79	1.28	0.64	9.04	0.19	14.42	1.63
Wage growth (quadratic) $\times 10^5$:	α_2	-4.53	0.78	-3.36	2.67	-1.71	0.36	-24.14	2.21
Θ_2									
Borrowing Tightness %:	s	0.43	0.04	1.29	0.27	4.85	0.42	4.90	2.31
Mean of log-wealth dbn :	μ_0	6.17	0.00	8.74	0.00	8.69	2.53	10.53	2.04
St. dev. of log-wealth dbn :	σ_0	0.04	0.34	0.33	0.42	1.73	1.09	1.84	0.98
Θ_3									
Unemployment Transfers:	b	1049	73	389	237	515	41	326	209
Risk aversion	γ	1.08	0.00	0.26	0.19	1.07	0.03	1.31	0.09
Disutility of working:	ψ	0.20	0.06	0.86	6.21	0.11	0.03	0.21	0.07
Proportions of types %:									
	p_{111}		43.59	3.45			39.33	2.59	
	p_{112}						0.16	0.47	
	p_{121}		26.33	8.63					
	p_{122}		1.71	3.41			4.95	0.65	
	p_{211}						21.38	0.12	
	p_{212}		21.21	0.11			3.22	1.36	
	p_{221}		7.16				30.96		
Criterion value:	χ^2	266.16				340.58			

Table 5: Decomposition by Types of Selected Predicted Variables
Unemployment Rate, Wages and Wealth by Race, Type and Year

Variable		Unemp. %			Wage			Wealth		
		Year			Year			Year		
	Types	3	6	9	3	6	9	3	6	9
Blacks										
p_{111}	43.59	38	33	24	3226	3922	4620	3259	5332	8394
p_{121}	26.33	40	32	23	3275	3920	4608	3587	5016	8019
p_{122}	1.71	28	22	11	2935	3538	4163	752	-9	-511
p_{212}	21.21	7	4	3	2191	2449	2473	176	214	166
p_{221}	7.16	42	30	26	2528	2789	2870	1176	1965	4170
Whites										
p_{111}	39.33	15	12	8	2345	2663	3063	4184	3188	2558
p_{112}	0.16	64	65	70	3002	3393	3576	8057	9831	9887
p_{122}	4.95	72	67	70	3084	3406	3564	11305	10075	9760
p_{211}	21.38	8	6	4	3988	4818	5266	4323	6992	17512
p_{212}	3.22	64	61	31	4900	5653	5547	8528	10153	16726
p_{221}	30.96	9	6	4	4028	4833	5271	7842	8695	18587

Table 6: Summary. Blacks and Whites: Actual and Predicted Choice Distribution.
Employment Status and Transitions for three selected Years after Graduation (in %)

Employment Variables	Year 3 Act.	Year 3 Pred.	Year 3 χ^2	Year 6 Act.	Year 6 Pred.	Year 6 χ^2	Year 9 Act.	Year 9 Pred.	Year 9 χ^2
Unemployment Rate									
Blacks	34.2	31.3	2.5	19.3	24.8	9.7	19.7	18.3	0.7
Whites	18.3	16.3	2.5	10.9	12.9	2.8	8.8	9.8	0.9
Transitions									
From Unemployment to Employment									
Blacks	24.9	27.7	0.8	22.8	25.0	0.4	33.0	27.0	1.9
Whites	37.4	40.6	0.6	45.1	39.0	1.7	47.9	43.9	0.5
Transitions from Employment									
Blacks: job separations	12.2	12.2	0.4	5.9	8.3	3.7	8.3	5.6	7.0
Blacks: job-to-job	9.5	10.3		8.2	8.4		7.4	7.0	
Whites: job separations	8.4	7.9	1.5	6.5	6.2	0.1	5.6	4.6	5.3
Whites: job-to-job	11.3	10.2		8.5	8.4		5.2	7.0	
Layoff rate in job separations									
Blacks	68.9	75.8	1.2	46.2	68.0	5.7	52.8	58.2	0.4
Whites	69.4	73.3	0.4	56.8	72.5	4.6	62.1	72.0	1.4
Layoff rate in job-to-job transitions									
Blacks	52.8	38.0	3.3	27.8	33.3	0.5	41.4	30.9	1.5
Whites	34.3	27.1	1.8	20.0	21.1	0.0	33.3	19.2	4.3

Crit. values at .5% signif.: $\chi^2_{(1)} = 7.9$, $\chi^2_{(2)} = 10.6$.

Table 7: Summary. Blacks and Whites: Actual and Predicted Choice Distribution. Wealth and Wages for three selected Years after Graduation

Wealth and Wages	Years after Graduation											
	Year 3				Year 6				Year 9			
	Blacks		Whites		Blacks		Whites		Blacks		Whites	
	Act	Pre	Act	Pre	Act	Pre	Act	Pre	Act	Pre	Act	Pre
Wealth Distribution:												
$A \leq 0$	2.8	6.7	7.8	14.1	5.7	6.0	13.8	12.2	6.2	5.5	10.7	7.6
$0 < A \leq 10K$	95.8	88.1	76.6	65.7	86.8	84.8	68.8	66.6	83.2	81.1	60.0	47.6
$10K < A \leq 20K$	0.0	4.4	10.9	13.1	4.7	6.9	10.9	14.3	6.2	9.4	12.1	22.0
$20K < A \leq 30K$	1.4	0.8	3.1	5.2	0.9	1.4	2.2	4.8	2.7	2.6	10.7	14.7
$A > 30K$	0.0	0.1	1.6	1.9	1.9	0.9	4.3	2.1	1.8	1.4	6.4	8.1
χ^2	5.6		3.7		2.1		6.8		1.5		14.5	
Average Wealth	1393	2547	4921	5844	3381	3621	5664	6282	3702	4525	8780	11541
Black-White ratio	28	44			60	58			42	39		
Wage Distribution:												
$w \leq 2K$	20.2	19.6	16.7	16.1	12.7	11.7	8.4	7.9	10.9	9.4	4.6	3.2
$2K < w \leq 4K$	61.3	66.6	58.2	57.5	60.7	63.5	50.7	50.3	56.1	51.6	38.2	45.6
$4K < w \leq 6K$	16.2	11.4	18.6	20.7	19.1	19.4	27.6	28.6	21.6	28.0	40.7	33.7
$w > 6K$	2.3	2.4	6.5	5.7	7.5	5.5	13.2	13.2	11.4	11.0	16.5	17.6
χ^2	8.6		2.3		4.1		0.5		8.8		22.8	
Average Wage	3104	2876	3363	3345	3473	3403	4114	3945	3739	3934	4552	4362
Black-White ratio	92	86			84	86			82	90		

Crit. values at .5% signif.: $\chi^2_{(3)} = 12.8$, $\chi^2_{(4)} = 14.9$.

Table 8: Actual and Predicted First Unemployment Duration, First Accepted Wage, and Savings and Frequencies in Employment Transitions

Variables	Blacks		Whites	
	Act.	Pred.	Act.	Pred.
First Unemployment Spell Duration	4.2	3.2	2.5	2.7
First Accepted Wage	2236	2272	2291	2468
Savings and frequencies (below) in transitions from				
Unemployment to unemployment	-101	-577	-2918	-1530
	73.1	72.9	58.1	58.4
Unemployment to employment	1720	695	365	368
	26.9	27.1	41.9	41.6
Employment to unemployment	-953	-1002	-1514	-1512
	9.4	8.9	6.3	6.2
Employment to same employment	-73	404	545	480
	81.7	82.2	85.2	84.7
Employment to new employment	243	239	139	425
	8.8	8.9	8.5	9.1

Table 9: Regime Changes: Blacks with Whites' Parameters

Variables at First Unemp Spell 4th and 40th Quarter after Grad.	Blacks Pred. (1)	Counterfactuals: Blacks with whites' Parameters: Labor (2)	Wealth (3)	Taste (4)	Labor Wealth (5)	Labor Taste (6)	Wealth Taste (7)	Whites Pred. (8)
Welfare	3661	5810	4102	217	21388	235	232	236
			First unemployment spell					
Duration	3.2	2.4	4.6	2.4	3.6	2.2	2.4	2.7
Wages	2272	2690	2618	2409	2138	2363	2015	2468
	92	109	106	98	87	96	82	100
			4th Quarter after Graduation					
Unemployment Rate %	43	23	49	36	21	20	36	24
Exit from unemp. %	28	40	22	37	39	47	31	40
Job separations %	16	8	14	21	6	9	12	9
Transition job-to-job %	13	13	13	10	14	13	19	13
Wealth	1556	1218	7556	2206	4670	2517	7972	7842
	20	16	96	28	60	32	102	100
Wages	2568	3145	2681	2386	2859	2819	2331	2885
	89	109	93	83	99	98	81	100
Consumption	1783	2599	2900	1495	3618	2358	2323	2939
			40th Quarter after Graduation					
Unemployment Rate %	16	8	16	20	6	9	13	9
Exit from unemp. %	26	35	24	25	53	42	35	41
Job separations %	4	3	4	6	3	3	5	3
Transition job-to-job %	6	6	6	4	7	7	8	7
Wealth	5879	13435	4355	9301	121	15609	9383	15682
	37	86	28	59	1	100	60	100
Wages	4191	4872	4206	4150	4452	4456	3658	4466
	94	109	94	93	100	100	82	100
Consumption	3390	3804	3361	3024	3926	3490	2807	3518
Savings rates								
Employed	12	19	13	18	8	18	19	18
Unemployed	-22	-52	-20	-243	-131	-522	-470	-502

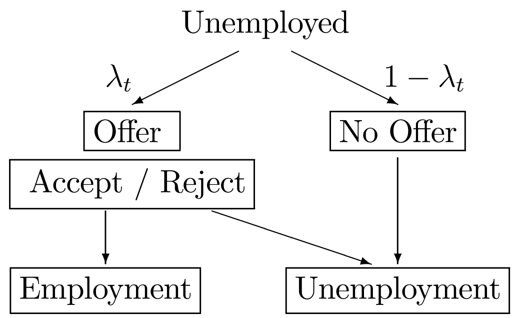


Figure 1: Transitions from Unemployment

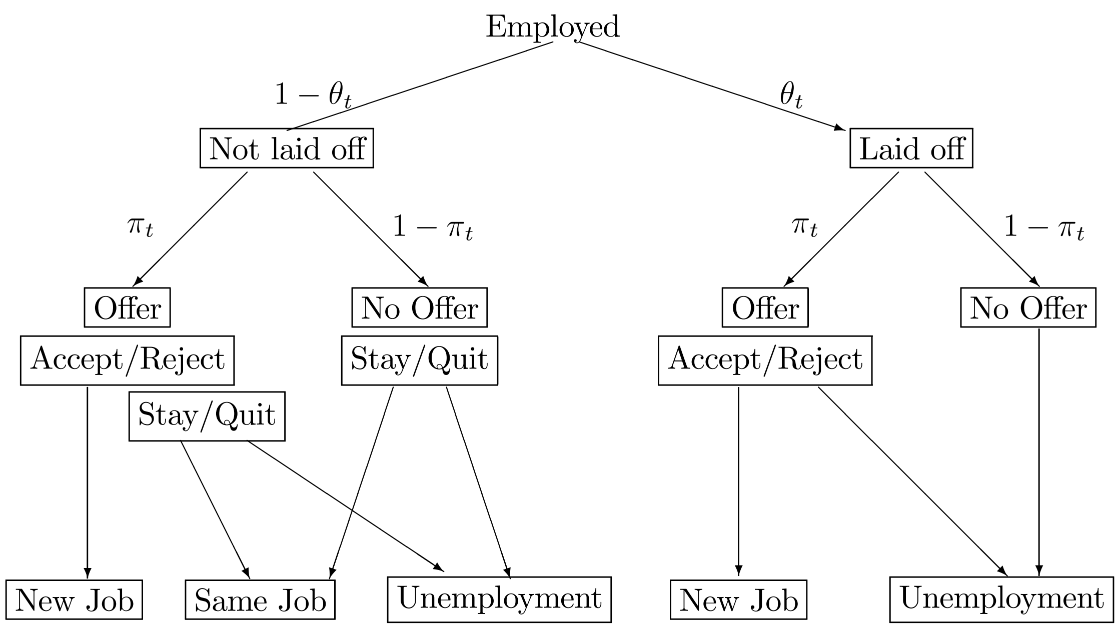


Figure 2: Transitions from Employment

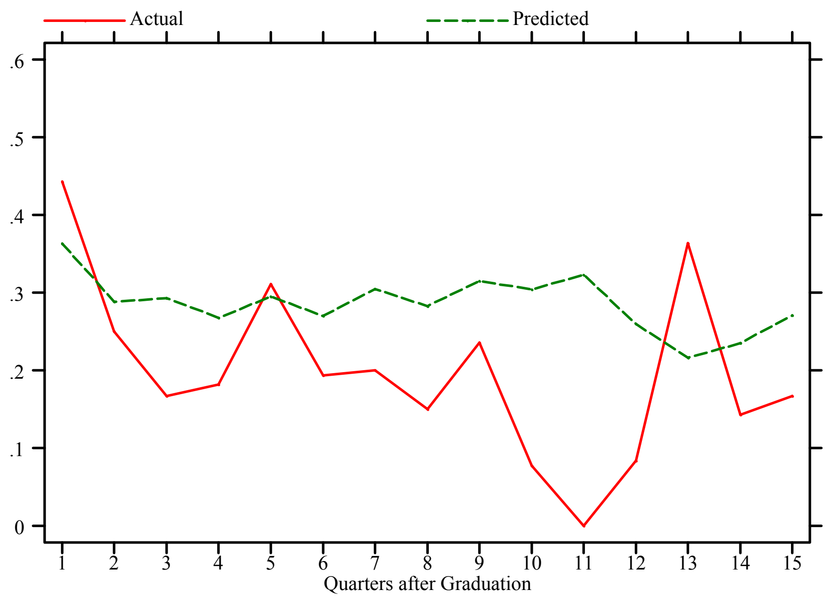


Figure 3: Blacks' Hazard Rates: First Unemployment Spell

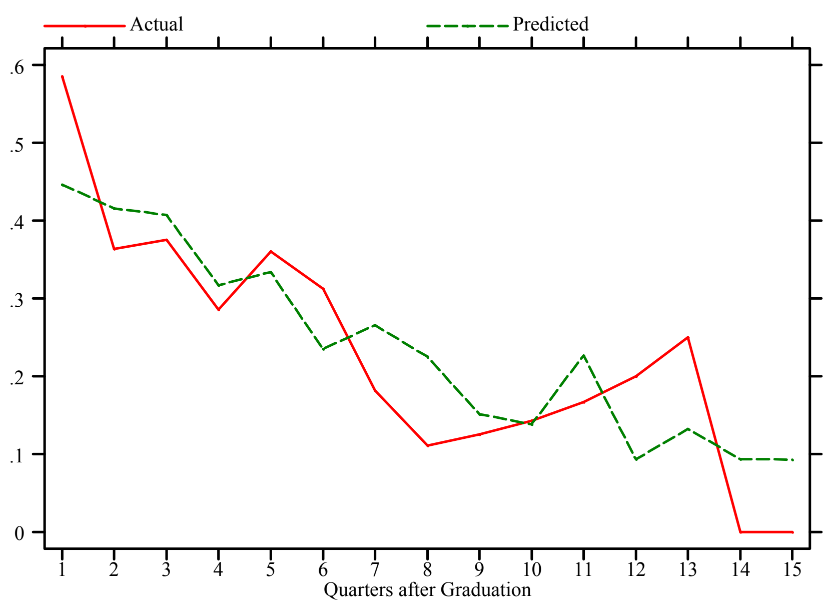
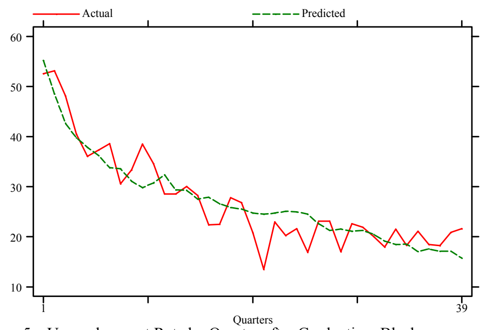
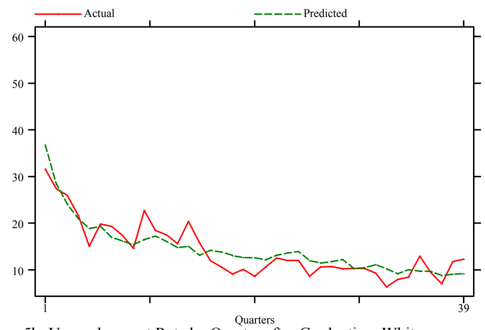


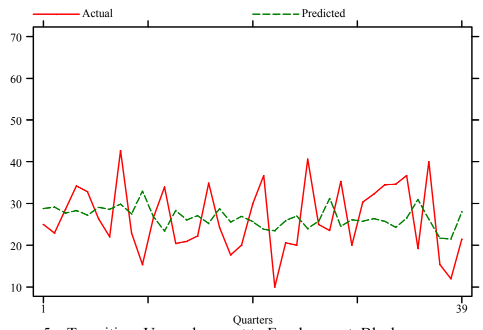
Figure 4: Whites' Hazard Rates: First Unemployment Spell



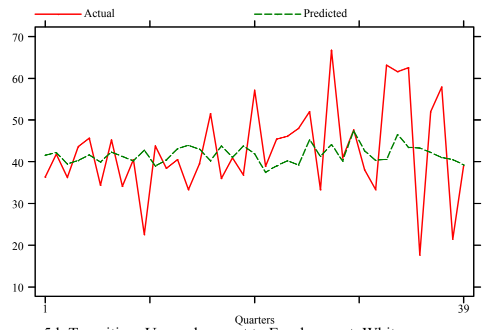
5a: Unemployment Rate by Quarter after Graduation. Blacks



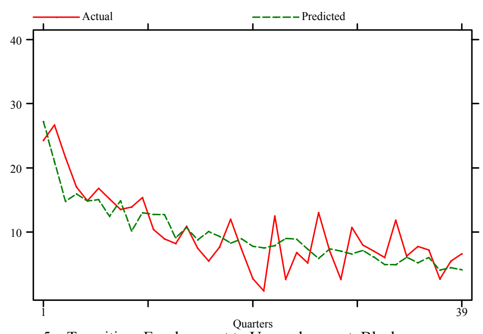
5b: Unemployment Rate by Quarter after Graduation. Whites



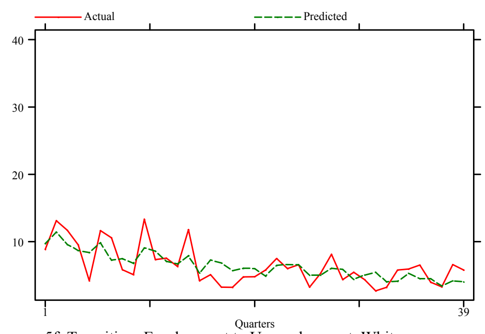
5c: Transition: Unemployment to Employment. Blacks



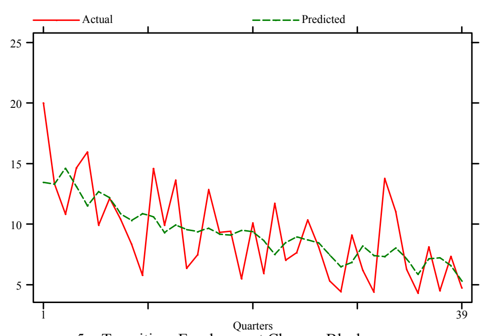
5d: Transition: Unemployment to Employment. Whites



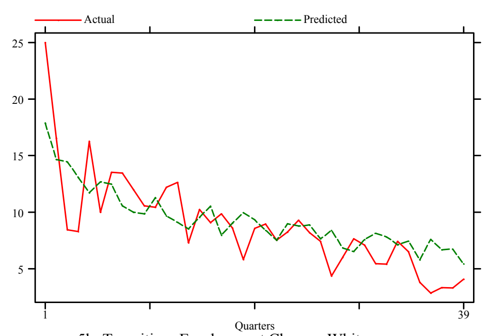
5e: Transition: Employment to Unemployment. Blacks



5f: Transition: Employment to Unemployment. Whites



5g: Transition: Employment Change. Blacks



5h: Transition: Employment Change. Whites

Figure 5: Actual and Predicted Paths by Race Group: Employment Status and Employment Transitions

Figure 5 (cont): Actual and Predicted Paths by Race Group: Layoffs, Wealth, and Wages