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Source: *Journal of Political Economy*, Vol. 100, No. 3 (Jun., 1992), pp. 535-560
Published by: The University of Chicago Press
Stable URL: http://www.jstor.org/stable/2138730
Accessed: 07/09/2011 17:53

The Determinants of Black-White Differences in Early Employment Careers: Search, Layoffs, Quits, and Endogenous Wage Growth

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This paper studies the transition from school to full-time employment and subsequent labor mobility during the first five postschooling years for several recent cohorts of black and white male "terminal" high school graduates using unique data from the 1979 youth cohort of the National Longitudinal Surveys of Labor Market Experience. A constrained optimization model of labor force dynamics is implemented empirically integrating features of models previously described in the literature. The estimates of the model provide quantitative evidence on underlying structural differences in labor market constraints faced by blacks and whites. For example, while blacks have overall a substantially smaller wage return to work experience and face a less disperse wage offer distribution, blacks face a higher probability of receiving job offers.

I. Introduction

This paper studies the transition from school to full-time employment and subsequent labor mobility during the first five postschooling years for several recent cohorts of black and white male "terminal" high school graduates using unique data from the 1979 youth cohort of the National Longitudinal Surveys of Labor Market Experience.

Research support is gratefully acknowledged from the National Science Foundation (grant SES-8713819), from the Institute of Empirical Macroeconomics at the University of Minnesota, and from the Minnesota Supercomputer Institute. Jaeho Kum provided exceptional research assistance.

[*Journal of Political Economy*, 1992, vol. 100, no. 3]
 0022-3808/92/0003-0009$01.50

The data reveal large racial differences in the accumulation pattern of work experience, presumably as a result of the interaction between behavior and labor market constraints. This paper empirically implements a constrained optimization model of labor force dynamics that integrates features of models previously described in the literature, as, for example, in Burdett (1978), Jovanovic (1979), Flinn and Heckman (1982), Katz (1986), Mortensen (1986), Wolpin (1987), and Topel and Ward (1988). Specifically, the model allows for uncertainty about job offers both while unemployed and while employed, for uncertain layoffs and recalls, for unemployment compensation benefits while on layoff, and for wage growth due to the separate accumulation of general and employer-specific work experience. Individuals, assumed to be homogeneous on graduation except for race, maximize expected lifetime wealth modified by the value they attach to nonmarket time, and they accumulate different work experiences as they probabilistically receive and accept or decline wage offers. Thus the observed employment patterns are posited to arise from aspects of the labor market environment and their interaction with forward-looking optimizing behavior.

The estimates of the model provide quantitative evidence on underlying structural differences in labor market constraints faced by blacks and whites and on a number of other important labor market issues. Specifically, the following questions are addressed: To what extent is the structure of wage offers different for blacks and whites (Smith and Welch 1977; Lazear 1979), and to what extent does the difference in the wage offer structure account for differential employment patterns? What are the effects of unemployment compensation benefits on the length of covered unemployment spells, the accumulation of work experience, and wages (e.g., Ehrenberg and Oaxaca 1976; Ham and Rea 1987)? What is the effect of work experience, general and specific, on wages (e.g., Bartel and Borjas 1981; Mincer and Jovanovic 1981; Altonji and Shakotko 1985; Abraham and Farber 1987; Marshall and Zarkin 1987; Topel 1991)? Is the probability of receiving job offers while unemployed greater or smaller than while employed (e.g., Holzer 1987; Blau and Robbins 1989)? To what extent is a layoff a binding constraint as opposed to offers that workers reject?

The major findings are the following: (1) Wage offer functions for black and white male high school graduates differ in two dimensions. Black high school graduates have overall a substantially smaller payoff to work experience than white high school graduates do, and they face a less disperse wage offer distribution. Both of these factors reduce the potential for upward wage mobility among blacks relative to whites. (2) Blacks face a higher probability of receiving job offers both while unemployed and while employed and have a slightly

higher layoff rate. (3) Accepted wages, which are the wages measured and thus observed in all data sets, would not be equalized by a policy that enforced racial equality of the wage offer functions. (4) Increasing unemployment compensation benefits induces blacks to accept the first job more quickly and actually increases work experience in the first five postschooling years. The effect on whites is opposite, but negligible.

The paper is organized as follows. Section II describes the data and presents important features of the employment transition process for black and white male high school graduation cohorts for 1978–84. The model is presented in Section III. The numerical solution algorithm is outlined in Section IV and the likelihood function in Section V. The estimation approach follows the recent literature on estimating stochastic dynamic structural models (Miller 1984; Wolpin 1984; Pakes 1986; Rust 1987) as reviewed in Eckstein and Wolpin (1989) and more recently in Rust (1991). Section VI presents the estimation results and goodness-of-fit test results. Section VII provides evidence on the relationship between the wage offer structure and black-white employment differences and simulates the effects of a change in unemployment compensation benefits on employment patterns. Section VIII briefly raises methodological issues.

II. Data

The data are taken from the 1979 youth cohort of the National Longitudinal Surveys of Labor Market Experience (NLSY). The NLSY consists of 12,686 individuals who were 14–21 years old as of January 1, 1979. It contains a nationally representative core random sample, oversamples of blacks and Hispanics, and a special military oversample. Respondents have been interviewed annually since 1979. I make use of the data collected in the first eight personal interviews (1979–86) for the white male core sample and the black male core and supplemental samples.

This paper focuses on the employment experience of black and white male high school graduates who never attended college. High school graduates are the modal group in the NLSY, and male labor force behavior is more likely than female behavior to be credibly characterized by the simple search-theoretic framework adopted below.[1]

[1] Conditioning on high school completion requires that the school-leaving decision be statistically independent of the employment process in the sense that individuals are not induced to leave or remain in school because of employment search motivations, i.e., because they received good or bad wage draws while in school. In addition, in the black-white comparisons that follow, it is a maintained assumption that schooling level adequately captures educational achievement.

The NLSY collects employment and school enrollment data at the time of each interview for the period since the date of the last interview (usually about 1 year). In the 1979 interview, employment data were collected back to January 1, 1978, and the date of last school enrollment was obtained if the individual was not enrolled in school at the time of the 1979 interview. In each survey round, information is collected on the starting and ending weeks of each employer-specific employment spell and on all gaps in employment due to layoff, illness, and so forth within an employer spell. In addition, respondents report their usual weekly hours worked and the reason for leaving an employer for each employer spell; the usual rate of pay is obtained for all employer spells that lasted at least 9 weeks and for which there were 20 or more usual weekly hours worked. It is therefore possible to construct a week-by-week accounting of employment and schooling for eight full calendar years, 1978–85. For those respondents who had already completed school prior to January 1, 1978, it is impossible to construct a complete employment history since leaving school, and so they are not included in the analysis sample. Moreover, because it is unclear how to model the choice of military service in a search-theoretic framework, respondents who ever served in the armed forces are dropped.[2] The final analysis sample consists of 543 white male high school graduates and 322 black male high school graduates.[3]

The week of permanent school leaving is defined to be the last week in which the individual was enrolled in school. That week is assigned to its particular calendar quarter, and the employment history is begun in the next calendar quarter. By far the most common calendar graduation quarter is the second (April–June): over 70 percent of blacks and over 75 percent of whites were graduated in that calendar quarter.[4] Given the original ages of the respondents, most

[2] In addition, the wage return to military experience may differ from the return to civilian experience. Approximately 15 percent of white male high school graduates from the core sample had ever served in the armed forces during the sample period; the comparable figure for black male high school graduates is 25 percent. As with the selection of only high school graduates, considering only civilian employment may lead to sample selection biases in the interpretation of observed black-white differences in employment. Racial differences would be exaggerated, e.g., if relatively more talented blacks than whites entered the armed forces.

[3] In addition, those few individuals who graduated from high school in 1985 were omitted so as to maintain a sample with at least one full year of employment data. The sample was further reduced because of longitudinal inconsistencies in the school completion data and because of missing information on school enrollment.

[4] A small number of individuals received a general equivalency diploma (GED) after dropping out of high school without ever reenrolling. Of the 543 white male high school graduates, 30 received a GED; of the 322 black male high school graduates, 35 received a GED.

graduations occurred before 1983. Because of missing data or attrition, not all individuals are observed through 1985. Forty-six percent of the white sample and 41 percent of the black sample have employment data for at least 5 years after graduation.

Table 1 provides descriptive employment data for the sample by years since graduation (potential experience) and by race. Measured by weeks worked, full-time weeks worked (usual number of hours worked in the week on a single [main] job is at least 30), or by annual hours worked, labor market activity increases with potential experience for both groups. However, while work attachment grows with potential experience, there is still considerable non-full-time employment even several years after graduation, particularly for blacks. Multiple job holding, that is, working for two employers during the same week, is not uncommon. Secondary jobs, however, account for only a small proportion of total annual hours for those with such jobs and for much less in the population as a whole.

Table 1 only superficially makes use of the longitudinal features of the NLSY data. It is possible, however, to provide much richer detail by using the employer event history information more explicitly. Moreover, the longitudinal characterization corresponds to the theoretical model of the life cycle employment transition process to be described in the next section. It is useful both for the current descriptive purpose and for the later structural analysis to divide the post-schooling lifetime into cycles that begin and end in the unemployment state. An individual's career profile is depicted as consisting of L such cycles, where the lth cycle is

$$c_l = (d_l, e_{l1}, e_{l2}, \ldots, e_{ls_l}) \tag{1}$$

and the lifetime profile is

$$c = (c_1, c_2, \ldots, c_L). \tag{2}$$

In (1), d_l corresponds to the duration of the lth unemployment spell, e_{lk} corresponds to the uninterrupted duration of employment with the kth employer in cycle l, and s_l is the number of employers in the lth cycle. Because an individual may be laid off and recalled to the same employer, the first job in a cycle may be with the last employer of the previous cycle.

Throughout the rest of the paper it is assumed that the only relevant jobs are full-time jobs, that is, those for which the number of (usual) hours worked per week is at least 30. Because it is computationally intractable to estimate the structural model using weekly observations, the data have been aggregated by 13-week periods based on the calendar quarter in which the individual was last enrolled in school. Thus an individual who was last enrolled in school in the first

TABLE 1

EMPLOYMENT CHARACTERISTICS BY POTENTIAL EXPERIENCE AND RACE: MALE HIGH SCHOOL GRADUATES BETWEEN 1978 AND 1984

	Year 1	Year 2	Year 3	Year 4	Year 5
Average weeks worked (all jobs):*					
Black	30.3	33.4	34.5	36.7	37.8
White	40.0	41.8	43.5	43.9	46.1
Percentage worked zero weeks:					
Black	11.1	10.2	12.1	10.7	8.8
White	4.0	3.5	3.1	2.2	1.5
Average full-time weeks worked (main job):					
Black	25.0	29.7	31.8	33.5	34.5
White	34.7	38.5	40.7	42.2	44.5
Percentage worked zero full-time weeks (main job):					
Black	21.6	16.4	17.6	14.7	12.9
White	10.1	7.9	4.7	4.2	2.9
Percentage worked 48 or more full-time weeks (main job):					
Black	21.3	37.2	42.2	44.7	44.9
White	40.4	51.4	55.5	62.9	67.6
Percentage worked 52 full-time weeks (main job):					
Black	16.5	29.4	36.3	40.0	38.1
White	30.4	38.5	44.8	53.1	59.3
Average annual hours worked (all jobs):					
Black	1,136	1,326	1,403	1,497	1,534
White	1,635	1,780	1,865	1,951	2,083
Average cumulative number of employers:					
Black	1.15	1.77	2.25	2.88	3.51
White	1.39	2.01	2.56	3.04	3.58
Percentage multiple job holders:					
Black	13.6	16.9	11.8	13.7	15.0
White	28.7	24.3	23.2	23.3	26.2
Percentage of total hours accounted for by secondary jobs for those with a secondary job:					
Black	12.5	11.0	11.1	10.5	15.0
White	8.21	10.8	12.3	10.6	14.0

* Employment includes weeks of paid vacation.

quarter of 1978, with a quarterly employment history that therefore began in the second quarter of 1978, has potentially 31 quarters of employment data; an individual who was last enrolled in the fourth quarter of 1984 has potentially four quarters of data. Because the weekly information is aggregated to quarterly information, some definitional arbitrariness is unavoidable. In particular, an individual is assumed to be working in a quarter only if all 13 weeks were spent working at a full-time job. If this condition is not met, that quarter is classified as having been spent in "unemployment." Also, because the employment career begins in the first full calendar quarter after graduation from high school, there may be as many as 12 weeks between school leaving and the beginning of the employment career as defined. Multiple jobs are ignored; the job with the most hours worked in the week is considered the main job. If two main full-time jobs are held in the same quarter (by definition, not simultaneously), the job held in the last week of the quarter is taken to be the main job of that quarter. The quarterly wage associated with that job is the weekly wage on the main job in the last week of the quarter times 13.

The number and characteristics of the cycles as defined above depend on the length of time individuals are observed. For each racial group, approximately one-third of the sample completed at most one cycle and another third completed at most two cycles. Less than 10 percent completed five cycles, the most cycles observed in the sample. Further, within a cycle it is relatively uncommon to have had more than one employer: only between 15 and 25 percent had a second, third, or greater number of employers.

Almost one-half of white male high school graduates and over one-quarter of black male high school graduates worked full-time, according to the definition above, in the first calendar quarter after leaving school. Almost 80 percent of whites and over 60 percent of blacks spent less than 1 year without a full-time job in the first cycle. However, about 10 percent of whites and 25 percent of blacks spent more than 2 years without a full-time job.[5] For cycle 2 and 3 unemployment spells, approximately one-third of whites and one-quarter of blacks became reemployed in a full-time job within one quarter

[5] Because unemployment is defined here as the lack of a full-time job, it is important to consider quantitatively the extent to which they differ. For whites, those without a full-time job for at least 1 year during the first cycle actually were without any job for 31 weeks during the year on average, and those without a full-time job for at least 2 years during the first cycle actually were without any job for 72 weeks during the 2-year period on average. For blacks, the comparable figures are 37 weeks and 81 weeks. Therefore, the absence of full-time work, while not identical to unemployment, is closely related, and the use of full-time work understates racial differences.

and, as with the first cycle, about four-fifths of the whites and two-thirds of the blacks were reemployed within 1 year.

There is also substantial employer turnover. In cycle 1, 27 percent of whites and 33 percent of blacks remain in their first full-time job only one quarter and only about 15 percent of either group remain more than 3 years. Second jobs in the first cycle (i.e., those without an intervening spell of unemployment) are more stable than first jobs for both races. However, the first job after a spell of unemployment (cycles 2 and 3) exhibits a degree of instability similar to that of the first job in cycle 1, with blacks again having slightly less stable employment. Indeed, first employment spells in the third cycle have shorter durations on average than those in cycles 1 and 2.

Kaplan-Meier hazard functions for each of the first three unemployment spells are generally declining. Exit rates from unemployment are higher for later cycles at the same duration and are lower for blacks than for whites in all cycles. First-job employment hazard rates also exhibit negative duration dependence but are not obviously ordered by cycle, and there is little systematic difference between blacks and whites.

III. Model

The model described in this section provides a discrete-time characterization of the postschooling employment career as depicted in equations (1) and (2) of the last section. It integrates transitions between unemployment and employment states and between employers, distinguishes between "causes" of transitions, and allows for wage growth due to general and specific human capital accumulation.

The individual is assumed to maximize expected wealth (modified by the value of nonmarket time) subject to the constraints imposed by the labor market environment. The constraints are characterized as follows.

1. While not employed, wage offers arrive stochastically from a known distribution. The probability per period of receiving an offer depends on the employment history in a known way.

2. Once an offer is accepted, there is no further stochastic variation in the wage at that employer.[6] However, wage offers are received (exogenously) from other firms, again from a known distribution. The probability of receiving a "new" offer in a period also depends on history.

[6] There is one important exception, namely, if the individual is laid off and subsequently recalled (see below).

3. While employed, there is a history-dependent positive probability per period of layoff and while on layoff a positive probability per period of a recall offer that depends on the employment career to date in a known way.

4. There is a fixed and known unemployment insurance benefit available during periods of layoff. Benefits are available for a fixed and known duration.[7]

5. Wage offers depend on the level of general capital as measured by the number of prior periods of employment and on the level of specific capital as measured by the number of prior periods of employment or tenure at the current employer. Thus a recall offer will systematically differ from an offer from a new employer while on layoff by the payoff to specific capital.

Relevant notation is presented and defined in table 2. Expected lifetime wealth differs according to the current employment state and the career history. Expected lifetime wealth in the quit-unemployment state V_t^Q depends on the number of periods of unemployment (n) in the current spell up to period t (because the probability of receiving an offer while unemployed, P_1, depends on the length of the current spell) and on the number of periods of prior employment, GK, which in part determines the level of the wage offer. The function V_t^Q does not depend on the number of periods worked at the last employer, SK, because specific capital is assumed to be nontransferable between employers and because offers are assumed never to be received from a firm one has previously quit. Expected wealth in the layoff-unemployment state (V_t^L) depends on n because P_1 and the recall probability, P_4, depend on n and because eligibility for unemployment compensation depends on n. It depends on GK and SK through the wage, P_1, and P_4. Expected wealth in the employment state (V_t^E) depends on GK and SK through the wage, the probability of receiving an offer while employed, P_2, and the layoff probability, P_3. In addition, it depends on the wage draw, u. It should be noted that the career history is assumed to be summarized completely by four numbers, SK, GK, n, and u. More complex state dependencies would considerably complicate the model and the estimation problem.[8]

[7] This is a simplification because both the benefit level is usually related to prior wage earnings up to a maximum benefit level and the duration of eligibility varies geographically across states and over time.

[8] There are obvious restrictions on the state space. In particular, specific capital is bounded between zero and GK ($0 \leq SK \leq GK$), and the number of prior periods of unemployment at t and the amount of general capital at t cannot be greater than $t - 1$ ($n + GK \leq t - 1$).

TABLE 2

Notation	Definition
$w_t(SK, GK, u)$	The wage of an individual in period t who has been working for a particular firm for SK periods up to t, has GK periods of employment over all firms up to t (including the current firm), and has SK periods of employment at the current employer, having received a random draw u, either at the time of initial employment or at the time of the most recent recall
$V_t^Q(n, GK)$	The expected lifetime wealth at period t given that the individual has been unemployed for n periods up to t, having quit a prior job (or school) n periods before and having had GK periods of employment over all prior firms up to t
$V_t^L(n, SK, GK)$	The expected lifetime wealth at period t given that the individual is currently unemployed, having been laid off from a firm n periods before for which the individual worked SK periods and having had at the time of layoff GK periods of employment over all firms
$V_t^E(u, SK, GK)$	The expected lifetime wealth at period t for an individual who has been employed with a firm for SK periods, has been employed a total of GK periods, and has received a stochastic wage draw u at the time of initial employment at that firm or at the time of the most recent recall
b	The (monetary) value of unemployment or nonmarket time
$\bar{n}$	The number of periods of eligibility for unemployment compensation
c	The amount of unemployment compensation received if $n \leq \bar{n}$
δ	The discount factor
$P_1(n, GK)$	The probability of receiving an offer while unemployed
$P_2(GK)$	The probability of receiving an offer from a new firm while employed
$P_3(SK)$	The probability of a layoff
$P_4(n, SK)$	The probability of receiving a recall offer while on layoff

It is straightforward to specify the value function representation of the optimization problem. In particular, for $t < T$,

$$V_t^Q(n, GK) = b + \delta\{P_1(n+1, GK)E_t[\max[V_{t+1}^Q(n+1, GK), V_{t+1}^E(u, 0, GK)]] + [1 - P_1(n+1, GK)]V_{t+1}^Q(n+1, GK)\}; \quad (3a)$$

$$\begin{aligned} V_t^L(n, SK, GK) = {} & b + c(n) \\ & + \delta\{P_1(n+1, GK)E_t[\max[V_{t+1}^L(n+1, SK, GK), \\ & \qquad V_{t+1}^E(u, 0, GK)]] \\ & + P_4(n+1, SK)E_t[\max[V_{t+1}^L(n+1, SK, GK), \\ & \qquad V_{t+1}^E(u, SK, GK)]] \\ & + [1 - P_1(n+1, GK) - P_4(n+1, SK)] \\ & \times V_{t+1}^L(n+1, SK, GK)\}; \end{aligned} \quad (3b)$$

$$V_t^E(u, SK, GK) =$$

$$\begin{cases} w_t(SK, GK, u) + \delta\{P_2(GK+1)E_t[\max[V_{t+1}^Q(0, GK+1), \\ \qquad V_{t+1}^E(u', 0, GK+1)]] \\ \quad + [1 - P_2(GK+1)]V_{t+1}^Q(0, GK+1)\} \\ \qquad \text{if } u < u_{t+1}^{*Q}(0, SK+1, GK+1), \\ w_t(SK, GK, u) + \delta\{P_2(GK+1)[1 - P_3(SK+1)] \\ \quad \times E_t[\max[V_{t+1}^E(u, SK+1, GK+1), V_{t+1}^E(u', 0, GK+1)]] \\ \quad + P_2(GK+1)P_3(SK+1)E_t[\max[V_{t+1}^L(0, SK+1, GK+1), \\ \qquad V_{t+1}^E(u', 0, GK+1)]] \\ \quad + [1 - P_2(GK+1)]P_3(SK+1)V_{t+1}^L(0, SK+1, GK+1) \\ \quad + [1 - P_2(GK+1)][1 - P_3(SK+1)]V_{t+1}^E(u, SK+1, GK+1)\} \\ \qquad \text{if } u > u_{t+1}^{*Q}(0, SK+1, GK+1). \end{cases} \tag{3c}$$

The terminal period value functions are $V_T^Q = b$, $V_T^L(n) = b + c(n)$, and $V_t^E(u, SK, GK) = w_T(SK, GK, u)$.

The value functions given either a prior quit or a layoff are self-explanatory, although it should be noted that, while on layoff, receipt of a recall offer and a new offer in the same period, neither of which is actually observed in the data, is precluded. However, one can be laid off and receive an offer from another firm in the same period. The employment value function, however, requires further explanation. It is possible that an individual may accept a job offer in a period that may not be high enough to preclude quitting that firm at a later period even without a new job offer, that is, quitting into unemployment. If the random draw of u originally received and accepted is less than the reservation draw at period $t + 1$, the individual will quit into unemployment at $t + 1$ (or take a new job if an acceptable offer is received); if it is greater than the reservation draw, the individual will not quit into unemployment. The possibility of quitting into unemployment accounts for the two-part characterization of the employment value function. That such a strategy may be optimal is shown below.

Decision rules can be described fully and uniquely by a set of state-dependent reservation values for u. They are implicitly defined as follows:

$$\begin{aligned} V_t^Q(n, GK) &= V_t^E(u_t^{*Q}(n, SK, GK), SK, GK), \\ V_t^L(n, SK, GK) &= V_t^E(u_t^{*L}(n, SK, GK), 0, GK), \end{aligned} \tag{4}$$

$$V_t^L(n, SK, GK) = V_t^E(u_t^{*R}(n, SK, GK), SK, GK),$$

$$V_t^E(u, SK, GK) = V_t^E(u_t^{*N}(u, SK, GK), 0, GK),$$

where u_t^{*Q} defines the value of u at which the individual is indifferent between unemployment and employment. If the individual is currently unemployed having quit sometime in the past ($n > 0$, $SK = 0$), then it defines the value of u necessary to induce the individual to accept an offer; if the individual is currently employed ($n = 0$, $SK > 0$), then it defines the value of u necessary to induce the individual to remain with the firm rather than quit to become unemployed. The term u_t^{*L} is the value of u at which an individual will just accept an offer from a new firm while on layoff, u_t^{*R} is the value of u at which an individual will just accept a recall offer, and u_t^{*N} is the value of u at which an individual will be induced to leave the current employer for a new employer.

The model is sufficiently flexible to be able to fit the gross features of the data; the existence of quits, layoffs, and recalls; the accumulation of work experience and associated wage growth; and the shapes of unemployment and employment duration hazards. The ability to explain quits into unemployment in a model in which there are no new wage draws from a given employer once the offer is accepted is most easily understood in a two-period context. In the last period, period 2, the individual who is currently employed can quit into unemployment and receive b or remain employed and receive $w_2(1, 1, u)$. The question is whether an individual will ever accept a wage (a value of u) in period 1 of $w_1(0, 0, u)$ such that $w_2(1, 1, u) < b$. A necessary condition for such behavior to be optimal is that the probability of receiving an offer from a new firm while employed be positive. The value of employment at such a wage is

$$w_1(0, 0, u) + \delta\{P_2 E \max[b, w_2(0, 1, u')] + (1 - P_2)b\};$$

the value of being unemployed is

$$b + \delta\{P_1 E \max[b, w_2(0, 0, u')] + (1 - P_1)b\}.$$

Clearly, if $P_2 > P_1$ and there is no return to either general or specific human capital, there exists a range of values of u for which employment is optimal at $w_1 = w_2 < b$. Moreover, if human capital increases wages, even if $P_2 < P_1$, such values of u may exist. The argument above generalizes to any finite-period model. Moreover, in the multiperiod setting, individuals may accept an offer knowing that they will quit into unemployment $k > 1$ periods in the future unless an acceptable new offer is received. The rationale for this behavior is that a job in this model is an investment good both because of

the accumulation of general capital and because employment itself generates new offers, and the value of the investment increases with the distance from the horizon.

A closely related result is that for given experience (*GK* and *SK*) an increase in employment duration (and, in consequence, age) may increase the reservation wage draw necessary to induce employment. A sufficient condition is that $P_2 > P_1$ even with no wage return to experience. Thus the model can account for declining unemployment hazard rates without relying necessarily on offer probabilities that decline with unemployment duration, that is, $dP_1/dn < 0$.[9]

IV. Numerical Solution Algorithm

The sequences of reservation u's, the u_t^*'s given in (4), completely describe the solution to the individual's wealth maximization problem. Without analytical solutions, it is necessary to solve for these sequences numerically. As is standard, the dynamic program is solved backward from T for a given set of parameter values (b, c, $\bar{n}$, δ), for given functions $w_0(SK, GK)$, P_1, P_2, P_3, and P_4 and for a given distribution of u. Because of the size of the problem, a number of "approximations" to the full solution were required for tractability.[10]

1. The wage offer function has the form $w_0 e^u$. Because u is itself a state variable, the distribution of u is taken as a discrete approximation to the normal. It was practicable to take 121 (evenly spaced) discrete values of u within $\pm 3\sigma$. Thus the value function V_t^E is computed at each discretized value of u. The reservation values, the u_t^{*N}'s, are calculated as the value of u from among the discretized values closest to the solution to (4) in terms of the distance between value functions. Reservation values are considered acceptable offers.

2. If the dynamic program were solved over the 160 quarters that would compose a 40-year employment career, the state space for V_t^E would contain over 1.5 million elements at $t = T(160)$. This is computationally intractable as an estimation problem, that is, where the dynamic program must be numerically solved thousands of times. To make the problem tractable, the solution was approximated by optimizing over different period lengths during the backward solution, using longer period lengths for the more distant future value functions. The individual is assumed to optimize quarterly (the shortest

[9] Wolpin (1987) estimated a standard search model in this way, allowing for such a property of the offer probability in order to explain the observed negatively sloped unemployment hazard.

[10] Details of the numerical solution algorithm are provided in an appendix to an earlier version of this paper (Wolpin 1989).

decision period) over only the first 24 quarters. The calculation of future value functions beyond the first 24 quarters is carried out over annual decision periods for 12 years and then over 10 biannual periods until the end of the horizon is reached. The total horizon is thus 38 years. The discount factor, the value per period of leisure, the level of unemployment compensation, the probability functions (P_1, P_2, P_3, and P_4), and the wage function are all adjusted for the period length. In addition, at the period switch points (from biannual to annual and from annual to quarterly), value functions are interpolated via regression for the state values that are missing, for example, every other year at the biannual-annual switch point.

V. The Likelihood Function

The u_t^* sequences obtained from the numerical solution of the dynamic program serve as input into a likelihood function. In specifying the likelihood function, one must determine the probability of observing any particular career profile:

$$\Pr(c) = \Pr(d_1, e_1^1, \ldots, e_{s_1}^1, d_2, e_1^2, \ldots, e_{s_2}^2, \ldots, d_L, e_1^L, \ldots, e_{s_L}^L). \quad (5)$$

Because u is independently and identically distributed (i.i.d.), cycles are independent, that is,

$$\Pr(c) = \Pr(d_1, e_1^1, e_2^1, \ldots, e_{s_1}^1) \cdots \Pr(d_L, e_1^L, e_2^L, \ldots, e_{s_L}^L). \quad (6)$$

There are two ways in which an individual can enter unemployment (from an employment spell), either through layoff or by quitting, without, in either case, receiving an immediately acceptable offer from a new firm. Layoffs and recall wage offers are assumed to be independent of prior draws of u and so begin a new and independent cycle. Quits into unemployment arise, as seen, because the reservation u falls below the current u. Once a new unemployment spell begins, however, the duration of that spell is independent of the u associated with the previous job, accounting correctly for the fact that the last employment spell is closed, that is, that unemployment follows. A further consequence of the i.i.d. assumption is that the unemployment spell durations are independent of each other and of the subsequent employment spell durations. Thus

$$\Pr(c) = \Pr(d_1)\Pr(e_1^1, e_2^1, \ldots, e_{s_1}^1) \cdots \Pr(d_L)\Pr(e_1^L, e_2^L, \ldots, e_{s_L}^L). \quad (7)$$

It is important to recognize that employment spells within cycles are not independent: the wage one is willing to accept on a new job depends on the wage on the previous job net of specific and general experience, that is, u_t^{*N} in (4) depends on u.

Suppose further, as is the case, that wages are observed while employed, and, as is usual, rejected wage offers while unemployed or employed are not observed. Further, assume that wages are measured with error, as seems to be evident in many micro surveys.[11] Let $\hat{\mathbf{w}}_i^j = (\hat{w}_{i1}^j, \hat{w}_{i2}^j, \ldots, \hat{w}_{ie_i^j}^j)$ be the vector of observed wages on the ith job in the jth cycle; e_i^j is the number of periods (quarters) of employment on the job. The true wage vector is $\mathbf{w}_i^j = (w_{i1}^j, w_{i2}^j, \ldots, w_{ie_i^j}^j)$. The observed and true wages are assumed to be related by

$$\hat{w}_{ik}^j = w_{ik}^j \exp(\epsilon_{ik}^j), \quad k = 1, \ldots, e_i^j, \tag{8}$$

where ϵ_{ik}^j, the measurement error, is assumed to be i.i.d. over i, j, and k. If the true wage is $w_{ik}^j = w_{0ik}^j \exp(u_{ik}^j)$, then the observed wage is

$$\hat{w}_{ik}^j = w_{0ik}^j \exp(u_{ik}^j + \epsilon_{ik}^j), \tag{9}$$

where w_{0ik}^j depends on *SK* and *GK*. In estimation it is assumed that ϵ_{ik}^j is normal and independent of u_{ik}^j, which, as already noted, is a discrete approximation of a normal.

The likelihood function consists of products over individuals and cycles of

$$\Pr(c_j) = \Pr(d_j) \Pr(e_1^j, \hat{w}_1^j, e_2^j, \hat{w}_2^j, \ldots, e_{s_j}^j, \hat{w}_{s_j}^j), \tag{10}$$

where $\Pr(c_j)$ depends on the reservation values obtained from the numerical solution of the dynamic program. Because employment spell durations within spells are not independent, the likelihood function requires the evaluation of multiple integrals (actually sums given the explicit discretization of u); the degree of multiplicity depends on the number of jobs held in the cycle. For this reason, I consider only two complete jobs in the sense that if an individual takes a third job in any cycle, the likelihood accounts for that but does not follow that individual further. This restriction still requires the calculation of triple integrals (sums) for the very few individuals who complete two employer spells in any cycle.[12] Estimation proceeds by iterating over the parameter space between the solution of the dynamic program and the evaluation of the likelihood function.

VI. Results

The estimation sample was restricted to the first 20 quarters of any individual's employment profile. This was done for two reasons. First,

[11] To some extent, the measurement error in wages also captures nominal wage variation across geographical areas that is primarily independent of behavior, although the i.i.d. assumption would not literally be appropriate.

[12] Details of the likelihood function are provided in an appendix to an earlier version of this paper (Wolpin 1989).

it enables out-of-sample tests of the model. Second, it does not use the reservation values of u that are close to the quarter that requires interpolation of the value functions as described above (i.e., quarter 25). In addition to this restriction, employment profiles were truncated at the quarter of leaving an employer whenever the reason for leaving an employer was other than a layoff or a permanent quit, that is, recorded as "unknown" or "other" in the data.[13] It is necessary to assume that these reasons for leaving are exogenous in the context of the model and that the future after leaving the employer would be no different on average from what it is for those with the same history who left via a layoff or permanent quit.[14]

The values of the state variables for the truncated black and white samples are shown in table 3. As is consistent with the data previously presented, the black unemployment rate exceeds the white unemployment rate in each quarter of the first 5 years after school leaving. The difference is mostly due to the much greater time it takes blacks to become employed on their first job, which also accounts for the significant and increasing difference in general work experience.[15] The propensity to be unemployed after the first job is not very dissimilar: the unemployment propensity from a quit is perhaps slightly lower for blacks and that from a layoff somewhat higher. Thus the racial difference in general work experience would stabilize with age since all individuals eventually became employed for the first time. It is also seen in table 3 that the proportion of individuals unemployed because of either having quit or having been laid off sometime in the past follows an inverted U shape. The peak for quits occurs around quarter 9 for both races, and for layoffs the peak occurs at around quarter 10 for both races.[16]

The parameter estimates are shown in table 4. All probabilities

[13] The effects of these restrictions are unfortunately not small. For example, 72 black observations and 157 white observations are lost in moving from the first to the second cycle because job leaving did not occur through a layoff or a permanent quit.

[14] If, e.g., the reason for leaving is to search for a new job and to return to the firm if unsuccessful, then simply truncating the observation will create a choice-based sample. To model this phenomenon would have added complexities both in the optimization problem and in the estimation.

[15] It is interesting to note that black men are considerably more likely to remain at home, i.e., with at least one parent, than white men. For example, the NLSY data reveal that even by age 25, 40 percent of black men reside with a parent but only 23 percent of white men reside with a parent.

[16] It is of some concern whether this pattern is truly representative of any cohort given that cohorts are combined and business cycle effects may potentially distort the pattern. Although statistical tests reject the hypothesis that the life cycle patterns are identical across all cohorts for both quits and layoffs and for both races, the inverted U shape exists in all cohorts. The peak in these measures ranges between four and 11 quarters. Thus the basic shape is maintained in the combined cohort data.

TABLE 3

Quarterly State Variables for the Estimation Sample by Race

	Sample Size		Fraction Unemployed						Average General Experience*		Average Specific Experience*		Average Current Duration of Unemployment*		Average Wage†	
			Total		Quit		Layoff									
Quarter	Black	White	Black	White	Black	White	Black	White	Black	White	Black	White	Black	White	Black	White
1	322	543	.717	.532	.000	.000	.000	.000	.283	.468	.283	.468	.717	.532	2,713	3,077
2	312	527	.654	.464	.010	.017	.042	.033	.612	.998	.583	.941	1.26	.861	2,828	2,994
3	296	491	.661	.450	.017	.041	.071	.063	.953	1.51	.895	1.35	1.71	1.19	2,750	3,115
4	283	473	.572	.395	.042	.061	.078	.057	1.34	2.09	1.19	1.79	2.03	1.33	2,699	3,166
5	277	456	.520	.375	.036	.061	.090	.075	1.80	2.69	1.55	2.28	2.22	1.50	2,747	3,224
6	264	431	.508	.339	.066	.056	.103	.084	2.24	3.32	1.85	2.77	2.48	1.56	2,677	3,283
7	242	403	.537	.372	.050	.066	.136	.109	2.70	3.92	2.24	3.15	2.88	1.78	2,810	3,364
8	230	365	.478	.318	.057	.069	.122	.090	3.25	4.52	2.63	3.65	2.98	1.72	2,913	3,385
9	225	341	.458	.290	.062	.065	.107	.082	3.78	5.18	2.95	4.08	3.25	1.72	2,945	3,376
10	214	319	.435	.285	.061	.063	.103	.085	4.33	5.85	3.35	4.58	3.41	1.87	2,941	3,352
11	187	287	.455	.286	.070	.080	.112	.094	4.81	6.56	3.56	4.99	3.78	1.83	2,972	3,477
12	178	261	.393	.245	.073	.088	.067	.065	5.39	7.32	3.98	5.40	3.69	1.64	2,871	3,525
13	174	246	.333	.207	.069	.059	.034	.065	6.09	8.13	4.20	5.87	3.47	1.51	2,920	3,525
14	165	237	.352	.194	.061	.065	.061	.076	6.70	8.94	4.58	6.49	3.68	1.32	3,019	3,530
15	122	197	.361	.203	.057	.051	.074	.096	7.35	9.90	5.15	7.31	4.03	1.46	3,165	3,697
16	109	173	.294	.173	.037	.035	.064	.087	8.38	11.0	6.03	8.09	3.55	1.34	3,254	3,673
17	104	163	.269	.110	.038	.031	.058	.043	9.24	11.8	6.33	8.98	3.44	.96	3,230	3,690
18	95	149	.221	.107	.021	.034	.042	.034	10.3	12.9	7.11	9.89	3.26	.99	3,254	3,648
19	72	117	.264	.068	.041	.017	.055	.026	11.0	14.2	7.82	10.8	3.71	.59	3,228	3,795
20	62	106	.145	.047	.000	.009	.000	.009	11.9	15.1	7.09	11.6	2.90	.58	3,135	3,929

* Values are based on end-of-quarter distributions.

† Sample sizes are smaller because of both nonemployment and missing data.

TABLE 4

MAXIMUM LIKELIHOOD ESTIMATES

Parameter	Black	White
b	1,648	845
P_{10}	.5964	.1796
P_{11}	−.0005	.0061
P_{12}	.0494	−.0336
P_{20}	.4268	−1.179
P_{21}	−.0312	.0071
P_{30}	−2.750	−2.910
P_{31}	−.0142	−.0293
P_{40}	38.00	.5185
P_{41}	6.944	4.033
P_{42}	1.388	3.481
σ_u	.5922	.8329
σ_ϵ	.2673	.2122
w_{00}	6.977	7.064
w_{01}	.0138	.0091
w_{02}	.0066	.0173
w_{03}	−.00043	−.00071
w_{04}	−.000067	−.000108
Log likelihood	−2,274	−3,609

NOTE.—The quarterly discount factor (δ) is set equal to .988; the unemployment benefit duration ($\bar{n}$) is set equal to 2; the level of unemployment compensation (c) is 1,221 for blacks and 1,468 for whites, the sample averages for those who reported receiving benefits while unemployed; and P'_{10} is .9170 for blacks and .8080 for whites.

(offer, layoff, and recall) are estimated from a logit form. Specifically,

$$\ln \frac{P_1}{1 - P_1} = P'_{10} \cdot d(t = 1) + P_{10}[1 - d(t = 1)] + P_{11} n + P_{12} GK,$$

$$\ln \frac{P_2}{1 - P_2} = P_{20} + P_{21} GK,$$

$$\ln \frac{P_3}{1 - P_3} = P_{30} + P_{31} SK,$$

$$\ln \frac{P'_4}{1 - P'_4} = P_{40} + P_{41} n + P_{42} SK,$$

where $P'_4 = P_4/(1 - P_1)$ is the conditional probability of a recall given that a new offer is not received. The reason for using the conditional recall probability is to impose the restriction that $P_1 + P_4 \leq 1$. Note that the offer probability P_1 is assumed to differ in the first period after graduation from all other periods; $d(t = 1)$ is equal to one in the first period and zero otherwise.[17] Also, the systematic component

[17] As already noted, the proportion of individuals employed directly on graduation is quite high. One hypothesis is that search for a postgraduation job actually begins

of the wage is specified as $w_0 = \exp(w_{00} + w_{01}SK + w_{02}GK + w_{03}SK^2 + w_{04}GK^2)$.

The estimated mean quarterly wage offer with zero prior work experience is \$1,277 for a black and \$1,654 for a white: $\overline{w}(0, 0) = \exp(w_{00} + \frac{1}{2}\sigma_u^2)$. Notice, however, that w_{00} is almost identical for blacks and whites. Thus this differential is almost entirely the result of the substantially larger degree of wage dispersion (σ_u) in the white wage offer function. Wages grow at a declining rate with both general and specific work experience for both races. Wages grow more quickly with specific experience for blacks and peak later (at 16.0 quarters for blacks and at 6.4 quarters for whites), but wages grow more quickly with general experience for whites and peak later (at 80.1 quarters for whites and 49.3 quarters for blacks).[18] The highest attainable mean wage offer for blacks is only \$1,680. It is more than double that for whites, \$3,404. The wage return to experience is thus considerably smaller for blacks than for whites. On the other hand, the estimated quarterly nonmarket value of time (net of search costs) is greater for blacks, \$1,648, than for whites, \$845.

The probability of receiving a wage offer while unemployed is higher for blacks than for whites. It decreases trivially with the length of the unemployment spell for blacks and increases for whites, but increases with general experience for blacks and falls for whites. In the first period out of school, the quarterly offer probability is .65 for blacks and .55 for whites. With 20 quarters of prior experience, in the first unemployment period the offer probability is .83 for blacks and .38 for whites.

The probability of receiving a wage offer while employed is also higher for blacks. It declines with general experience for blacks but increases for whites. With no prior work experience, the offer probability is .61 for blacks and .24 for whites; after 20 quarters of work experience, the probabilities are .45 and .26. The layoff probability is slightly higher for blacks than for whites with the same tenure. In the first employment period, it is .06 for blacks and .05 for whites;

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while in school. The offer probability associated with the first period, P'_{10}, captures this possibility. It should be recognized that this additional parameter automatically yields a perfect fit to the data in the first period, i.e., to the employment rate. It is exactly equal to the first-period employment rate divided by the first-period acceptance rate, where the latter is determined in the solution to the model for any given set of parameters.

[18] Wage growth independent of work experience, i.e., that due to exogenous productivity growth, is ignored. This is a difficult issue because if behavior is conditional on the anticipation of such growth, then omitting it will bias the results. On the other hand, to the extent that there is exogenous productivity growth in nonmarket time, productivity growth overall may be neutral with respect to employment profiles. Further, as is consistent with other data sources, real wages have not grown over this period for given education and experience.

after 20 quarters of tenure, it is .05 and .03. The recall rate rises with tenure and layoff duration for both blacks and whites. However, regardless of tenure, layoff duration, or race, the conditional recall probability is almost identically one. In each layoff period the individual is assured of receiving either a recall offer or an offer from a new firm, the latter given by P_1. The reason then for continued layoff (and indeed for the layoff itself) conditional on the lack of an offer from a new employer is the (possibly implicit) rejection of recall offers.[19]

Chi-square statistics were calculated on the basis of a comparison of actual distributions of each state variable in each quarter to predicted distributions obtained from one-step-ahead forecasts of state variables conditioned on the previous quarter's state. Overall, the fit of the model was quite good; there were very few quarters in which the model did not accurately mimic the actual distributions of the state variables.[20]

In addition χ^2 statistics were calculated on the basis of actual and predicted distributions of average general and average specific experience for quarters 21–30. These 10 quarter predictions are based only on the state at the start of quarter 21; that is, the only information used is the actual state as of quarter 21 so that updates of the state depend on current-period predictions. The forecasts were obtained by drawing a random sequence of offers and wages for each individual remaining in the sample as of quarter 21, 106 whites and 62 blacks. For general experience, in only one quarter for whites and in none for blacks was the fit statistically rejected by the data. However, for specific experience the fit was rejected in all but the first few quarters.

VII. Discussion

The results indicate that work history has an important effect on the labor market environment faced by an individual both through its effect on the likelihood of receiving job offers and on the level of the wage offer received. Thus although individuals may take as given the structure of the labor market constraints they face, they can signifi-

[19] As is apparent in table 4, standard errors are not reported. Because the likelihood function has steps as a result of the discretization of the wage error distribution, the asymptotic properties of the estimates are not easily derived. Standard errors would thus have to be viewed with caution. At a practical level, it was found that standard errors obtained from numerical first derivatives were very sensitive to the step size used to calculate derivatives.

[20] As a way to provide evidence at low computational cost about whether black and white parameter estimates are actually different, χ^2 statistics based on quarterly values of the state variables were calculated for the white data using black parameter values and vice versa. The fit was clearly rejected in both cases.

cantly alter their current constraints by past behavior. Moreover, the labor market environment and the effect of history on it evidently differ by race.

Taking the estimates of the model's parameters as given and the parameters themselves as fundamental, one can perform a number of interesting policy-relevant experiments. I address two issues: (1) what would the employment pattern of black male high school graduates look like in the first 5 years after graduation if they faced the white wage offer distribution; and (2) what would happen to the early employment careers of blacks and whites if the level of unemployment compensation benefits increased?

It is clear from the estimates of the wage offer functions that blacks receive a much lower reward for work experience than whites do and that whites face a much greater chance of receiving especially high wage offers. Whites therefore have considerably greater potential for upward mobility. In table 5 the predicted levels of average general experience, average specific experience, and the average accepted wage over the 20 quarters of the sample are contrasted for blacks and whites with their own wage offer functions and for blacks under the assumption that they face the white wage offer function. The effect on general experience is dramatic: blacks with the white wage offer function now have even greater work experience in all but the first quarter than whites do.[21] However, they have increased specific experience only for the first four quarters with the white wage function.

The effect on the average accepted wage is shown in the last three columns and demonstrates the well-known pitfall in comparing accepted wages rather than wage offers. Black accepted wages actually are lower in the first eight quarters with the white wage offer function than with their own wage offer function. The increased return to experience induces blacks to accept lower initial wages. Further, black accepted wages are lower than white accepted wages in all periods even though they receive, on average, the same offers. The reason for this result is that blacks, having a substantially higher probability of receiving offers while employed, are more likely to accept offers in spite of their higher value of nonmarket time. However, the black-white accepted wage differential remains roughly constant (about $700) in favor of whites throughout the first 20 quarters that they both have the same wage offer function as opposed to widening using "own" wage offer parameters.

Table 6 reports the effect of a 50 percent increase in unemploy-

[21] Comparing predicted general experience in table 5 to actual general experience in table 3 reveals that when based only on initial conditions the model significantly underpredicts the accumulation of general experience.

TABLE 5

PREDICTED BLACK EMPLOYMENT STATISTICS BASED ON THE WHITE WAGE FUNCTION

QUARTER	PREDICTED AVERAGE GENERAL EXPERIENCE			PREDICTED AVERAGE SPECIFIC EXPERIENCE			PREDICTED AVERAGE ACCEPTED WAGE		
	Black	White	Black-White Wage Function	Black	White	Black-White Wage Function	Black	White	Black-White Wage Function
1	.283	.468	.458	.283	.468	.458	2,458	2,607	2,186
2	.665	1.09	1.25	.644	1.04	1.18	2,545	2,782	1,990
3	1.15	1.77	2.06	1.08	1.66	1.79	2,568	2,922	2,217
4	1.71	2.51	2.94	1.57	2.29	2.37	2,639	3,066	2,350
5	2.32	3.29	3.81	2.06	2.92	2.88	2,700	3,207	2,535
6	2.96	4.09	4.70	2.55	3.55	3.38	2,755	3,328	2,641
7	3.63	4.90	5.59	3.04	4.15	3.84	2,805	3,419	2,760
8	4.33	5.72	6.49	3.52	4.73	4.27	2,884	3,565	2,896
9	5.04	6.55	7.38	3.97	5.24	4.63	2,937	3,667	3,011
10	5.76	7.37	8.27	4.42	5.73	5.02	2,993	3,778	3,103
11	6.49	8.19	9.17	4.83	6.19	5.35	3,035	3,901	3,200
12	7.23	9.01	10.1	5.25	6.64	5.66	3,078	3,984	3,265
13	7.96	9.83	11.0	5.61	7.05	5.97	3,143	4,109	3,361
14	8.70	10.6	11.8	5.95	7.38	6.26	3,197	4,222	3,446
15	9.44	11.5	12.7	6.28	7.70	6.57	3,245	4,333	3,526
16	10.2	12.3	13.6	6.56	8.02	6.78	3,288	4,390	3,587
17	10.9	13.1	14.5	6.80	8.36	6.98	3,328	4,460	3,667
18	11.7	13.9	15.4	7.05	8.69	7.11	3,354	4,501	3,722
19	12.4	14.7	16.2	7.26	9.01	7.29	3,409	4,573	3,831
20	13.1	15.5	17.1	7.49	9.39	7.47	3,436	4,619	3,905

TABLE 6

EFFECT OF A 50 PERCENT INCREASE IN UNEMPLOYMENT COMPENSATION BENEFITS ON SELECTED EMPLOYMENT CHARACTERISTICS

	Average Current Duration of Unemployment Spell				Average General Experience				Average Specific Experience				Average Accepted Wage			
	Black		White		Black		White		Black		White		Black		White	
Quarter	c	$1.5c$	c	$1.5c$	c	$1.5c$	c	$1.5c$	c	$1.5c$	c	$1.5c$	c	$1.5c$	c	$1.5c$
1	.729	.629	.533	.565	.283	.371	.468	.435	.283	.371	.468	.435	2,458	2,189	2,607	2,718
2	1.20	.941	.760	.817	.665	.891	1.08	1.02	.644	.851	1.04	.989	2,545	2,276	2,782	2,870
3	1.49	1.07	.854	.906	1.15	1.51	1.77	1.69	1.08	1.39	1.66	1.60	2,568	2,333	2,922	2,972
4	1.63	1.08	.875	.925	1.71	2.20	2.51	2.43	1.57	1.95	2.29	2.23	2,639	2,421	3,066	3,106
5	1.74	1.12	.880	.924	2.32	2.90	3.29	3.19	2.06	2.37	2.92	2.86	2,700	2,538	3,207	3,242
6	1.79	1.11	.853	.891	2.96	3.62	4.09	3.99	2.55	2.84	3.55	3.49	2,755	2,615	3,328	3,358
7	1.79	1.11	.821	.856	3.63	4.36	4.90	4.80	3.04	3.32	4.15	4.09	2,805	2,689	3,419	3,450
8	1.74	1.11	.803	.830	4.33	5.10	5.72	5.61	3.52	3.76	4.73	4.66	2,884	2,799	3,565	3,594
9	1.70	1.11	.806	.835	5.04	5.84	6.55	6.43	3.97	4.17	5.24	5.16	2,937	2,876	3,667	3,700
10	1.67	1.13	.801	.832	5.76	6.58	7.37	7.24	4.42	4.59	5.73	5.66	2,993	2,615	3,778	3,809
11	1.60	1.13	.796	.824	6.49	7.33	8.19	8.06	4.83	4.98	6.19	6.14	3,035	3,005	3,901	3,925
12	1.56	1.16	.806	.822	7.23	8.06	9.01	8.88	5.25	5.31	6.64	6.58	3,078	3,071	3,984	4,008
13	1.56	1.19	.812	.823	7.96	8.80	9.83	9.70	5.61	5.63	7.05	6.98	3,143	3,137	4,109	4,138
14	1.51	1.21	.841	.852	8.70	9.53	10.6	10.5	5.95	5.95	7.38	7.34	3,197	3,207	4,222	4,243
15	1.45	1.19	.860	.864	9.44	10.3	11.5	11.3	6.28	6.26	7.70	7.67	3,245	3,258	4,333	4,350
16	1.41	1.21	.871	.873	10.2	11.0	12.3	12.1	6.56	6.49	8.02	8.01	3,288	3,304	4,390	4,398
17	1.38	1.22	.872	.872	10.9	11.7	13.1	12.9	6.80	6.73	8.36	8.36	3,328	3,348	4,460	4,465
18	1.38	1.26	.890	.871	11.7	12.5	13.9	13.8	7.05	6.97	8.69	8.68	3,354	3,374	4,501	4,501
19	1.38	1.28	.896	.893	12.4	13.2	14.7	14.6	7.26	7.18	9.01	9.02	3,409	3,425	4,573	4,569
20	1.40	1.30	.919	.918	13.1	13.9	15.5	15.4	7.49	7.43	9.39	9.40	3,436	3,450	4,619	4,615

ment compensation benefits on employment in the first 20 quarters for both races. For whites, as one might anticipate, the increase in benefits increases the average duration of unemployment spells, reduces average general and specific work experience, and increases accepted wages. However, the effects are in magnitude quite small. For blacks, all the effects are exactly opposite and substantial in magnitude. Average unemployment spells decrease in length, average general and specific experience increases, and average accepted wages fall. The reason for these seemingly anomalous results lies in the fact that these unemployment spells are dominated by the length of time it takes to become employed at the first job. An increase in benefits reduces the delay in accepting the first job; for example, the first-quarter increase in the fraction of employed blacks is 10 percentage points. The logic, it would seem, is that in order to collect unemployment compensation benefits, one first must be employed. The higher level of benefits induces blacks to lower their first-job reservation wage.[22] However, with respect to later unemployment spells, results are as in the white case; that is, the fraction unemployed at any quarter is higher as benefits are greater. The work inducement created by this intervention is thus only temporary.

VIII. Conclusions

Rather than reiterate findings, it is possibly more useful to raise briefly a number of important caveats. An important issue concerns the extent to which the approximations to the solution and estimation of the optimization problem and the simplicity of the behavioral model affect the empirical estimates. Methods for estimating dynamic stochastic models of this kind are still in a relatively undeveloped stage, and knowledge about the effects of model and solution misspecification is very limited. This enterprise, then, is part of a much larger long-term research agenda; exactly how seriously one should take these particular estimates as reflecting real phenomena is open to debate.

A second, more concrete, qualification concerns the fact that the model is incomplete in several dimensions. There are actions taken as exogenous in the model, such as schooling, which might substantially alter the results if treated as choices. In addition, both of the experiments of the previous section assume that the structure is fundamental. However, it is likely that a more complete model would reveal interdependencies between parameters. Altering the wage structure or unemployment benefits in an equilibrium setting would

[22] Mortensen (1977) rated the theoretical possibility of this result.

likely also alter the offer probability structure in the first experiment and the layoff and recall rate structure in the second.[23] The results must be viewed only within this partial equilibrium context.

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[23] For example, Topel (1984) estimates that a 10 percent increase in the level of unemployment compensation benefits would increase the probability of layoff by 0.2 percentage points if permanent and by 0.6 percentage points if temporary.

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