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The Effect of Match Quality and Specific Experience on Career Decisions and Wage Growth

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Abstract

This paper constructs and estimates a career decision model where individuals search for both career matching and employer matching to understand wage growth and career mobility using the NLSY79. It departs from previous papers in that career mobility decisions and participation decisions are explicitly modeled. I find substantial returns to career-specific experience. However, college graduates' wage grows little through career-match upgrading, which results in a lower incidence of career changes than high school graduates. The finding suggests that college graduates learn about their suitable careers before they enter a labor market.

1 Introduction

Wages of young workers grow rapidly. One major explanation is that the human capital accumulation of young workers is fast. Another explanation is that they change jobs frequently and find a better match during the course of their careers. Human capital is often categorized as either general or firm-specific, and matching is usually considered firm-specific. However, workers often find that knowledge and skills learned in a previous job are still useful in a new job, when the tasks of the two jobs are related. This implies that human capital and matching could be better captured at a broader level such as industry or occupation. Identifying the relative importance of different types of skills and matching is useful for designing training programs and job placement services.

This paper's objective is to construct and estimate a structural model of career search to evaluate the effects of specific experiences, and match qualities on wages and career decisions. In the model, workers search for a better career match as well as a better employer match. They make

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decisions on labor force participation as well as on career and employer changes. Specifically, workers are allowed to change employers while remaining in the same career or change both career and employer if they are not satisfied with the matches. In addition to match-quality changes, career-specific experience and employer tenure, as well as general experience increase wages. The optimal search strategy in the model is characterized by a two-stage search in which a worker first searches for a career match and then searches for an employer, which is supported by evidence from the National Longitudinal Survey of Youth (NLSY). The model accounts for individuals' unobserved heterogeneity in wage, mobility, and participation. Family variables that affect mobility and participation are also included in the model.

This paper is closely related to the seminal work by Neal (1999). He finds evidence of the two-stage search in the NLSY and presents a highly stylized model where workers search for both career match and employer match. One important limitation of the model is that human capital accumulation is omitted. If career-specific human capital grows, the probability of career change decreases with experience because individuals do not want to lose it. However, career-specific human capital does not discourage employer changes within the same career. Thus, experienced workers change employers within the same career, while inexperienced workers change employers across careers, which is also consistent with the two-stage search. One of the important contributions of the paper is to include human capital accumulation to distinguish between match quality and human capital.

The paper also contributes to a large literature of returns to specific experience and employer tenure. Altonji and Shakotko (1987), Topel (1991), and Altonji and Williams (2005) estimate the returns to employer tenure using instrumental variable techniques and debate the magnitude. Neal (1995) and Parent (2000) claim that the return to employer tenure is markedly reduced once industry-specific experience is controlled. Kambourov and Manovskii (2007) find that the return to occupation-specific experience is more important for wage profile than industry-specific experience and employer tenure. This paper considers skills similar to these recent contributions in that skills are transferable within a career, but it takes different routes in methodology. In contrast to these previous contributions, the participation decision and the mobility decision are explicitly modeled. Consequently, this paper is able to account for unobserved heterogeneity at individual level, career level, and employer level in these decisions.

Pavan (2006) extends Neal's two-stage search model so that match quality grows stochastically over time and structurally estimates it. My model differs from his in a number of different dimensions. First, the high school sample and the college sample are estimated separately. As I will describe below, this has an important empirical implication. Second, the participation decision and the effects of family variables on the mobility decision are also considered. Finally, this paper allows for a concave wage profile in career-specific experience and tenure. In contrast, in

Pavan (2006), wage growth due to the accumulation of specific skills is convex within career and employer spells because a linear drift in logwages is assumed, which is pointed out by Kambourov and Manovskii (2007).[1] My model is flexible enough so that the predicted skill profiles are concave and the model fits the observed job mobility patterns well.

The wage growth literature has paid scant attention to the different nature of careers between high school graduates and college graduates. College graduates typically occupy professional or management jobs, while many high school graduates occupy jobs demanding less skill, such as craftsmen, operators, and laborers. The common assumption that the returns to experience and tenure are homogeneous across careers seems to be strong. Skill specificity, on-the-job human capital investment, and wage determination mechanisms may be very different across occupations. Education is also associated with the career search pattern. Empirical papers, including Paglin and Rufolo (1990), Arcidiacono (2004), and Joy (2006), find a strong relationship between early career jobs and the major field of study in college. This evidence suggests that, to some extent, college graduates have learned about their comparative advantages and the nature of different careers through the choice of a major field of study. This paper estimates the model by separating the high school graduate sample and the college graduate sample to take into account the different nature of careers between them.

The structural model is numerically solved and the parameters are estimated by the Maximum Likelihood. The parameter estimates are intuitive, and the evidence from simulation exercises shows that the model fits reasonably well to interesting features of the data. The results indicate that the returns to general experience and employer tenure are, in fact, very different between high school graduates and college graduates. The return to five-year general experience for a college graduate's wage is 16%, which is more than double the wage increase for a high school graduate (7%). In contrast, the employer tenure of five years does not increase a college graduate's wage, but it increases the wage of a high school graduate by 7%. The return to five-year career-specific experience is greater than the return to tenure, and is 11-12%.

The effects of match quality upgrading on wage growth are also found to be quite different across education groups through a numerical simulation. In particular, the contribution of career-match quality upgrading is small for college graduates. It increases their wages by only 2% during the first ten years in the labor market, which is considerably lower than the growth of high school graduates' wage through the same channel. This result suggests that college graduates learn about their future careers before they enter a labor market, while high school graduates learn about careers by experiencing different jobs. As confirmed by another counterfactual simulation, this low returns to career search, as well as the high returns to career experience, are responsible for the lower rate of career change for college graduates than high school graduates.

[1] This can be confirmed by table 5 in Pavan (2006), for example.

The rest of the paper is organized as follows: In the next section I pose a model. In section 3, the data is described. I also present evidence that the fraction of within-career employer change increases over time. Section 4 contains estimation results and an analysis of the model fit to the data. In section 5, counterfactual simulations are conducted to decompose wage growth and assess the effects of matching and specific experiences on career mobility. Section 6 concludes the paper.

2 The Model

2.1 Basic Model

I first present a highly stylized model of career search. Although this basic model does not incorporate some important factors that affect career decisions, it is useful for illustrating the model's main feature. A more realistic empirical model that incorporates learning by doing, mobility costs, and preference shocks will follow in the next subsection.

Workers are infinitely lived and maximize the lifetime utility derived from match quality with the career θ and the match quality with the employer ξ. In each period, workers choose among three mutually exclusive alternatives: (1) remaining in the same career and the same employer, (2) remaining in the same career, but changing employers, (3) changing both careers and employers. Workers are not able to change careers when they stay with the same employer, because they are still on the same line of tasks. When workers decide to change careers, they draw a new career-match quality from the known fixed distribution F. Similarly, a new employer match quality is drawn from the known fixed distribution G. Workers do not know their match qualities until they actually take on a new task and work for a new employer. But, after the new match qualities are drawn, they are precisely observed by all relevant agents in the economy. Thus, the model does not include learning about match quality.

The instantaneous utility of a worker is given by $u = \theta + \xi$. The economic environment for workers is stationary. The worker's problem can be characterized by the following Bellman equation:

$$
\begin{aligned}
V(\theta,\xi) &= \max_{i=1,2,3} V_i(\theta,\xi) \\
V_1(\theta,\xi) &= \theta + \xi + \beta V(\theta,\xi) \\
V_2(\theta,\xi) &= \theta + \xi + \beta \int V(\theta,\xi')g(\xi')d\xi' \\
V_3(\theta,\xi) &= \theta + \xi + \beta \int\int V(\theta',\xi')f(\theta')g(\xi')d\theta' d\xi'
\end{aligned}
$$

where β is a discount factor and f and g are the probability density functions of career match and employer match. The value of remaining in the same career and with the same employer is given by V_1, the value of employer change is V_2, and the value of career change is V_3.

Neal (1999) finds that the worker's optimal policy can be characterized by the following reservation match-quality rule:

- Stop if $\xi \geq \xi^*$ and $\theta + \xi \geq \theta^* + \xi^*$.
- Change employers if $\xi < \xi^*$ and $\theta \geq \theta^*$.
- Change careers and employers if $\theta \leq \theta^*$ and $\theta + \xi \leq \theta^* + \xi^*$.

This optimal policy implies that a career search consists of two stages. In the first stage, workers change careers and employers. In the second stage, they change employers but remain in the same career. Workers never change careers once they enter the second stage of the search. Thus, the probability of career change given that some change occurs decreases over time. This proposition is the central feature of the career search of young workers.

2.2 Extended Empirical Model

Although the basic model clarifies the central feature of the career search model, it must incorporate many other features to be realistic and to fit the data. First, the extended model includes learning by doing. Wages increase with general work experience, career-specific experience, and employer tenure. Topel (1991) finds significant returns to employer tenure and Parent (2000) finds large returns to industry tenure using an instrumental variable technique. These previous results suggest that the returns to career and employer tenure should be included in the wage equation. Second, the model allows for transitory preference shocks. The strict two-stage career search predicted by the basic model does not fit to the data. Many workers change careers after making an employer change within the same career. Some of observations are, perhaps, due to coding errors, but some are real changes. To reconcile with this fact, transitory preference shocks are included so that any choice patterns can occur with a positive probability. However, this still does not change the main feature of the basic model in that the fraction of career change among any changes decreases over time, at the estimated parameters. Third, non-work state is taken into account. Some young workers do not work after graduating from high school or college, although the model mainly considers workers who are in the labor market. The model avoids endogeneity due to selection into working state by explicitly incorporating non-work state. Lastly, entry costs to a new career and a new employer are taken into account, to improve the model fit to the data.

The objective of individuals is to maximize the present value of their lifetime utility over a finite horizon. When individuals work, they receive wages that depend on innate ability, match qualities, and experiences. Working individuals choose among four mutually exclusive alternatives: (1) remaining in the same career and with the same employer, (2) changing employers but staying in the same career, (3) changing both careers and employers, and (4) not working. To draw a new career match quality, a new employer match quality, or both, individuals pay the entry costs. Match qualities are drawn from the known fixed distributions and are precisely observed immediately by all relevant economic agents.

Non-working individuals who have worked previously choose among three mutually exclusive alternatives: (1) working in the same career, (2) working in a new career, and (3) remaining non-working. These individuals are able to maintain the career-match quality and career-specific experience in the last career, because returning to the same career is commonly observed in the data. Non-working individuals who have never worked choose between two alternatives: (1) beginning to work and (2) remaining non-working. When they decide to begin to work, they draw a career-match quality and an employer-match quality. Working and non-working individuals draw match qualities from the same known distributions. The draws are immediately and precisely observed.

The worker's decision problem can be characterized by the Bellman equation. In the following, subscripts for individuals are omitted for notational simplicity unless otherwise noted. Let GX_t be general work experience in age t. Similarly, CX_t and FX_t denote career-specific experience and firm-specific experience, respectively. A vector of family variables such as marital status and number of children is denoted by Z_t. It is assumed that the family variables affect labor force participation and the mobility of workers, but they do not affect wages. The decision of those who are currently working and are t years old is denoted by an indicator variable d_{jt}. Individuals remain in the same career and with the same employer when $d_{1t} = 1$. They remain in the same career, but change employers when $d_{2t} = 1$. Career change and employer change occur when $d_{3t} = 1$. Finally, individuals choose not to work when $d_{4t} = 1$. Notice that individuals are making decisions about the next period's job and employment status. Because choices are mutually exclusive, it is imposed that $\sum_{j=1}^{4} d_{jt} = 1$ if currently working and $\sum_{j=1}^{4} d_{jt} = 0$ otherwise. Let S_t be a vector of state variables at age t. The state variables include general experience GX, career-specific experience CX, employer tenure FX, career match quality θ, employer match quality ξ, an iid productivity shock ε, a vector of choice specific iid preference shocks ν, and a vector of family variables Z. The Bellman equation of working individuals is given by

$$V_t(S_t) = \max_{d_{it}} \sum_{j=1}^{4} d_{jt} V_j(S_t)$$

$$V_{1t}(S_t) = u(w_t, Z_t) + \nu_{1t} + \beta E_{\varepsilon,\nu}[V_{t+1}(S_{t+1})|d_{1t} = 1]$$

$$
\begin{aligned}
V_{2t}(S_t) &= u(w_t, Z_t) - c_e^E(Z_t) + \nu_{2t} + \beta E_{\xi,\varepsilon,\nu}[V_{t+1}(S_{t+1})|d_{2t}=1] \\
V_{3t}(S_t) &= u(w_t, Z_t) - c_c^E(Z_t) + \nu_{3t} + \beta E_{\theta,\xi,\varepsilon,\nu}[V_{t+1}(S_{t+1})|d_{3t}=1] \\
V_{4t}(S_t) &= u(w_t, Z_t) + \nu_{4t} + \beta E_{\nu}[U_{t+1}(S_{t+1})|d_{4t}=1] \\
w_t &= w(GX_t, CX_t, FX_t, \theta_t, \xi_t, \varepsilon_t)
\end{aligned}
$$

where u is utility function, c_e^E is entry cost to a new firm, c_c^E is entry cost to a new career, and U is the value of non-working state. The law of motion of the deterministic state variables is

$$
\begin{aligned}
GX_{t+1} &= GX_t + 1 \\
CX_{t+1} &= CX_t + 1 \; if \; d_{1t} = 1 \; or \; d_{2t} = 1 \; or \; d_{4t} = 1 \\
&\quad 0 \; otherwise \\
FX_{t+1} &= FX_t + 1 \; if \; d_{1t} = 1 \\
&\quad 0 \; otherwise.
\end{aligned}
$$

Notice that individuals do not lose career-specific experience when they choose not to work ($d_{4t} = 1$) in the next period. The law of motion of match qualities is the followings, as readers may expect from the subscripts of the expectation operator,

$$
\begin{aligned}
\theta_{t+1} &= \theta_t \; if \; d_{1t} = 1 \; or \; d_{2t} = 1 \; or \; d_{4t} = 1 \\
\theta_{t+1} &\sim N(0, \sigma_\theta^2) \; otherwise \\
\xi_{t+1} &= \xi_t \; if \; d_{1t} = 1 \\
\xi_{t+1} &\sim N(0, \sigma_\xi^2) \; otherwise \\
\varepsilon_{t+1} &\sim N(0, \sigma_\varepsilon^2) \\
\nu_{jt+1} &\sim \text{Type I extreme value distribution for all } j.
\end{aligned}
$$

Notice that individuals do not lose the career-specific experience when they choose not to work ($d_{4t} = 1$) in the next period. The last parametric assumption that iid preference shocks follow type I extreme value distribution makes this model a multinomial logit. The family variables evolve exogenously over time and follow this transition process:

$$
Z_{t+1} = h(Z_t, t)
$$

where h is a transition function for the family variables.

The Bellman equation for non-working individuals who have previously worked is given by

$$U_t(S_t) = \max_{d_{jt}} \sum_{j=5}^{7} d_{jt} U_{jt}(S_t)$$

$$\begin{aligned}
U_{5t}(S_t) &= -c_e^U(Z_t) + \nu_{5t} + \beta E_{\xi,\varepsilon,\nu}[V_{t+1}(S_{t+1})|d_{5t}=1] \\
U_{6t}(S_t) &= -c_c^U(Z_t) + \nu_{6t} + \beta E_{\theta,\xi,\varepsilon,\nu}[V_{t+1}(S_{t+1})|d_{6t}=1] \\
U_{7t}(S_t) &= \nu_{7t} + \beta E_{\nu}[U_{t+1}(S_{t+1})|d_{7t}=1]
\end{aligned}$$

where c_e^U and c_c^U are the entry costs to a new employer and a new career, respectively. It is imposed that $\sum_{j=5}^{7} d_{jt} = 1$ if individuals are in a non-working state and have worked before and that $\sum_{j=5}^{7} d_{jt} = 0$ otherwise. Remember that career-specific experience and career-match quality are from the last time the individuals worked. Work experience and career-specific experience do not change, because they are not working in this period. If individuals decide to work ($d_{5t} = 1$ or $d_{6t} = 1$), the next period's firm-specific experience is zero ($FX_{t+1} = 0$), and they also draw a new employer-match quality. When individuals decide to work in a new career ($d_{6t} = 1$), the next period's career-specific experience is zero ($CX_{t+1} = 0$) and they also draw a new career match quality.

Lastly, the Bellman equation for non-working individuals who have never worked is given by

$$N_t(S_t) = \max_{d_{jt}} \sum_{j=8}^{9} d_{jt} N_{jt}(S_t)$$

$$\begin{aligned}
N_{8t}(S_t) &= -c_c^U(Z_t) + \nu_{8t} + \beta E_{\theta,\xi,\varepsilon,\nu}[V_{t+1}(S_t)|d_{8t}=1] \\
N_{9t}(S_t) &= \nu_{9t} + \beta E_{\nu}[N_{t+1}(S_t)|d_{9t}=1]
\end{aligned}$$

where c_c^U is the entry cost to a new career. When individuals decide to work, they draw a new career match quality and a new employer match quality. It is imposed that $\sum_{j=8}^{9} d_{jt} = 1$ if individuals have never worked before and that $\sum_{j=8}^{9} d_{jt} = 0$ otherwise.

2.2.1 Initial Conditions

Individuals make career decisions from the year they graduate from school to retirement age T (= 65.) The age at which individuals graduate from school is exogenously given and is different across individuals. In the last year of schooling, they decide whether or not to work ($d_{8t} = 1$ or $d_{9t} = 1$) the following year. Any work experience before graduating does not count. So, individuals start their careers with no experience ($GX = CX = FX = 0$.)

2.2.2 Preference and Technology

Utility Function The utility function for wages is given by

$$u(w_t, Z_t) = (\alpha_{0,r} + \alpha_Z Z_t) \cdot w_t$$

where r is the subscript for individual type that is constant over time. This heterogeneity of utility function is to capture the different responses to wage incentives across individuals. For example, an individual with a high α has strong labor force attachment. Several empirical papers find that male labor supply is affected by marital status and the number of children in the household. The specified utility function is consistent with the empirical evidence.

Wage Equation Wages are given by the following Mincerian-type equation

$$\ln w_t = \omega_{0,r} + \omega_1 GX_t + \omega_2 GX_t^2 + \omega_3 CX_t + \omega_4 CX_t^2 + \omega_5 FX_t + \omega_6 FX_t^2 + \theta_t + \xi_t + \varepsilon_t$$

where the intercept $\omega_{r,0}$ is allowed to vary across individuals.

Cost Function The entry cost functions to a new employer and a new career are determined by the current employment status and household structure

$$c_n^L = \gamma_{0,r} + \gamma_n^L + \gamma_z Z_t$$

where the superscript L is for the current employment status (working E or not working U) and the subscript n is for type of change (employer change e or career and employer change c.) In addition, the entry costs vary across individuals depending on the type r. Family variables are included to capture the effects of marital status and the children in the household on job mobility. Job changes sometimes entail relocation and this is more costly for a family than a single individual, because the wife's new job and the school for children may also need to be searched for.

Family Variables The family variables Z include marital status M and number of children K, and they exogenously change over time. The transition probabilities of marital status and number of children are given by the functions of marital status and number of children in the last period and age. Specifically, the transition probability has a probit form

$$\Pr(M_t = 1 | M_{t-1}, K_{t-1}, t) = \Phi(u_m(M_{t-1}, K_{t-1}, t))$$

$$\Pr(K_t = 1 | M_{t-1}, K_{t-1}, t) = \Phi(u_k(M_{t-1}, K_{t-1}, t))$$

$$\begin{aligned} u_m &= \delta_0^m + \delta_1^m t + \delta_2^m M_{t-1} + \delta_3^m K_{t-1} + \delta_4^m t M_{t-1} + \delta_5^m t K_{t-1} + \delta_6^m M_{t-1} K_{t-1} + \delta_7^m t M_{t-1} K_{t-1} \\ u_k &= \delta_0^k + \delta_1^k t + \delta_2^k M_{t-1} + \delta_3^k K_{t-1} + \delta_4^k t M_{t-1} + \delta_5^k t K_{t-1} + \delta_6^k M_{t-1} K_{t-1} + \delta_7^k t M_{t-1} K_{t-1} \end{aligned}$$

where Φ is the cumulative distribution function of the standard normal.

2.3 Solution and Likelihood Function

The model is numerically solved by backward induction because this is a finite horizon problem. Each individual is assumed to start making decisions in the year he graduates from school and to retire at age 65. Following Keane and Wolpin (1997), the value function is approximated by polynomial regressions, in order to decrease computational burdens. Specifically, the expected value function (sometimes called the Emax function) is first evaluated at some selected points in the dimensions of general experience, career-specific experience, tenure, and match qualities for any given age. Then the Emax function is approximated by a second-order polynomial. The distributions of both career and employer match quality are approximated by the discrete distribution with five support points. The discount rate is set at 0.95.

The likelihood function is constructed using this numerical solution to the dynamic programming. Following Rust (1987), the transition probability of exogenous variables (i.e. family variables Z) is separately estimated before the estimation of the choice probabilities. I assume there are R(= 4) unobserved types of individuals. Because experiences are functions of the history of the career choice variable $d_{it} = \{d_{ijt}\}_{j=1}^{9}$, the likelihood for individual i is given by

$$\Pr(\{d_{it}, w_{it}\}_{t=t_{i,0}}^{\bar{t}_i} | \{Z_{it}\}_{t=t_{i,0}}^{\bar{t}_i}, \Theta) = \sum_{r=1}^{R} \pi_r \Pi_{t=t_{i,0}}^{\bar{t}_i} P_{rt}(d_{it}, w_{it} | \{d_{i\tau}, w_{i\tau}\}_{\tau=t_{i,0}}^{t-1}, Z_{it}; \Theta)$$

where $t_{i,0}$ is the age of graduation of individual i, $\bar{t}_i$ is the age that individual i most recently observed in the survey, π_r is the probability that individual i is type r, and P_{rt} is the conditional choice probability of career choice and wage given the individual type r, his career history, and the family variables. A vector of parameters to be estimated is given by Θ. The likelihood for the whole sample that includes N individuals is given by

$$\Pr(\{d_i, w_i, Z_i\}_{i=1}^{N} | \Theta) = \Pi_{i=1}^{N} \Pr(\{d_{it}, w_{it}, Z_{it}\}_{t=t_{i,0}}^{\bar{t}_i} | \Theta)$$

where $d_i = \{d_{it}\}_{t=t_{i,0}}^{\bar{t}_i}$ and the vectors w_i and Z_i are similarly defined.

3 Data

3.1 Sample

The data are taken from the 1979 youth cohort of the National Longitudinal Survey of Youth. The NLSY consists of 12,686 individuals who were 14-21 years old as of January 1, 1979. The analysis in this paper is based on the white males in the core random sample to reduce heterogeneity. Sub-samples of high school graduates and college graduates are taken according to the following rules. Individuals are included in the high school graduate sample if (1) their highest grade completed is 12 in the most recent survey until 2004, and (2) they are 18 or younger in the 1979 interview. The first restriction excludes those who re-enter a school after entering a labor market. The second restriction excludes individuals whose initial labor market experiences are missing in the survey.

Similarly, individuals are included in the college graduate sample if (1) their highest grade completed is 16 years. The initial labor market experience is observed for all individuals in the college graduate sample, because they are 21 or younger in the first survey year. If a college graduate went to graduate school after some years of work, his employment history before entering graduate school is included in the sample. Those who went to graduate school right after completing undergraduate study are omitted from the college graduate sample. This sampling criterion is necessary to control years of education precisely, because the link between education and career is one of the important issues in this paper. Estimation results for an expanded college graduate sample with those who went to graduate school are reported in appendix B.

To split the white male sample into the high school graduate sub-sample and college graduate sub-sample, I use the highest grade completed. If this variable is missing in any given survey year, the reported grade in the following year is used if available. If not, the reported grade in the previous year is used. To determine individuals' grade ever completed, I take the highest reported grade throughout all the survey years. Out of 2439 white males in the cross-section sample, 252 individuals did not complete high school, 1027 individuals completed high school but did not go to college, 493 individuals went to college for less than four years, and 667 individuals completed four-year college education or higher. Notice that GED recipients are not counted as those who completed high school.

To avoid initial condition problems, I omit individuals those who are 19 or older from the high school sample. Out of 1027, 677 high school graduates remain in the sample. I also omit 17 individuals who report that they completed high school at age 17 or younger (660 individuals remain). For 26 individuals out of 660, hours of work in a year never exceed 1000 hours throughout all the survey years. After omitting them, I have 642 individuals remaining. Out of 642, 30 individuals did not work more than 1000 hours in any survey years after graduating from high school (610 individuals remain). In estimating the structural model, I use continuous spells of work history and family variables. If work history except for wages or family variables are missing, I drop all the information from that survey year on. After this procedure, I do not observe any work experience more than 1000 hours in a year for 17 individuals. The final sample size of high school graduates is 593.

For the college graduate sample, the initial transition to the labor market is mostly observed because all individuals are 22 or younger at the first survey year. I omit 14 individuals who report that they completed a four-year college at age 21 or younger, and 653 individuals remain in the sample. For 11 individuals out of 653, hours of work in a year never exceed 1000 hours throughout all survey years. After omitting them, I have 642 individuals remaining. Out of 642, 157 individuals did not work more than 1000 hours in any survey years after graduating from a four-year college. Those who went to graduate school right after completion of undergraduate study are omitted at this stage. Omitting these individuals, I have 485 individuals in the college graduates sample. If work history except for wages or family variables are missing in a given survey year, I drop all the information from that survey year on. After this procedure, I do not observe any work experience more than 1000 hours in a year for 8 individuals. The final sample size of college graduates is 478.

3.2 Variable Definitions

Labor force status after graduating is determined by the number of hours worked in a year. An individual is considered to have worked during the year if he worked more than 1,000 hours.

Hourly wages and industry and occupation codes are assigned from the current or most recent job. Hourly wages are deflated by the 2000 CPI. All wage observations less than $1 and more than $100 are omitted. Marital status of individuals and the number of children in the household are also used in the analysis.

Career change in this paper is defined as a significant change of tasks of jobs. If job changers are unable to transfer their skills acquired in a previous job, this job change is not only an employer change, but also a career change. From this perspective, I rely primarily on industry codes to identify career changes in the data, which is consistent with the findings by Neal (1995, 1999) and Parent (2000) that individuals lose a substantial fraction of their wages when they change jobs across industries. Although skills are well captured at industry level, some exceptions may exist. The tasks of some workers are not directly related to their employers' products or services, but are related to activities common across industries. For example, the tasks of an accountant are not very different across industries. An accountant is able to transfer most of his skills from an old job to a new one in a different industry. Thus, occupation codes are also included for the definition of career change to address this issue.

I also assume that career change does not occur when an individual stays with the same employer, as seen in the model above, for two reasons. First, when an individual stays with the same employer, a change of industry code seems to be a coding error as discussed in Neal (1999). Second, many occupation code changes within the same employer are moves to management positions. It seems to be reasonable to consider this move as a promotion within the same career. Although the tasks of a manager are different from those of his subordinates, the skills he acquired in the previous position are certainly useful for performing management tasks. Thus, he still remains in the same line of work.

Many previous empirical papers find that occupation code in the NLSY is riddled with measurement error. Measurement error in occupation code overstates occupation changes, which is problematic for estimating the effects of career-specific experience and career matching on wages and mobility. As mentioned above, two or more occupations are often reported across survey years even when an individual stays with the same employer. While I do not know which one represents the true occupation, one of them is likely to be the truth. Thus, comparing all reported occupations between two employment spells can reduce biases due to measurement error. This method works well particularly when multiple occupations are reported because they are similar to each other. Given the discussion above, I empirically define career change as follows: an individual is considered to change careers if he changes employers, and any reported one-digit industry classification codes and any three-digit occupation codes do not match between the employment spell with the new firm and that with the old firm.

3.3 Descriptive Statistics

Summary statistics for the high school graduate sample and the college graduate sample are presented in table 1 and table 2. The average age of the pooled high school sample is 23.6 and that of the pooled college sample is 26.3. The average general work experience of high school graduates is 3.7 years, which is longer than that of college graduates (2.8 years.) Notice that any work experiences before graduating school are not counted. The average career experience and employer tenure of high school graduates are 2.5 years and 1.4 years, and those of college graduates are 2.4 years and 1.5 years. The annual job change rate and career change rate are calculated for individuals who worked for two consecutive years. Job separations due to transitions from work to non-work are excluded. Both within- and between-career job changes are included. The annual job change rate is 0.29 for high school graduates, and 0.23 for college graduates. Similarly, the career change rate of high school graduates is 0.14 and 0.09 for college graduate, which implies that about 50% of high school graduates' job changes are career changes, while the rate is about 40% for the college graduates. The evidence shows that high school graduates change jobs and careers more frequently.

Table 1: Summary Statistics for high school Graduates

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	Nobs
Age	17.00	20.00	23.00	23.60	27.00	32.00	6055
General Experience	0.00	0.00	3.00	3.67	6.00	14.00	6055
Career Experience	0.00	0.00	1.00	2.52	4.00	14.00	6055
Employer Tenure	0.00	0.00	0.00	1.43	2.00	14.00	6055
Employers per Individual	1.00	2.00	3.00	3.45	5.00	14.00	593
Careers per Individual	1.00	1.00	2.00	2.25	3.00	12.00	593
Employers within Career per Individual	0.00	0.00	1.00	1.20	2.00	9.00	593
Years Surveyed per Individuals	1.00	7.00	12.00	10.21	14.00	16.00	593
Job Change Rate	0.00	0.00	0.00	0.29	1.00	1.00	4307
Career Change Rate	0.00	0.00	0.00	0.14	0.00	1.00	4307
Wage (2000 CPI)	1.02	8.03	10.98	12.12	14.69	83.77	4906
Married (at age 30)	0.00	0.00	1.00	0.66	1.00	1.00	247
Has Children (at age 30)	0.00	0.00	1.00	0.56	1.00	1.00	247

Table 2: Summary Statistics for College Graduates

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	Nobs
Age	21.00	24.00	26.00	26.33	29.00	35.00	3328
General Experience	0.00	0.00	2.00	2.83	5.00	13.00	3328
Career Experience	0.00	0.00	1.00	2.40	4.00	13.00	3328
Employer Tenure	0.00	0.00	0.00	1.54	2.00	12.00	3328
Employers per Individual	1.00	1.00	2.00	2.29	3.00	8.00	478
Careers per Individual	1.00	1.00	1.00	1.48	2.00	7.00	478
Employers within Career per Individual	0.00	0.00	0.00	0.81	1.00	5.00	478
Years Surveyed per Individuals	1.00	3.00	7.00	6.96	10.00	15.00	478
Job Change Rate	0.00	0.00	0.00	0.23	0.00	1.00	2527
Career Change Rate	0.00	0.00	0.00	0.09	0.00	1.00	2527
Wage (2000 CPI)	1.04	12.03	16.85	18.12	22.17	98.24	2932
Married (at age 30)	0.00	0.00	1.00	0.67	1.00	1.00	211
Has Children (at age 30)	0.00	0.00	0.00	0.44	1.00	1.00	211

The average hourly wage of high school graduates is $12, which is deflated by the 2000 CPI. College graduates earn $18 per hour on average, which is about 50% more than high school graduates. The fractions of married individuals at age 30 are 0.66 and 0.67 for the high school graduates and college graduates, respectively. The fractions of those who have one or more children at age 30 are 0.56 and 0.44 for the high school graduates and college graduates, respectively.

Logwage-experience profiles are presented in figure 1 for high school graduates and college graduates. Both profiles are concave, while the slope for the college graduates is steeper. The fraction of working individuals is plotted in figure 2 and it quickly increases with years of experience. The rate for the five-year-experience high school graduates is about 0.94, and that for the five-year-experience college graduates is about 0.98. Figure 3 plots the probability that currently employed individuals will decide to stay with their current employers. The probability of staying increases with general work experience, and is higher for the college graduates. The probability of changing employers within the same career is plotted in figure 4. The probability of changing

Table 3: Testing Upward Trend of Employer Change within the Same Career

High School (N=1256)		
	Estimates	Std. Dev.
Intercept	−0.239	0.055
Experience	0.072	0.011

College (N=580)		
	Estimates	Std. Dev.
Intercept	0.063	0.077
Experience	0.102	0.022

careers is also plotted in figure 5. This probability decreases with experience for both education groups. The probability that an employed individual decides not to work is shown in figure 6 and this probability decreases with experience.

The most important feature of the data for this paper is that the fraction of employer change within the same career increases with experience, which is shown in figure 7. The fraction is calculated for those who worked for two consecutive years and changed employers. For both education groups, an upward trend can be seen, although the confidence interval is wide due to the small sample size. A test for the null hypothesis that a time trend does not exist is conducted under the following parametric assumptions. Let y_i be an indicator variable that takes one if an individual changes employers within the same career and takes zero otherwise. Let $y_i^* = a + bGX_i + \varepsilon_i$ be a latent variable where GX is general experience and ε is normally distributed with zero mean and unit variance. Assume that $y_i = 1$ if $y_i^* > 0$ and $y_i = 0$ otherwise. Table 3 presents the estimation results of this probit model. The coefficient for experience is significantly positive for both education groups and the null hypothesis is strongly rejected.

4 Estimation Results

This section presents and discusses the structural parameter estimates in tables 4, 7, 8, and 9. The parameter estimates for the family variable transitions are not of central interest and are summarized in appendix A.

First, I discuss the estimation result of the wage equation in table 4. The type of individuals is ordered by the intercept of the wage equation. The wage function of high school graduates is concave in general experience, career experience, and employer tenure. The returns to career experience and tenure are of a similar magnitude. The estimated cumulative return to career experience of five years is about 0.11 and the return to employer tenure of five years is about 0.07. The wage function of college graduates is also concave in general experience, career experience and employer tenure. For college graduates, the estimated cumulative return to career experience of five years is about 0.12 and the return to employer tenure of five years is about 0.03; the latter

Table 4: Wage Equation

	High School		College	
	Estimates	Std. Dev.	Estimates	Std. Dev.
Intercept (Type 1)	1.779	0.059	1.722	0.091
Intercept (Type 2)	2.074	0.024	2.168	0.041
Intercept (Type 3)	2.281	0.041	2.573	0.041
Intercept (Type 4)	2.401	0.027	2.921	0.051
GX	0.020	0.005	0.037	0.009
CX	0.026	0.006	0.025	0.010
FX	0.019	0.005	0.015	0.008
$GX^2/100$	−0.116	0.034	−0.097	0.070
$CX^2/100$	−0.065	0.039	−0.024	0.063
$FX^2/100$	−0.077	0.040	−0.182	0.065
S.D. of Career Match Quality, σ_θ	0.188	0.010	0.054	0.013
S.D. of Employer Match Quality, σ_ξ	0.238	0.007	0.267	0.010
S.D. of iid Shocks, σ_ε	0.240	0.001	0.264	0.001

is not statistically significant. Interestingly, the returns to general experience of college graduates are substantially larger than those of high school graduates, but their returns to employer tenure are almost zero. This significant difference in human capital transferability across careers and firms suggests that the nature of career is very different between high school graduates and college graduates.

Previous papers, including Parent (2000), Kambourov and Manovskii (2007), and Pavan (2006) also estimate the returns to career experience and employer tenure. The results across these papers and this paper cannot be directly compared because all of them use different data, variable definitions, and estimation strategies. Nevertheless, I find it useful to clarify what is common across these papers and what is new in this paper. First I discuss the returns to employer tenure. Parent (2000) and Kambourov and Manovskii (2007) find no return to tenure, while Pavan (2006) find a positive (4% in five years) return. This paper shows that it is 7% for high school graduates and 0% for college graduates. Notice that only the estimates by Kambourov and Manovskii (2007) are from the PSID. This paper and Pavan (2006) use a structural approach and find a positive return to employer tenure, while Parent (2000) and Kambourov and Manovskii (2007) estimate the model by the instrumental variable method. However, all the results are largely consistent with each other in that the estimated return to employer tenure is much lower than that reported by Topel (1991), which is 25% for ten-year tenure, once career-specific experience is controlled.

Second, I examine the returns to career-specific experience. Parent (2000) reports that five years of continuous industry experience increases the logwage by 0.15. Kambourov and Manovskii (2007) use the PSID and find that five years of occupation-specific experience increases the logwage by between 0.12 and 0.20. Pavan (2006) estimates the return to five-year career experience is about 0.05. I find that five years of continuous career-specific experience increases the logwage of high school graduates by 0.11 and that of college graduates by 0.12. My results are in comparable

Table 5: Cumulative Returns to Experiences (High school)

	2 Years		5 Years		8 Years	
	Estimates	Std. Dev.	Estimates	Std. Dev.	Estimates	Std. Dev.
General Experience	0.035	0.009	0.069	0.018	0.082	0.022
Career Specific Experience	0.049	0.010	0.112	0.020	0.164	0.025
Employer Tenure	0.034	0.008	0.074	0.016	0.099	0.019

Table 6: Cumulative Returns to Experiences (College)

	2 Years		5 Years		8 Years	
	Estimates	Std. Dev.	Estimates	Std. Dev.	Estimates	Std. Dev.
General Experience	0.070	0.016	0.161	0.032	0.235	0.039
Career Specific Experience	0.049	0.018	0.118	0.035	0.183	0.042
Employer Tenure	0.022	0.013	0.028	0.025	0.002	0.030

scale to those of Parent (2000) and Kambourov and Manovskii (2007), but only Pavan (2006) reports a small return. Pavan (2006) assumes that career skills grow stochastically with a linear drift for computational tractability. Consequently, the logwage growth shows a convex profile within a career and he reports the return to ten-year career experience is 0.13. My results and the other two papers find a concave profile along a career spell. While not all papers agree with the magnitude of the returns, the bottom line is that the career-specific experience substantially increases the wage, and its effects are stronger than the employer tenure.

The different nature of careers between high school graduates and college graduates is also reflected in the dispersion of match-quality distributions. The estimated standard deviation of career-match quality is 0.19 for high school graduates and 0.05 for college graduates, which implies that college graduates benefit less from career search than high school graduates. On the other hand, the estimated standard deviations of employer-match quality are of a similar magnitude between the two. They are 0.24 for high school graduates and 0.27 for college graduates. This result suggests that college graduates learn about their future careers before they enter to the labor market, while high school graduates learn about careers by experiencing different jobs.

The parameter estimates for the utility function are presented in table 7. The intercepts for both education groups are significantly positive. The coefficient for being married is significantly negative for college graduates, while it is negative but insignificant for high school graduates. Income from a wife reduces the monetary incentive for a husband. The coefficients for having children are significantly positive for both education groups. In contrast to the income effect of a wife, children increase work incentives.

Table 8 presents the parameter estimates for the entry cost function. For both education groups, the entry cost to a new employer within the same career is higher than the entry cost to a new career, regardless of current employment status. When an individual enters a new career, he searches for a job across occupations and industries. So, he has a number of potential employers across the labor market. However, if he looks for a job within the same career, he has fewer potential employers

Table 7: Utility Function

	High School		College	
	Estimates	Std. Dev.	Estimates	Std. Dev.
Intercept, α_0	0.102	0.022	0.134	0.035
Married, α_M	−0.008	0.019	−0.031	0.017
Has Children, α_K	0.047	0.019	0.055	0.017
Type 2, $\alpha_{0,r=2}$	0.110	0.012	0.084	0.019
Type 3, $\alpha_{0,r=3}$	0.015	0.010	0.058	0.017
Type 4, $\alpha_{0,r=4}$	0.066	0.010	0.025	0.018

Table 8: Cost Function

	High School		College	
	Estimates	Std. Dev.	Estimates	Std. Dev.
New Employer (for the employed), $\gamma_{e,e}$	1.857	0.128	1.268	0.233
New Career (for the employed), $\gamma_{e,c}$	1.406	0.138	1.162	0.280
New Employer (for the unemployed), $\gamma_{u,e}$	2.929	0.204	2.424	0.392
New Career (for the unemployed), $\gamma_{u,c}$	1.586	0.148	1.559	0.315
Married, γ_M	0.177	0.100	0.102	0.155
Has Children, γ_K	0.030	0.110	0.170	0.187
Type 2, $\gamma_{0,r=2}$	−0.723	0.143	0.099	0.260
Type 3, $\gamma_{0,r=3}$	0.246	0.207	0.268	0.258
Type 4, $\gamma_{0,r=4}$	−1.329	0.148	−0.380	0.258

because he stays in a subset of the labor market. In other words, job search is more restrictive when an individual changes jobs within the same career. Even though a within-career job change is costly, he may transfer his career-specific skills and good match quality to the next job. When an individual moves to a new career, he pays a lower cost, but loses career-specific skills and match quality. The new career match quality can be worse than the current one. Being married and having children increase the cost of entering a new job, which is quite intuitive.

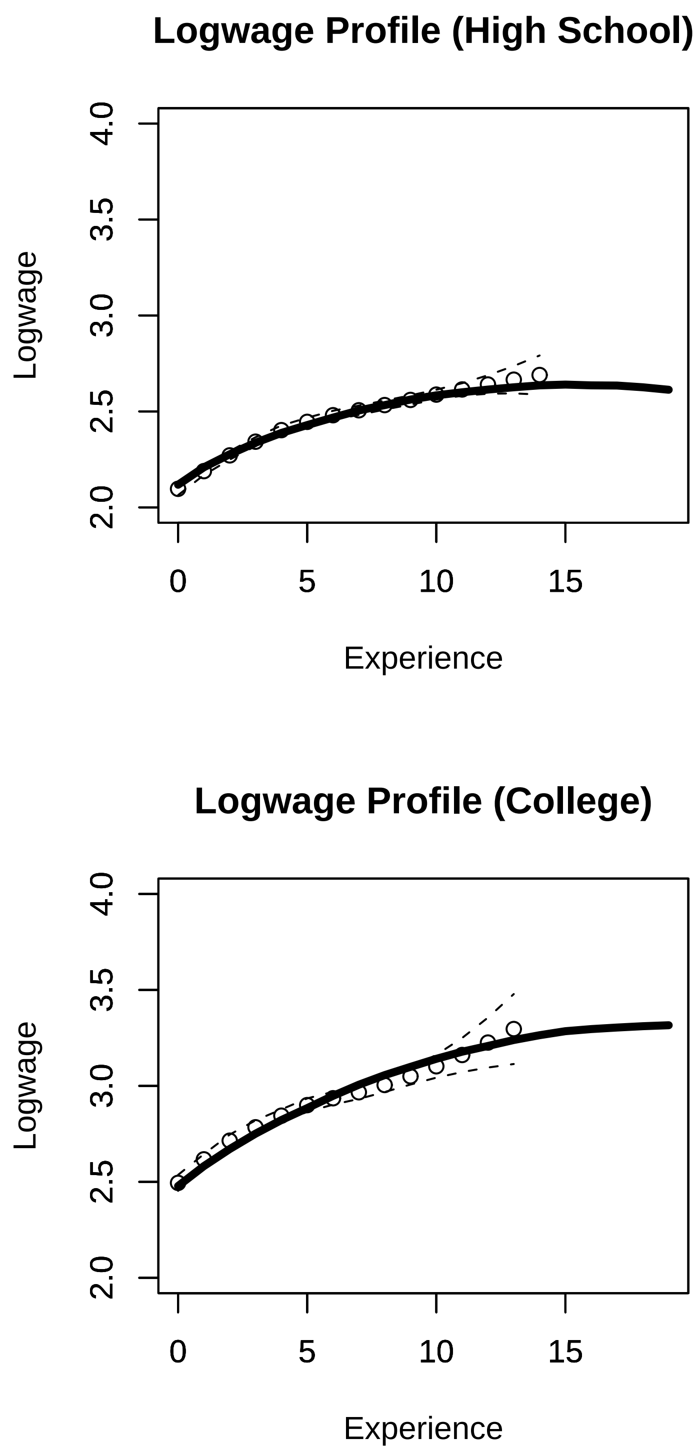
Notice that the entry costs of college graduates are lower than those of high school graduates. This implies that the low job mobility of college graduates (see table 1 and table 2) are driven not by the direct mobility cost, but by the opportunity cost of losing accumulated skills and match qualities. In particular, high returns to career experience for college graduates explain their high proportion of within-career employer changes.

Table 9: Type Weight

	High School		College	
	Estimates	Std. Dev.	Estimates	Std. Dev.
$\pi_{r=2}$	0.226	0.027	0.170	0.031
$\pi_{r=3}$	0.134	0.030	0.494	0.042
$\pi_{r=4}$	0.431	0.040	0.275	0.037

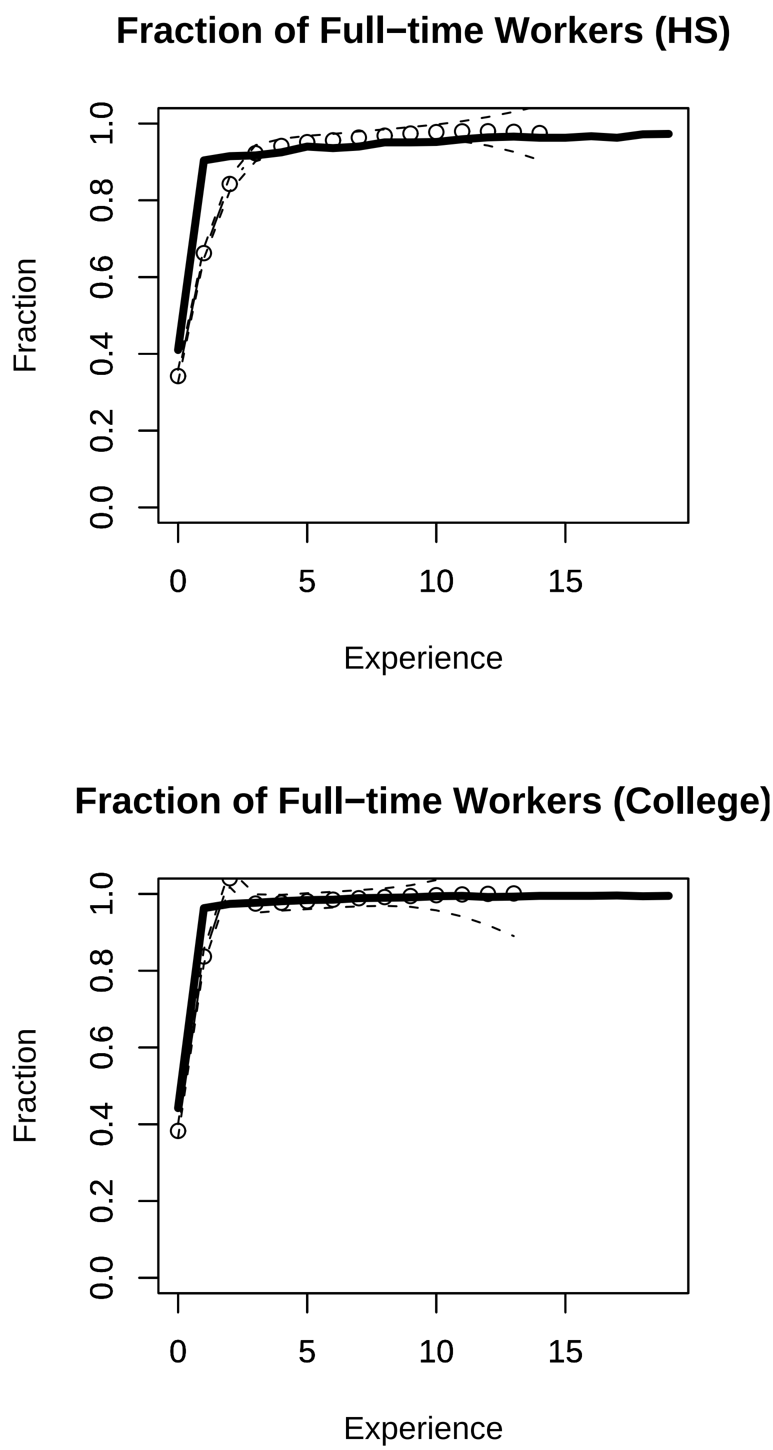
4.1 Model Fit

This subsection presents evidence on how well the model is able to fit several aspects of the data. Figure 1 presents logwage-experience profiles. As seen, the model fit for the wage profile is pretty good. The model fit for the fraction of working individuals is shown in figure 2. The model fit for this dimension of the data is also good for both education groups, although the prediction in the first couple of years is slightly higher than the data. Figure 3 through 6 present the choice distribution of working individuals. The model replicates the upward trend of the probability of staying with the same employer. However, the probabilities are underestimated for both education groups, particularly for those who have five years or more experience. The model fit for the probability that individuals change employers within the same career is presented in figure 4. The model shows a good fit to this aspect of the data. Figure 5 shows the model fit for career change probability. The model reproduces the downward trend of career change probability, but the predictions are higher for those who have five years or more experience for both education groups. Figure 6 plots the probability that individuals choose not to work. Except for the high school graduates who have no work experience, the model fits the data very well. The key feature of the data, the upward trend in within-career employer change, is presented in figure 7. The model is not expected to fit the data year by year, because the observed trend is noisy due to the small sample size. As seen, the model generates an upward trend for both education groups. The predictions seem to be lower than the data for high school graduates who have five years of experience or more, but the model shows a steady increase in experience. The model fit for college graduates seems to be good.



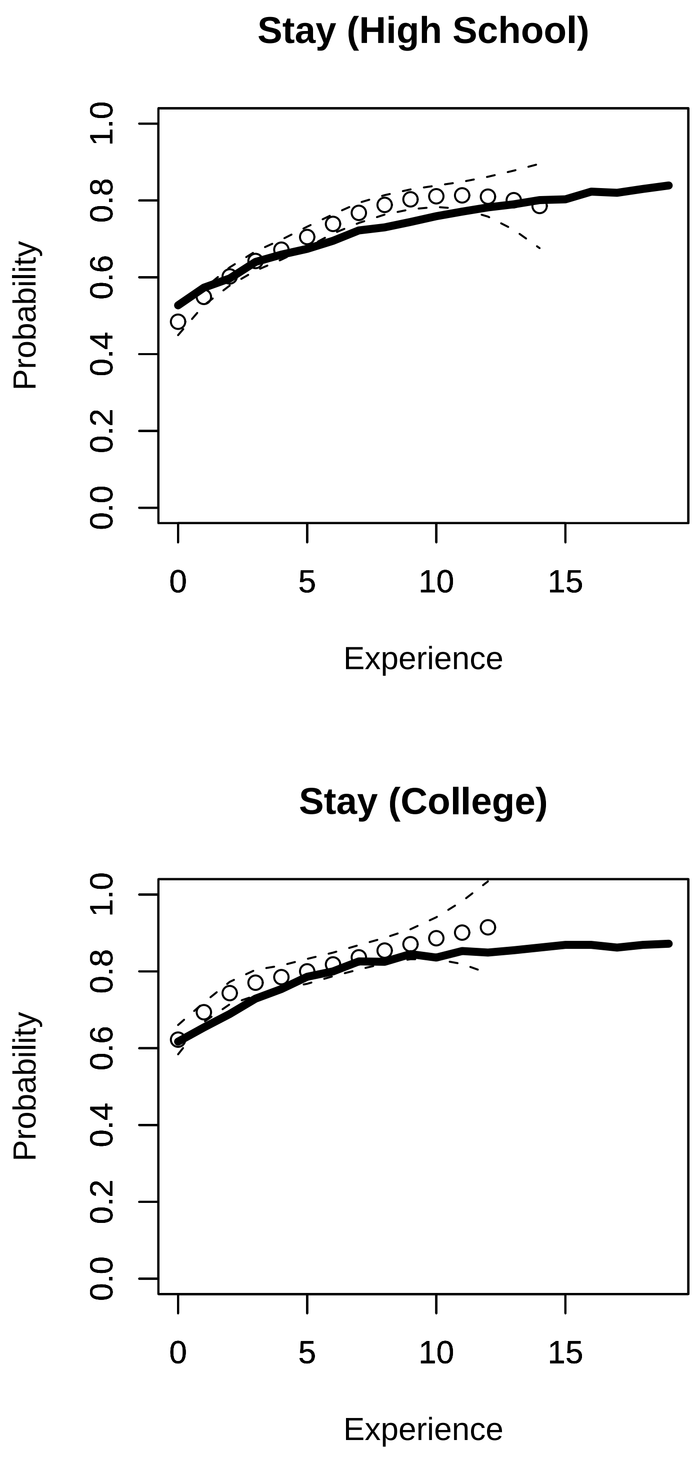
Note: Dots are smoothed data plots by local polynomial regression and dashed lines present the 95% confidence interval. The thick solid line is the model prediction.

Figure 1: Logwage Profile



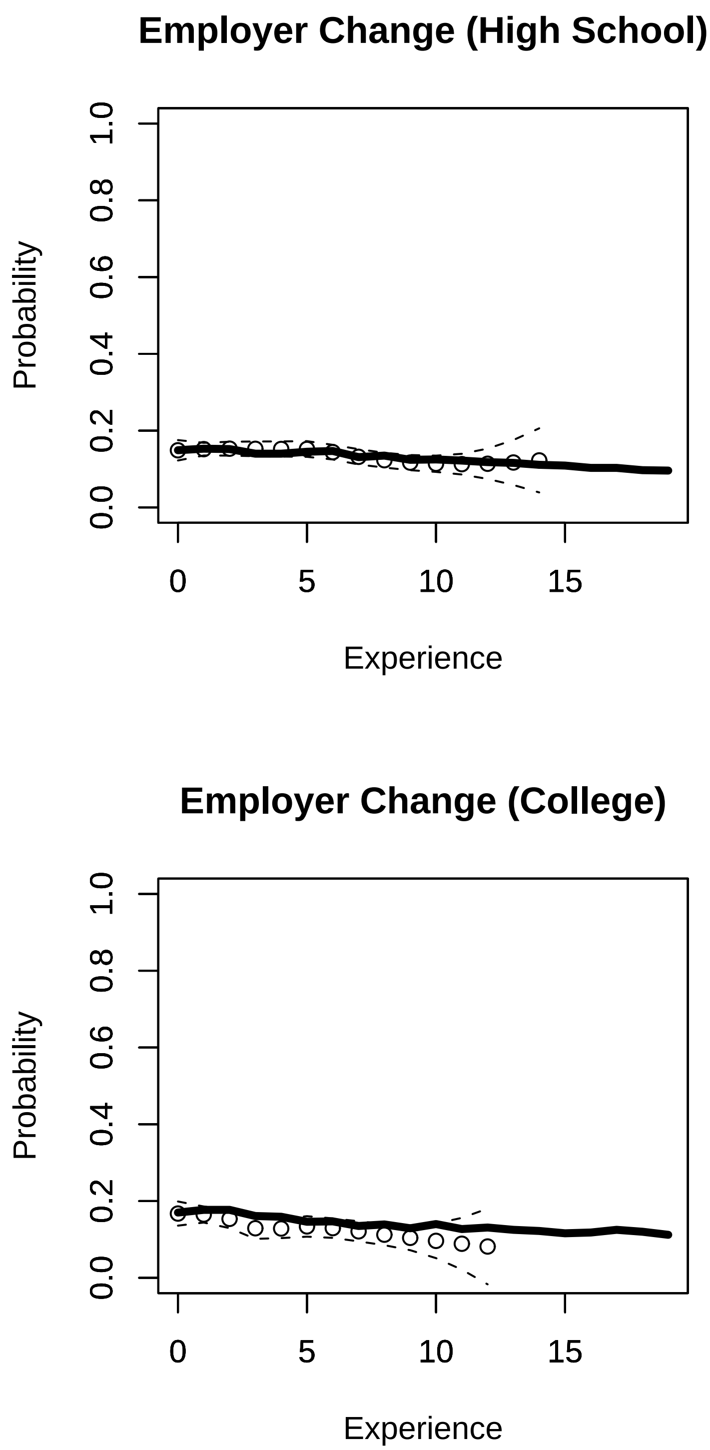
Note: Dots are smoothed data plots by local polynomial regression and dashed lines present the 95% confidence interval. The thick solid line is the model prediction.

Figure 2: Fraction of Working Individuals



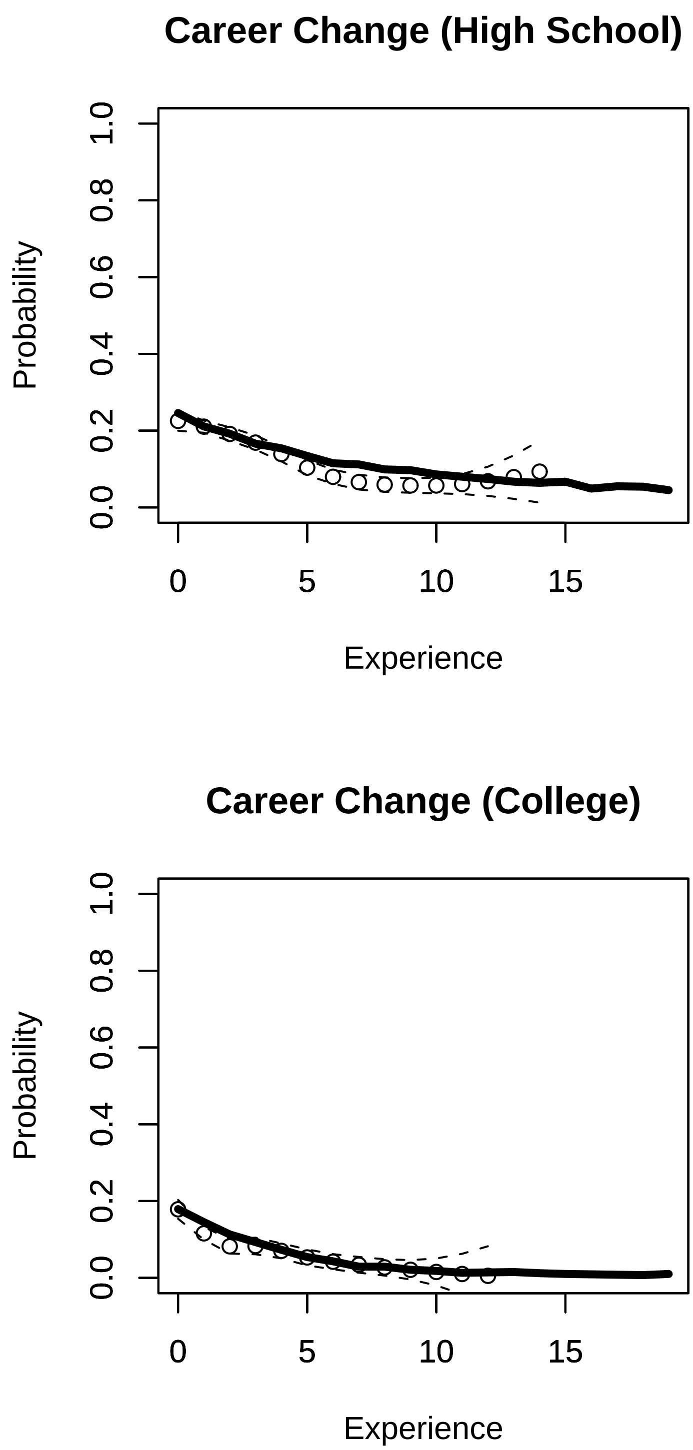
Note: Dots are smoothed data plots by local polynomial regression and dashed lines present the 95% confidence interval. The thick solid line is the model prediction.

Figure 3: The Probability of Staying with the Same Employer



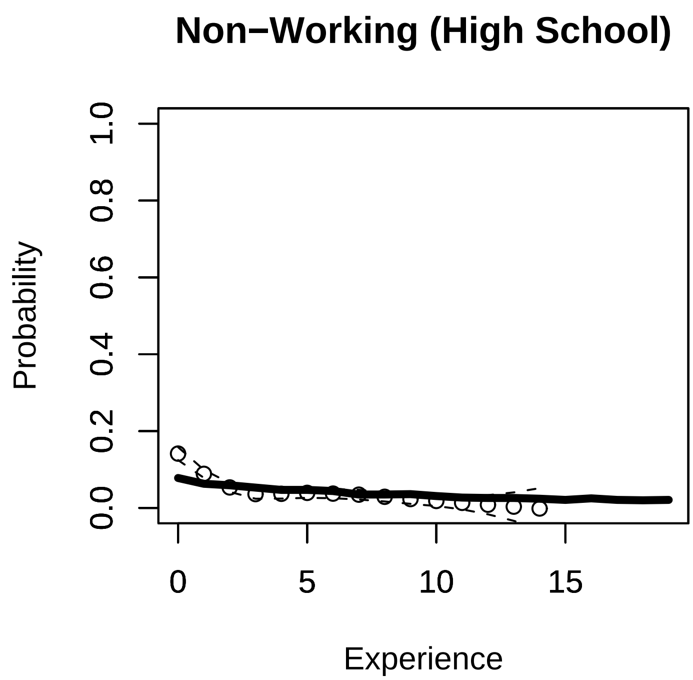
Note: Dots are the data plot and dashed lines present the 95% confidence interval. The thick solid line is the model prediction.

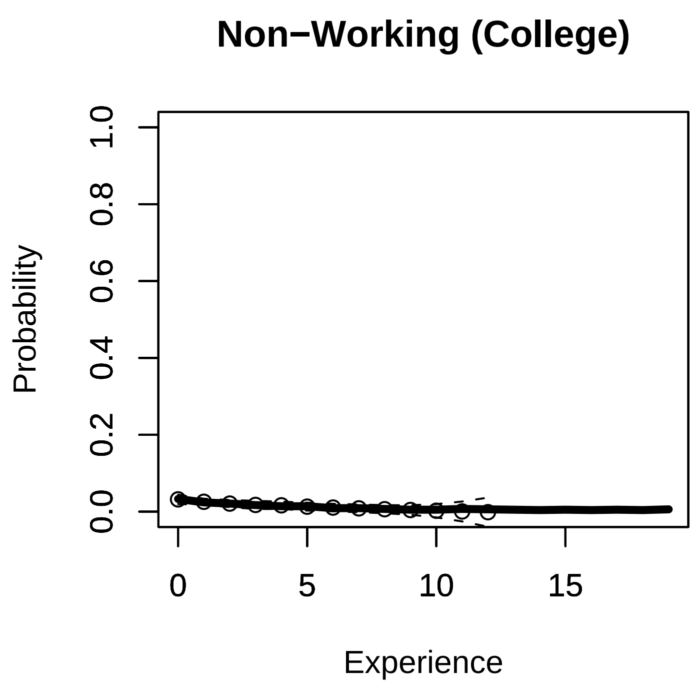
Figure 4: The Probability of Employer Change within the Same Career



Note: Dots are smoothed data plots by local polynomial regression and dashed lines present the 95% confidence interval. The thick solid line is the model prediction.

Figure 5: The Probability of Career Change





Note: Dots are smoothed data plots by local polynomial regression and dashed lines present the 95% confidence interval. The thick solid line is the model prediction.

Figure 6: The Probability of Non-Working

Note: Dots are smoothed data plots by local polynomial regression and dashed lines present the 95% confidence interval. The thick solid line is the model prediction. Only those who worked for two consecutive years are included.

Figure 7: The Fraction of Employer Change within Career (given any job change.)

5 Discussion

5.1 Wage Growth Decomposition

The parameter estimates are used for a simulation to evaluate the contributions of experiences and match qualities to the wage growth rate. Because the logwage is linearly separable, the contribution to the wage growth rate is measured by the logwage difference from the initial one. The decomposition results are presented for each education group in table 10. Wages of high school graduates grow by about 47%, while wages of college graduates grow by about 67% during their first ten years in the labor market. These predicted wage growth rates are consistent with the findings by Weiss and Rubinstein (2005) across different data sets including the NLSY.

For high school graduates, the contributions from match quality upgrading account for about half of the wage growth during the first ten years. They are greater than the contributions from career-specific experience and tenure that account for about a third of the wage growth. The remaining 17% is explained by the effect of general work experience. The simulation results suggest that both career and employer search are important for high school graduates to increase their wages.

For college graduates, general experience is by far the most important factor for wage growth. It accounts for about 40% of the wage growth during the first ten years. The effects of match quality and specific experiences are very different between career level and employer level. The cumulative contribution of career-match quality is as small as 2% for the first ten years, while the contribution of employer-match quality is 18%, which accounts for about a quarter of the wage growth rate in the first ten years. In contrast, wages grow by 18% because of career-specific experience, while employer tenure contributes little to wage growth. The small contribution of career match quality upgrading for college graduates suggests that college education provides useful information for career building. College graduates learn about their comparative advantage and their suitable careers while they are in school. They enter the labor market with a good match quality from the outset, and thus, career-match quality does not grow very much over time. However, college education does not provide information about what particular employer has a good match with each individual. College graduates, as well as high school graduates, have to find a good employer through trial and error.

5.2 Career Mobility

This subsection studies the effects of specific experiences and matching on career mobility. Searching for a better match quality is one of the important motivations of employer and career changes as shown by the basic model described in subsection 2.1. But the returns to career-specific experience

Table 10: Wage Growth Decomposition by Years of General Experience.

	High School			College		
	3 years	5 years	10 years	3 years	5 years	10 years
General Exp.	0.048	0.069	0.080	0.103	0.161	0.274
Career Exp.	0.047	0.072	0.126	0.056	0.090	0.183
Career Match	0.056	0.078	0.113	0.011	0.015	0.020
Employer Ten.	0.020	0.029	0.046	0.015	0.018	0.007
Employer Match	0.052	0.068	0.105	0.090	0.123	0.181
Total	0.223	0.316	0.470	0.275	0.407	0.665

Note: The cumulative contributions to wage growth are decomposed into five factors. The growth rate is measured by logwage difference from the first year logwage.

and employer tenure may also have substantial effects on mobility decisions. The estimation results indicate that the returns to career-specific experience are large for both high school graduates and college graduates. These results imply that individuals prefer a within-career employer change to across-career employer change because they want to avoid a loss of career-specific human capital.

To evaluate the relative effects of specific experiences and match qualities on career mobility, the model is simulated under four different assumptions. In the first simulation, all parameters are set to the estimated value. This simulation result is referred to as the benchmark case result. In the second simulation, the returns to career-specific experience and employer tenure are set to zero by setting coefficients for specific experience and tenure zero. In this simulation, the match qualities are the only driving force of increasing fraction of within-career employer change. In the third simulation, match qualities do not change over time, which is implemented by setting the variances of match qualities zero. In the fourth simulation, the effects of both specific experiences and match qualities are turned off.

The simulation results for the employer change rate are presented in table 11. In the benchmark case, employer change rates decrease with years of experience for both education groups. If both specific experience and match quality are removed from the model as in the fourth simulation, the employer change rates are increased and they present little downward trend. The remaining small trend of the employer change rate is due to the fact that more and more individuals get married and have children over time, which increases the cost of employer change. For both high school graduates and college graduates, specific experiences are more important than match qualities in accounting for the employer change rate. The rates are closer to the benchmark case result when specific experiences are included. However, neither specific experiences nor match qualities alone explain the entire employer change rate. The joint effect of these two is found to be important.

The simulation results for the fraction of within-career employer change are presented in table 12. For high school graduates, specific experiences generate a higher fraction of within-career employer change, but the joint effect is also important. In contrast, for college graduates, specific experiences explain the most of the fractions. This is consistent with the result above that the

Table 11: Employer Change Rate by Years of General Experience

	High School			College		
	3 years	5 years	10 years	3 years	5 years	10 years
Experience and Matching	0.324	0.293	0.217	0.259	0.203	0.159
Matching Only	0.383	0.383	0.352	0.314	0.277	0.236
Experience Only	0.361	0.349	0.315	0.265	0.236	0.219
None	0.409	0.409	0.398	0.333	0.325	0.320

Table 12: The Fraction of Within-Career Employer Change by Years of General Experience

	High School			College		
	3 years	5 years	10 years	3 years	5 years	10 years
Experience and Matching	0.457	0.520	0.593	0.634	0.731	0.885
Matching Only	0.407	0.405	0.424	0.485	0.482	0.491
Experience Only	0.456	0.457	0.495	0.673	0.717	0.870
None	0.383	0.394	0.409	0.459	0.482	0.481

Note: The model is simulated under four different assumptions. The results in the first row are from the simulation of the estimated model, i.e., the effects of both specific experiences and match quality on employer are incorporated. In the second simulation (see the results in the second row) the returns to specific experience including employer tenure are set to zero with all other parameters remain the same as the benchmark simulation. In the third simulation, all career- and employer-match qualities are homogeneous. In the fourth simulation, both of the two are shut off.

contribution of career match to wage is small, while that of career-specific experience is large.

6 Conclusion

This paper constructs and estimates a structural model of career decisions in which workers search for both career matching and employer matching. The model departs from previous contributions in that it incorporates career mobility decisions and participation decisions, as well as the wage function. The simulation evidence shows that the model is flexible enough to fit some interesting features of the data from the NLSY.

The estimation results indicate that wage growth patterns and career mobility are quite different between high school graduates and college graduates, an aspect to which the wage growth literature has given scant attention. I find that human capital is more transferable across careers and employers for college graduates than high school graduates. The returns to general experience for college graduates are more than twice as high as those for high school graduates. However, employer tenure little increases college graduates' wage, while high school graduates receive substantial returns to tenure. Another interesting finding is that career match quality upgrading during the first ten years in the labor market increases college graduates' wages by only 2%, which is considerably smaller than that for high school graduates (11%). Consequently, college graduates are less likely to search for jobs across careers than high school graduates. One interpretation of this finding is that college graduates learn about their future careers before they enter a labor market, while high school graduates learn about careers by experiencing different jobs. These results suggest that accounting for the different nature of careers across education groups is important to understand wage growth and career decisions of workers.

Some interesting questions remain unanswered. First, the effects of education on career choice are not assessed in this paper. Because education is treated as exogenous, causality of education for career and wage is not identified, although this paper finds a strong correlation. Second, skill difference across careers is not studied. The result suggests that tasks and skills are very different across careers. Although this paper studies skill progression within a career and separation from it, the choice among different careers and skill progression across careers are ignored. These interesting questions will be answered by future researches.

A Tables

Table 13: Transition Probability Estimation for Marital Status

	High School		College	
	Estimates	Std. Dev.	Estimates	Std. Dev.
Intercept	−1.635	2.087E−03	−2.154	5.726E−03
Age-17	2.592	2.724E−02	4.207	1.312E−01
Lagged Marital Status	0.252	1.470E−01	−0.804	1.757E+00
Lagged Children	0.037	2.146E−05	0.078	4.697E−05
Lagged Marital Status * (Age-17)	0.111	1.931E−01	0.074	2.087E+00
Lagged Children * (Age-17)	0.011	2.234E−04	−0.084	7.683E−04
Lagged Marital Status * Lagged Children	−0.016	8.290E−04	0.065	9.457E−03
Lagged Marital Status * Lagged Children * (Age-17)	−0.009	1.151E−03	0.005	1.124E−02

Note: The dependent variable is an indicator variable that takes one if an individual is married and takes zero otherwise.

Table 14: Transition Probability Estimation for Children.

	High School		College	
	Estimates	Std. Dev.	Estimates	Std. Dev.
Intercept	−2.184	4.116E−03	−3.061	2.894E−02
Age-17	1.865	1.779E−02	1.768	6.412E−02
Lagged Marital Status	2.042	9.344E−02	1.502	5.461E−01
Lagged Children	0.045	3.842E−05	0.067	2.081E−04
Lagged Marital Status * (Age-17)	−0.669	1.271E−01	1.418	8.138E−01
Lagged Children * (Age-17)	−0.082	1.397E−04	−0.035	4.073E−04
Lagged Marital Status * Lagged Children	0.034	5.927E−04	0.086	4.438E−03
Lagged Marital Status * Lagged Children * (Age-17)	0.047	8.150E−04	−0.077	5.795E−03

Note: The dependent variable is an indicator variable that takes one if an individual has a child in the household and takes zero otherwise.

B Additional Results

The results for an expanded college graduate sample are reported in the following. This expanded sample includes those who went to graduate school right after completing undergraduate study, in addition to all individuals in the main college graduate sample. The sample size is 570. As seen below, the results are not quite different from those of the main sample.

Table 15: Summary Statistics for College Graduates

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	Nobs
Age	21.00	24.00	26.00	26.59	29.00	35.00	3933
General Experience	0.00	0.00	2.00	2.73	5.00	13.00	3933
Career Experience	0.00	0.00	1.00	2.33	4.00	13.00	3933
Employer Tenure	0.00	0.00	0.00	1.51	2.00	12.00	3933
Employers per Individual	1.00	1.00	2.00	2.25	3.00	8.00	570
Careers per Individual	1.00	1.00	1.00	1.46	2.00	7.00	570
Employers within Career per Individual	0.00	0.00	0.00	0.79	1.00	5.00	570
Years Surveyed per Individuals	1.00	3.00	7.00	6.90	10.00	15.00	570
Job Change Rate	0.00	0.00	0.00	0.22	0.00	1.00	2978
Career Change Rate	0.00	0.00	0.00	0.08	0.00	1.00	2978
Wage (2000 CPI)	1.04	12.12	17.03	18.44	22.34	98.24	3414
Married (at age 30)	0.00	0.00	1.00	0.65	1.00	1.00	269
Has Children (at age 30)	0.00	0.00	0.00	0.43	1.00	1.00	269

Table 16: Wage Equation

	Estimates	Std. Dev.
Intercept (Type 1)	1.747	0.080
Intercept (Type 2)	2.184	0.039
Intercept (Type 3)	2.590	0.037
Intercept (Type 4)	2.967	0.043
GX	0.046	0.009
CX	0.019	0.009
FX	0.015	0.007
$GX^2/100$	-0.193	0.068
$CX^2/100$	0.037	0.060
$FX^2/100$	-0.158	0.060
S.D. of Career Match Quality, σ_θ	0.064	0.012
S.D. of Employer Match Quality, σ_ξ	0.270	0.009
S.D. of iid Shocks, σ_ε	0.262	0.001

Table 17: Cumulative Returns to Experiences (College)

	2 Years		5 Years		8 Years	
	Estimates	Std. Dev.	Estimates	Std. Dev.	Estimates	Std. Dev.
General Experience	0.084	0.016	0.182	0.030	0.244	0.037
Career Specific Experience	0.039	0.016	0.103	0.033	0.173	0.040
Employer Tenure	0.023	0.012	0.034	0.023	0.017	0.027

Table 18: Utility Function

	Estimates	Std. Dev.
Intercept, α_0	0.143	0.037
Married, α_M	-0.035	0.016
Has Children, α_K	0.053	0.016
Type 2, $\alpha_{0,r=2}$	0.083	0.020
Type 3, $\alpha_{0,r=3}$	0.058	0.018
Type 4, $\alpha_{0,r=4}$	0.024	0.019

Table 19: Cost Function

	Estimates	Std. Dev.
New Employer (for the employed), $\gamma_{e,e}$	1.293	0.227
New Career (for the employed), $\gamma_{e,c}$	1.199	0.270
New Employer (for the unemployed), $\gamma_{u,e}$	2.829	0.374
New Career (for the unemployed), $\gamma_{u,c}$	1.656	0.308
Married, γ_M	0.232	0.146
Has Children, γ_K	0.089	0.174
Type 2, $\gamma_{0,r=2}$	-0.004	0.249
Type 3, $\gamma_{0,r=3}$	0.213	0.248
Type 4, $\gamma_{0,r=4}$	-0.365	0.254

Table 20: Type Weight

	Estimates	Std. Dev.
$\pi_{r=2}$	0.157	0.027
$\pi_{r=3}$	0.502	0.039
$\pi_{r=4}$	0.272	0.035

References

ALTONJI, J. G., AND R. A. SHAKOTKO (1987): “Do wages Rise with Job Seniority?,” *Review of Economic Studies*.

ALTONJI, J. G., AND N. WILLIAMS (2005): “Do Wages Rise With Job Seniority? A Reassesment,” *Industrial and Labor Relations Review*, 58(3), 370–97.

ARCIDIACONO, P. (2004): “Abilitysorting and the returns to college major,” *Journal of Econometrics*, 121, 343–375.

JOY, L. (2006): “Occupational differences between recent male and female college graduates,” *Economics of Education Review*.

KAMBOUROV, G., AND I. MANOVSKII (2007): “Occupational Specificity of Human Capital,” University of Toronto.

KEANE, M. P., AND K. I. WOLPIN (1997): “The Career Decisions of Young Men,” *Journal of Political Economy*, 105(3), 473–522.

NEAL, D. (1995): “Industry-Specific Human Capital: Evidence from Displaced Workers,” *Journal of Labor Economics*, 13, 653–77.

——— (1999): “The Complexity of Job Mobility among Young Men,” *Journal of Labor Economics*, 17, 237–61.

PAGLIN, M., AND A. M. RUFOLO (1990): “Heterogeneous Human Capital, Occupational Choice, and Male-Female Earnings Differences,” *Journal of Labor Economics*.

PARENT, D. (2000): “Industry-Specific Capital and the Wage Profile: Evidence from the National Longitudinal Survey of Youth and the Panel Study of Income Dynamics,” *Journal of Labor Economics*, 18, 306–21.

PAVAN, R. (2006): “Career Choice and Wage Growth,” University of Rochester.

TOPEL, R. (1991): “Specific Capital, Mobility, and Wages: Wages Rise with Job Seniority,” *Journal of Political Economy,*.

WEISS, Y., AND Y. RUBINSTEIN (2005): “Post-Schooling Wage Growth: Investment, Search and Learning,” in *Handbook of the Economics of Education*, ed. by E. A. Hanushek, and F. W. (eds.). Elsevier Science Publisher (North-Holland).