Job Mobility and the Market for Lawyers

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This paper studies the life cycle career choices of law school graduates using unique data from the University of Michigan Law School. The model assumes that these graduates act according to the optimal solution of a dynamic optimization problem in which they sequentially choose among five employment sectors. The employment sectors are differentiated by pecuniary and nonpecuniary returns, promotion and dismissal probabilities, and the extent of transferability of human capital. The estimation of the model reveals a self-selection mechanism, based on unobserved heterogeneity in abilities and expected future returns, which plays a critical role in reproducing the sector-specific nonmonotonic separation hazards observed in the data. The underlying self-selection mechanism also has implications for policy interventions in the market for lawyers, such as loan forgiveness programs.

I. Introduction

This paper studies the first job choice and subsequent labor mobility of law school graduates. The model assumes that these individuals behave as though they were solving a finite-horizon, discrete-choice dynamic programming problem under uncertainty. The structural

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parameters of the optimization problem are estimated using unique data on several cohorts of graduates from the University of Michigan Law School. This study contributes to both the specific literature on the market for lawyers and the general literature on job mobility. It contributes to the specific literature by explicitly modeling attorneys' career choices. Attorneys are assumed to make joint and sequential job choice decisions among five employment sectors, which are differentiated by pecuniary and nonpecuniary returns, promotion and dismissal probabilities, and the extent of transferability of human capital. The study's contribution to the general literature is the innovative explanation for the nonmonotonic separation hazards that arise in this particular labor market. It is shown that a self-selection mechanism, based on expected future returns and individual ability type, assumed known to the worker and the employer but not to the researcher, is capable of reproducing the sector-specific nonmonotonic separation hazards observed in the data.

The theoretical framework of the model builds on the work of Weisbrod (1983) and Goddeeris (1988), in which attorneys choose between employment in a nonprofit sector and employment in private law firms, considering both pecuniary and nonpecuniary aspects of the job. From the findings of Spurr (1987), the choice set is expanded by separating private law firms into two distinct sectors, depending on firm size, which may promote or dismiss associates at different rates. Promotion and dismissal in both private law firm sectors are assumed to take place within an up-or-out employment structure, thus integrating the work of Gilson and Mnookin (1989) and O'Flaherty and Siow (1995). The choice set is further expanded by introducing separate business and sole proprietor sectors that may offer low degrees of transferability of human capital. Attorney choices among these sectors take into account future job opportunities and wage offers that depend on endogenously accumulated sector-specific work experience (Eckstein and Wolpin 1989*a*; Wolpin 1992), time since graduation, and attorney ability. This is in contrast to earlier work that has generally not incorporated the future considerations implicit in current job choices.

In order to explain nonmonotonic separation hazards observed in a variety of labor markets, including the market for lawyers, the general literature on job mobility has almost exclusively relied on the theory of job matching (Jovanovic 1979). The job-matching model assumes that productivity (or ability type) is revealed gradually over time to both worker and employer. In this paper, nonmonotonic hazard rates are generated, instead, by way of a self-selection mechanism in which ability types are known by worker and employer at the outset. The self-selection arises since high-ability attorneys

face high future promotion probabilities in the private law firm sectors. As soon as private law firm job offers arrive, high-ability attorneys enter these sectors, in which they have higher expected future earnings. Low-ability attorneys, in contrast, face low probabilities of future promotion, or high probabilities of dismissal, and hence exit the private law firm sectors after a short time. For these latter attorneys, private law firms serve as vehicles to high-paying jobs in other sectors of the market. This self-selection mechanism also has implications for policy interventions in the market for lawyers. To illustrate this, a loan forgiveness program is simulated and shown to have a sustained impact on the supply decisions of only low-ability attorneys.

The structural parameters of the model, which are used to assess model fit and simulate the policy intervention, are recovered by repeatedly solving the dynamic optimization problem and maximizing a likelihood function that reflects choices and wages observed for each attorney over a 15-year period since graduation. For the years in which wages are reported, only the wages in the chosen sectors are known. The solution of the dynamic program serves to correct the accepted wages so that wage function estimates represent wages offered by firms. The model is shown to fit the observed data quite well in several dimensions.

The rest of the paper is organized as follows. Section II describes the data. Section III presents the behavioral model. Section IV contains the estimation results and an evaluation of model fit. In Section V, the implications of the model are discussed in terms of the importance of unobserved heterogeneity in abilities and the effect of a loan forgiveness program. Section VI presents conclusions. The Appendix outlines the solution and estimation method.

II. Data

The University of Michigan Law School has been collecting data from surveying all alumni since 1952. This paper uses data from the surveys sent both 5 and 15 years after graduation to the classes of 1972–75. These classes contain a total of 1,691 individuals, 1,043 (61.7 percent) of whom answered the 15-year survey.[1] The largest subgroup of respondents is 888 white males, and only this subgroup

[1] Emphasis is placed on the 15-year surveys since the 5-year surveys are a less comprehensive source of longitudinal information. Prior to 1972, 15-year surveys were lacking in important details, and the 15-year survey of the class of 1975 was the last available at the time this study began. Wood, Corcoran, and Courant (1993) also used these class years.

is used in estimation.[2] Reasonably accurate 15-year employment histories could be constructed for 693 of these respondents.

Assignments to the different employment sectors in years 1, 5, and 15 after graduation were made first as follows. Sole proprietors were placed in the solo sector. An attorney employed in a Fortune 500 company, bank or other financial institution, accounting firm, insurance firm, other business organization, or other service organization was placed in the business sector.[3] An attorney employed in federal government, state or local government, legal services, public interest, or an educational institution was placed in the nonprofit sector.[4] If an attorney was employed in a private law firm, then a cutoff firm size determined assignment to the nonelite (small private law firm) or elite (large private law firm) sector. In order to account for differential growth in private law firms, the cutoff number of attorneys was allowed to vary over time and geographical location. In year 15, a firm outside of New York with fewer (more) than 100 attorneys and a firm inside New York with fewer (more) than 200 attorneys was considered nonelite (elite). In years 5 and 1, the nonelite/elite cutoffs were 50 and 35, respectively, regardless of location.[5] Private law firm attorneys could also be classified as associates or partners in years 5 and 15.

Completion of the longitudinal record was straightforward for an attorney who reported, on the 15-year survey, one or two jobs held since graduation and the number of years on the current job. If more than two jobs were reported, then the reported number of years spent in government and number of years spent in private practice were generally needed.

Table 1 shows the sectoral choice distribution (actual) over the first 15 years since graduation from law school. Several trends are evident. Only 10 percent of the sample chose first jobs in either

[2] The 83 white female respondents, the next largest subgroup, were not included in the model since a substantial proportion chose home production or part-time work after graduation. Only 10 white males chose these options at some point in their careers.

[3] In year 15, 40.7 percent of business attorneys worked in Fortune 500 companies and 35.1 percent of business attorneys were no longer practicing law. These latter attorneys were included in the sample following the assumption that a law degree was an essential part of their marketability.

[4] In year 15, 78.5 percent of nonprofit attorneys were employed in federal government, state or local government, or legal services; 17.7 percent were employed in education.

[5] The year 5 and 1 cutoffs were selected after examining firm growth rates in the subsample of attorneys who had only one job and were classified as either nonelite or elite according to the 15-year cutoff. Similar cutoffs were used by Kornhauser and Revesz (1995). Similar firm growth rates over this period are reported in Galanter and Palay (1991).

TABLE 1

ACTUAL AND PREDICTED CHOICE DISTRIBUTIONS

Year	Solo	Business	Nonprofit	Nonelite	Elite	χ^2_4
1	.027 (.027)	.071 (.071)	.185 (.185)	.405 (.405)	.312 (.312)	.00
2	.035 (.026)	.069 (.071)	.186 (.180)	.400 (.413)	.310 (.310)	1.07
3	.042 (.024)	.076 (.081)	.175 (.187)	.410 (.401)	.297 (.306)	3.69
4	.052 (.033)	.092 (.095)	.162 (.182)	.405 (.401)	.289 (.289)	3.74
5	.062 (.048)	.104 (.108)	.149 (.170)	.411 (.406)	.274 (.268)	2.47
6	.068 (.055)	.110 (.113)	.149 (.163)	.417 (.418)	.257 (.251)	1.49
7	.069 (.059)	.113 (.120)	.141 (.147)	.421 (.434)	.255 (.240)	1.28
8	.072 (.064)	.124 (.123)	.134 (.137)	.427 (.442)	.242 (.235)	.65
9	.071 (.066)	.131 (.126)	.133 (.127)	.426 (.453)	.240 (.228)	1.06
10	.069 (.074)	.137 (.126)	.128 (.117)	.433 (.459)	.232 (.225)	1.42
11	.072 (.078)	.141 (.131)	.124 (.108)	.436 (.459)	.227 (.224)	1.59
12	.075 (.079)	.147 (.131)	.124 (.108)	.429 (.454)	.225 (.227)	2.00
13	.078 (.082)	.149 (.134)	.120 (.105)	.429 (.450)	.225 (.228)	1.62
14	.079 (.085)	.154 (.138)	.118 (.097)	.426 (.452)	.222 (.228)	2.83
15	.081 (.088)	.156 (.153)	.114 (.091)	.426 (.443)	.224 (.225)	2.28
χ^2_{14}	9.41	2.23	8.50	1.79	.84	

NOTE.—Figures are actual and predicted row percentages for 693 attorneys in each year. Predicted row percentages are in parentheses. The critical values are $\chi^2_4(0.05) = 9.49$ and $\chi^2_{14}(0.05) = 23.68$. There are no statistically significant differences.

the solo or business sector, but the proportion steadily grows over time to 25 percent. The nonprofit sector contains 18 percent of new graduates, with the proportion steadily declining to 11 percent.[6] The nonelite and elite sectors in year 1 contain 72 percent of the sample. The combined proportion subsequently declines to 65 percent, whereas the proportion in the nonelite sector slightly increases.

Table 2 presents the transition matrix (actual), which aggregates sectoral transitions.[7] The figures indicate a high degree of persistence in all sectors but the nonprofit sector. The most common destination of exiting nonprofit attorneys is the nonelite sector, and transitions into the elite sector most likely originate from the nonprofit sector.

Figures 1–3 display sector-specific hazard functions (actual), which are nonparametric estimates of the probability that an attor-

[6] The higher proportion of first-job entrants in the nonprofit sector as well as the declining proportion over time is not due to temporary judicial clerkships. In year 1 after graduation, clerks were assigned to their first job sector after completing their clerkship. Less than 10 percent of the sample obtained clerkships, and over 80 percent joined private law firms on their completion. So as not to contaminate sector-specific wage offer functions, the reported salaries of clerks are ignored (Wood et al. 1993).

[7] The matrix does not aggregate transitions period by period for each attorney. The diagonals represent the number of attorneys who never switched sectors. Only 16 attorneys switched sectors more than once.

TABLE 2

ACTUAL AND PREDICTED TRANSITION MATRICES

	SECTOR *j*					
SECTOR *i*	Solo	Business	Nonprofit	Nonelite	Elite	Fisher Exact Test Statistic (Row)
Solo:						
Actual	15	4	0	2	0	
Predicted	16	4	0	0	0	1.70
Business:						
Actual	2	37	2	9	1	
Predicted	0	45	1	4	1	4.92
Nonprofit:						
Actual	15	11	48	46	13	
Predicted	11	9	49	64	15	3.15
Nonelite:						
Actual	27	28	23	209	9	
Predicted	26	20	22	227	8	3.56
Elite:						
Actual	9	30	11	34	134	
Predicted	9	30	11	34	133	.07
Fisher exact test statistic (column)	4.05	2.37	2.22	5.85	.49	

NOTE.—The rows represent the origin and the columns the destination. There are no statistically significant differences.

ney exits his first employment sector at time t conditional on not having left the sector at time $t - 1$.[8] Each hazard function rises to a global peak in the early years after graduation and declines thereafter. The nonprofit and nonelite sector hazard functions peak after 3 years of sectoral tenure. The elite sector hazard function peaks after 4 years.[9]

Table 3 reports average accepted real wages (actual), by position, in the first, fifth, and fifteenth years after graduation.[10] The figures show the highest first-year wages in the business sector and the lowest in the solo sector. In year 15, elite partners earn the most and nonprofit attorneys the least, less than one-third the earnings of elite partners. Standard deviations are generally highest in the solo, business, and partner positions.

[8] The solo and business sector hazard functions are not shown since both of these sectors have few first-year entrants and subsequent exits.

[9] Nonmonotonic hazard functions for private law firms have appeared before in the literature (Spurr 1987; Spurr and Sueyoshi 1994; O'Flaherty and Siow 1995). Hazard rates for other sectors in the market for lawyers (e.g., the nonprofit sector) have not, to this researcher's knowledge, been previously reported.

[10] Annual wages in other years after graduation were not requested on the surveys.

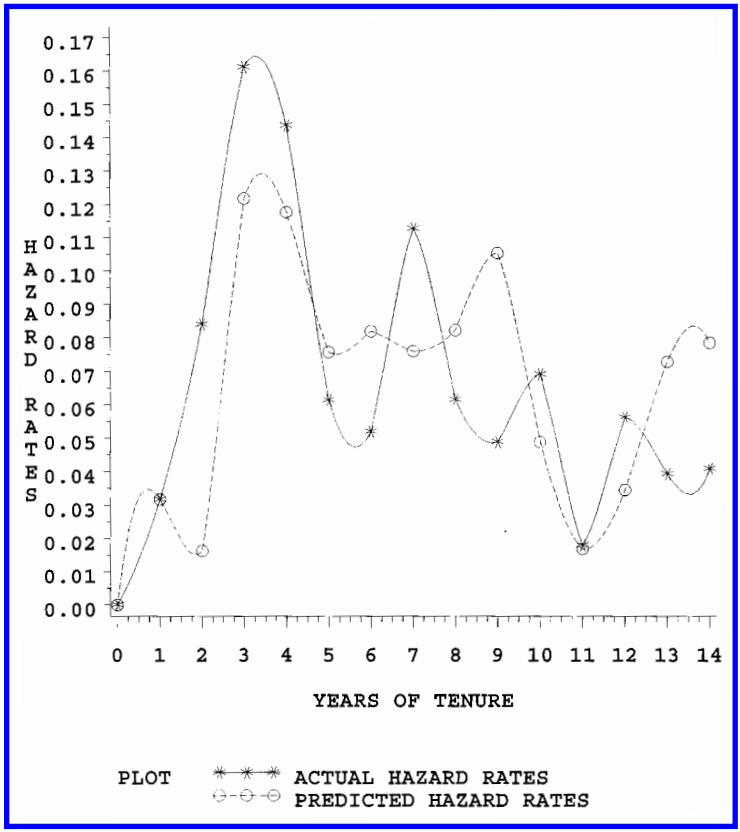

FIG. 1.—Nonprofit sector hazard functions

III. Model

The model of attorney behavior assumes that each attorney, on graduation from law school and until retirement, sequentially chooses among five alternative employment sectors, or seven alternative positions, with the objective of maximizing the expected present discounted value of remaining lifetime wealth, inclusive of the market value of nonpecuniary and indirect compensation benefits. The choice set, denoted as K, contains a solo position ($k = 1$), a business position ($k = 2$), a nonprofit position ($k = 3$), a nonelite associate position ($k = 4$), an elite associate position ($k = 5$), a nonelite partner position ($k = 6$), and an elite partner position ($k = 7$). The choice variable, $d_k(t)$, is defined such that $d_k(t) = 1$ if the attorney chooses position k at time t and $d_k(t) = 0$ otherwise. All seven alternatives, without loss of generality, are mutually exclusive, implying $\sum_{k=1}^{K} d_k(t) = 1$.

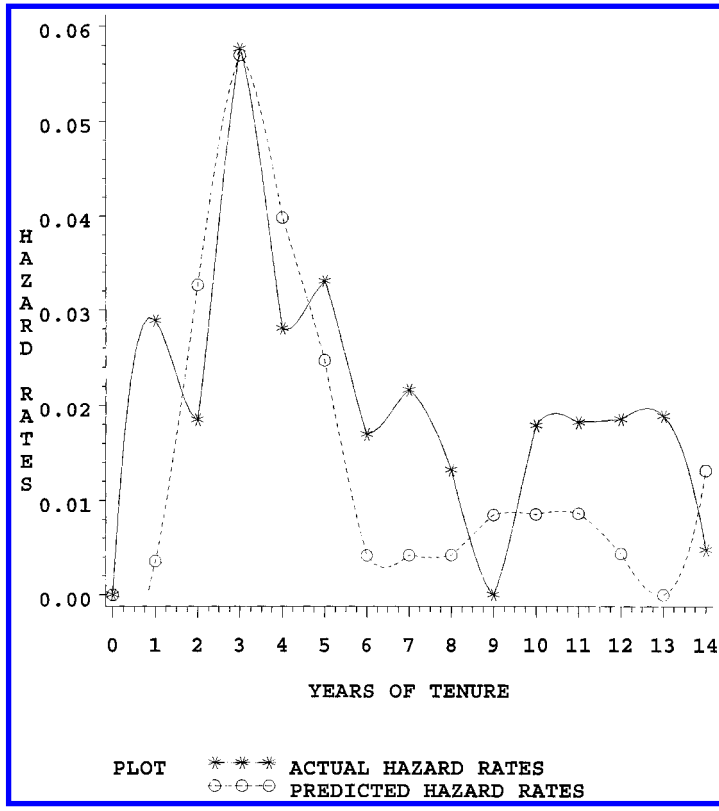

FIG. 2.—Nonelite sector hazard functions

The attorney's optimization problem over the seven choices can be described in terms of a set of alternative-specific value functions, each of which obeys the Bellman equation (Bellman 1957). The value functions for $t \leq T - 1$ and $t = T$ appear, respectively, as

$$V_k(S(t)) = w_{kt}e^{\epsilon_{kt}} + b_k + \delta E\left[\max_{k \in K} [V_k(S(t+1))] \mid S(t), d_k(t) = 1\right], \quad (1)$$

$$V_k(S(T)) = w_{kT}e^{\epsilon_{kT}} + b_k,$$

for $k \in K$, where T is the terminal period and is interpreted as the year of retirement after which the attorney receives retirement benefits,[11] and V_k denotes the expected present discounted value of life-

[11] Time T is assumed to be 35 years after law school graduation. The average age at graduation is 26, with very little variation. Lengthening the horizon to 40 years does not significantly change estimation results.

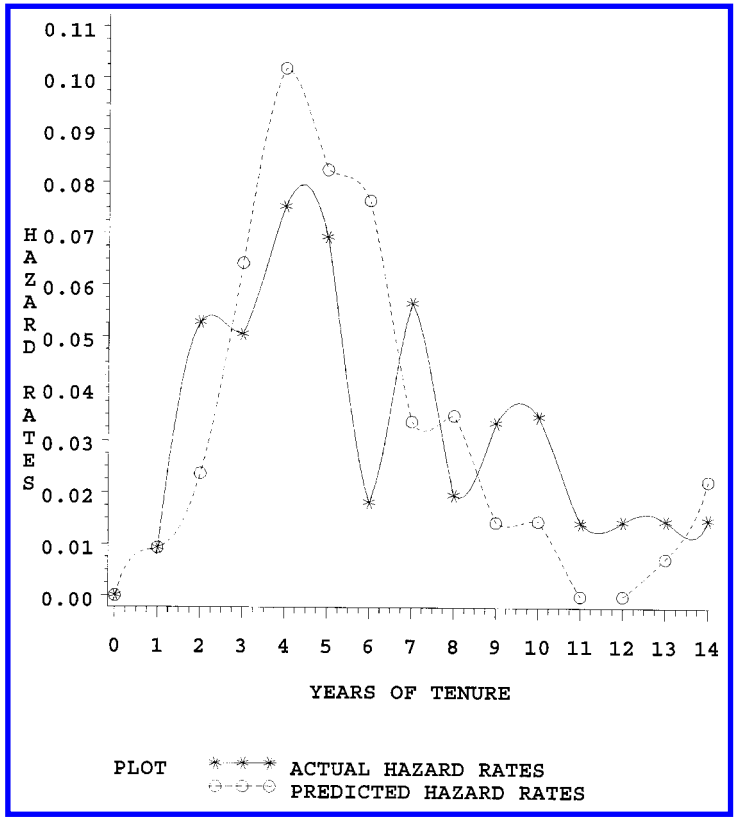

FIG. 3.—Elite sector hazard functions

time wealth in position k given a particular element of the state space, $S(t)$, at time t. The current-period return consists of the deterministic component of the wage offer in position k at time t, w_{kt}, and a time-varying, alternative-specific technology shock, ϵ_{kt}, which enters multiplicatively.[12] Yearly retirement contributions, other deferred or indirect compensation, and the monetary equivalent of nonpecuniary benefits are captured by the b_k's, δ is the discount factor, and future choices are assumed to be made optimally for any given current-period decision.[13]

The state space at time t, consisting of all the factors known to

[12] The wage offer can be viewed as the product of the position-specific equilibrium rental price and the number of position-specific skill units possessed by the attorney (see Roy 1951). The latter depends on the technology of skill production and is subject to shocks. The shocks depend on the vintage of each lawyer rather than on calendar time.

[13] Throughout the analysis, δ is assumed to be .95.

TABLE 3

ACTUAL AND PREDICTED MEAN ACCEPTED WAGES

Position	Year 1		Year 5		Year 15	
Solo:						
Actual	29,793	(12,619)	38,724	(19,640)	76,224	(84,783)
Predicted	30,825	(16,826)	34,545	(19,939)	65,849	(34,625)
Business:						
Actual	38,623	(10,828)	55,845	(15,204)	127,040	(75,684)
Predicted	36,563	(13,082)	50,152	(21,676)	111,788	(47,678)
Nonprofit:						
Actual	32,395	(8,377)	45,950	(9,636)	59,879	(18,004)
Predicted	32,294	(8,654)	39,262	(10,495)	62,604	(15,417)
Nonelite associate:						
Actual	33,366	(7,454)	48,770	(13,162)	65,423	(23,081)
Predicted	32,205	(6,805)	44,112	(10,343)	77,371	(15,763)
Elite associate:						
Actual	37,336	(6,074)	57,771	(11,274)	115,124	(47,087)
Predicted	37,117	(7,926)	56,208	(11,422)	105,752	(15,533)
Nonelite partner:						
Actual			55,191	(13,212)	138,242	(88,881)
Predicted			56,924	(24,397)	133,194	(63,422)
Elite partner:						
Actual			65,873	(12,923)	192,336	(92,936)
Predicted			69,642	(32,313)	170,851	(70,345)

NOTE.—Figures are in 1987 dollars. Standard deviations are in parentheses. $N = 16$, 46, 112, 248, and 194 in year 1, $N = 36$, 53, 75, 125, 157, 124, and 15 in year 5, and $N = 49$, 106, 77, 17, 4, 258, and 141 in year 15. Clerk salaries are not included.

the individual at time t affecting current returns or the probability distribution of future returns, is defined as

$$S(t) = \{x_{1t}, x_{2t}, d_k(t-1), A, \epsilon_{kt}\} \tag{2}$$

for $k \in K$, where x_{1t} denotes the accumulated number of years of experience outside of the elite sector at time t and x_{2t} denotes the accumulated number of years of experience at time t in only the elite sector. This division of experience distinguishes capital between sectors in a computationally tractable way.[14] The experience state variables evolve according to the following law of motion:

$$\begin{aligned} x_{1,t+1} &= x_{1t} + d_1(t) + d_2(t) + d_3(t) + d_4(t) + d_6(t), \\ x_{2,t+1} &= x_{2t} + d_5(t) + d_7(t), \end{aligned} \tag{3}$$

with initial conditions of $x_{10} = x_{20} = 0$. A choice of any of the five positions outside of the elite sector thus augments x_{1t} by one year.

[14] Ideally, experience in each of the five sectors would enter the state space separately. This would, however, greatly complicate solution and estimation of the model by increasing the number of elements of the state space and the number of parameters in the model.

A choice of either elite associate or elite partner analogously augments x_{2t}. The experience terms are assumed to enter quadratically into the deterministic component of the wage offer, that is,

$$w_{kt} = \exp(\beta_{0k} + \beta_{1k}x_{1,t+1} - \beta_{2k}x_{1,t+1}^2 + \beta_{3k}x_{2,t+1} - \beta_{4k}x_{2,t+1}^2). \quad (4)$$

This specification recognizes the endogeneity of wage offers arising from the dependence of experience levels on previous and current sectoral choices. The exponentiation ensures nonnegative wages.

The previous-period choice variables, $d_k(t-1)$, $k \in K$, appear in (2) because last period's choice is assumed to affect opportunities in the current period. For example, an attorney who chose the business sector last period faces a different probability of a current elite offer than if he chose the nonprofit sector.[15] The variable A distinguishes, by ability level, two types of attorneys. It is zero if the attorney is type 1 (low-ability) and one if the attorney is type 2 (high-ability). Attorney type is assumed to be common knowledge. The stochastic elements of the state space, ϵ_{kt}, $k \in K$, are allowed to be contemporaneously correlated but for simplicity are assumed to be mutually serially independent.

The constraints of the optimization problem lie in the offer probability structure. Let P_{0k} denote the probability of receiving an offer to work in position k immediately on graduation. The vector of first job offer probabilities is assumed to be

$$\mathbf{P}(1) = \{1, P_{02}, P_{03}, P_{04}, P_{05}, 0, 0\}. \quad (5)$$

That is, graduates can become sole proprietors with certainty, cannot enter the labor market as partners, and face stochastic probabilities of offers in the other positions.

The on-the-job offer probabilities P_{jk}, $j, k \in K$, are the probabilities of receiving an offer in position k, at the beginning of time t, conditional on having worked in position j in period $t-1$. The P_{jk}'s form a 7×7 offer probability matrix specified as

$$\mathbf{P}(t) = \begin{pmatrix} 1 & P_{12} & P_{13} & P_{14} & P_{15} & 0 & 0 \\ 1 & 1 & P_{23} & P_{24} & P_{25} & 0 & 0 \\ 1 & P_{32} & 1 & P_{34} & P_{35} & 0 & 0 \\ 1 & P_{42} & P_{43} & P_{44} & P_{45} & P_{46} & 0 \\ 1 & P_{52} & P_{53} & P_{54} & P_{55} & 0 & P_{57} \\ 1 & 1 & 1 & 1 & P_{65} & 1 & 0 \\ 1 & 1 & 1 & 1 & 1 & 0 & 1 \end{pmatrix} \quad (6)$$

[15] It is possible that current opportunities are affected by choices further into the past as well. The assumption that only previous-period choice matters simplifies model solution and estimation.

for $2 \leq t \leq T$. Column 1 assumes that an attorney can always become a sole proprietor regardless of prior-period position. The zeros in columns 5 and 6 imply that an attorney must spend the prior period as an associate before facing a nonzero partnership probability. Nonelite partners (row 6) receive offers with certainty in all positions but elite associate and elite partner. Elite partners (row 7) receive offers with certainty in all positions but nonelite partner. Solo, business, and nonprofit attorneys, like partners, can always continue in their respective positions.[16]

All offer probabilities except for the associate continuation probabilities, P_{44} and P_{55}, and the partnership probabilities, P_{46} and P_{57}, are assumed to be a function of attorney type and time, that is,

$$P_{jk} = \frac{\exp[\alpha_{jk,0} + \alpha_{jk,1}A + \alpha_{jk,2}I(t \geq \tau_k)]}{1 + \exp[\alpha_{jk,0} + \alpha_{jk,1}A + \alpha_{jk,2}I(t \geq \tau_k)]}. \tag{7}$$

The appearance of attorney type in the offer probabilities and not in the wage offer functions or the benefit terms suggests that type is related to an ability characteristic such as capacity to learn on the job (Rosen 1972).[17] The indicator function $I(t \geq \tau_k)$ equals one if the condition in parentheses is true and equals zero otherwise. Its presence allows discrete jumps in offer probabilities as time since graduation advances. The value of τ_k is four for $k = 1, 2, 3, 4, 6$ and five for $k = 5, 7$. Attorneys are assumed to know the value of τ_k for $k \in K$. The beginning of the fourth (fifth) year approximates the first period in which a nonelite (elite) associate can be considered for partner. It is assumed that outside opportunities begin to change at this time as well.[18]

An up-or-out employment structure in the nonelite and elite sectors is modeled in the following way. Let the event of coming up for review at the beginning of year t be denoted as $R(t)$, with $R(t) = 1$ if the associate comes up for review and $R(t) = 0$ otherwise. A neces-

[16] The restrictions on the offer probability matrix, while empirically motivated, help to simplify the expressions for expected future returns. A further but less general assumption could have been introduced that specifies an offer probability of one in the nonelite sector if an offer is received in the elite sector.

[17] Indeed, including attorney type in these latter functions does not yield significant results. Attorney type, therefore, affects returns solely through the opportunity to receive a fixed wage. No evidence is found that different attorney types differentially value sector-specific benefits.

[18] The assumption that the fifth year is the first period in which an elite associate can be considered for partner is consistent with evidence in Abel (1989) and Galanter and Palay (1991). The assumption that a nonelite associate can be considered earlier (the fourth year) is consistent with evidence in Spurr (1987). In principle, τ_k could be estimated but is not since it is integer valued.

sary condition for $R(t) = 1$ is $t \geq \tau_k$. The probability that $R(t) = 1$ is denoted as P_{c4} in the nonelite sector and P_{c5} in the elite sector. The associate continuation probabilities are therefore

$$P_{kk} = \begin{cases} 0 & \text{when } R(t) = 1 \\ 1 & \text{otherwise} \end{cases} \tag{8}$$

for $k = 4, 5$. That is, the associate either will not come up for review, in which case remaining an associate is always an option, or will come up for review and will either be offered partnership or be dismissed from the sector.[19]

The partnership probability in the nonelite sector is also conditional on coming up for review and is specified as

$$P_{46} = \begin{cases} \dfrac{\exp[\alpha_{46,0} + \alpha_{46,1}A + \alpha_{46,3}I(x_{2t} > 0)]}{1 + \exp[\alpha_{46,0} + \alpha_{46,1}A + \alpha_{46,3}I(x_{2t} > 0)]} & \text{when } R(t) = 1 \\ 0 & \text{otherwise.} \end{cases} \tag{9}$$

The indicator function, $I(x_{2t} > 0)$, equals one if the attorney has accumulated any experience in the elite sector at time t and zero otherwise. The partnership probability in the elite sector is similarly specified as

$$P_{57} = \begin{cases} \dfrac{\exp[\alpha_{57,0} + \alpha_{57,1}A + \alpha_{57,3}I(x_{1t} > 0)]}{1 + \exp[\alpha_{57,0} + \alpha_{57,1}A + \alpha_{57,3}I(x_{1t} > 0)]} & \text{when } R(t) = 1 \\ 0 & \text{otherwise,} \end{cases} \tag{10}$$

where the indicator function, $I(x_{1t} > 0)$, equals one if the attorney has accumulated any experience outside of the elite sector at time t and zero otherwise. The indicator functions help capture the effect of cross experience on partnership probabilities.[20] The numerical

[19] O'Flaherty and Siow (1995) model private law firm associates as facing the possibility of dismissal and promotion in every period after graduation. The requirement $t \geq \tau_k$ builds in greater job security in the early years. A permanent associate arises in the model when the attorney never comes up for review and never chooses to leave the sector.

[20] Expressions for the expected maximum return functions properly complete the model. They are not shown for the sake of brevity but can be found in Sauer (1995).

solution and maximum likelihood estimation of the model are outlined in the Appendix.

IV. Estimation Results

A. Parameter Estimates

Table 4 provides estimates of the offer probability parameters and their associated standard errors. Being a type 2 attorney has a positive impact on all first job offer probabilities. These probabilities are estimated to be .209, .838, .215, and .201 in the business, nonprofit, nonelite associate, and elite associate positions, respectively, if type 1 and .650, .910, .812, and .358 if type 2. Type 2 attorneys consistently face higher on-the-job offer probabilities as well.

Previous employment sector and time since graduation also affect arrival rates. This can be explained by the general and specific training attorneys receive (Leibowitz and Tollison 1978). General training in the first few years after graduation is presumably useful in all positions but may vary in quality depending on employment sector. After the first few years, training becomes more sector-specific. The higher on-the-job offer probabilities that nonprofit, nonelite, and elite attorneys face, regardless of type and time, may reflect higher-quality general and more transferable specific training. The quality of general training appears to be highest in the elite sector. The positive impact of time in the nonprofit sector suggests that specific training in this sector is highly transferable.[21]

The parameter estimates for the partnership probabilities show that being a type 2 attorney has a dramatic effect. The nonelite partnership probability, for an associate with no cross experience, is .037 if type 1 and .896 if type 2. The elite partnership probability, for an associate with no cross experience, is .023 if type 1 and .764 if type 2. O'Flaherty and Siow (1995) similarly estimate the partnership probability for a high-ability-type, large-firm associate to be .746. Partnership probabilities are higher for both types in the nonelite sector, and cross experience has a positive impact in both sectors.[22] These latter two results are consistent with previous findings in Spurr (1987). The positive effect of cross experience on the elite partner-

[21] High-ability attorneys who do not receive offers in private law firms immediately after graduation generally prefer the nonprofit sector over the business sector, even though the business sector offers higher current-period wages. This result is due to higher arrival rates for offers from private law firms in the nonprofit sector.

[22] The estimated probabilities per period of coming up for review are quite close: $\hat{P}_{c4} = .288$ and $\hat{P}_{c5} = .309$. The standard errors of the estimated intercepts in the corresponding logistic functions are .311 and .295, respectively.

TABLE 4

OFFER PROBABILITY PARAMETER ESTIMATES

Parameters	Business	Nonprofit	Nonelite Associate	Elite Associate	Nonelite Partner	Elite Partner
$\alpha_{0k,0}$	−1.33 (.33)	1.65 (.58)	−1.29 (.37)	−1.38 (.29)	...	...
$\alpha_{0k,1}$	1.95 (1.17)	.66 (.44)	2.76 (1.09)	.80 (.30)	...	...
$\alpha_{1k,0}$	−11.51 (3.24)	−11.34 (5.78)	−11.77 (4.64)	−11.80 (5.20)	...	...
$\alpha_{1k,1}$	9.86 (2.63)	9.95 (4.29)	10.37 (3.79)	9.71 (6.25)	...	...
$\alpha_{1k,2}$	−3.05 (3.18)	−3.64 (4.04)	−3.95 (4.23)	−4.23 (4.73)	...	...
$\alpha_{2k,0}$	...	−11.33 (3.85)	−11.35 (3.43)	−11.41 (3.18)	...	...
$\alpha_{2k,1}$	...	9.99 (3.92)	10.55 (3.43)	9.40 (3.30)	...	...
$\alpha_{2k,2}$	...	−3.42 (1.94)	−3.85 (1.11)	−4.10 (1.79)	...	...
$\alpha_{3k,0}$	−5.85 (.65)	...	−6.31 (1.11)	−6.59 (.77)	...	...
$\alpha_{3k,1}$	.75 (.38)	...	3.22 (1.02)	2.50 (.76)	...	...
$\alpha_{3k,2}$	1.35 (.59)	...	1.40 (.56)	.80 (.34)	...	...
$\alpha_{4k,0}$	−2.81 (.66)	−.73 (.34)	...	−6.81 (.80)	−3.25 (.94)	...
$\alpha_{4k,1}$	3.51 (.82)	3.22 (1.01)	...	.92 (.39)	5.40 (1.01)	...
$\alpha_{4k,2}$	−.25 (.16)	−3.00 (1.05)	...	−.75 (.53)	...	...
$\alpha_{4k,3}$	...	...	...	...	1.36 (.83)	...
$\alpha_{5k,0}$	−1.85 (.41)	−.18 (.10)	−1.41 (.83)	...	...	−3.75 (1.18)
$\alpha_{5k,1}$	4.15 (1.58)	3.11 (2.18)	3.90 (1.58)	...	...	4.92 (1.14)
$\alpha_{5k,2}$	−.51 (.39)	−3.56 (.93)	−1.92 (1.14)	...	...	...
$\alpha_{5k,3}$	...	...	...	...	...	4.01 (1.42)
$\alpha_{6k,0}$	...	...	...	−6.91 (.78)	...	...
$\alpha_{6k,1}$	...	...	...	1.21 (.50)	...	...

NOTE.—Standard errors are in parentheses.

ship probability probably reflects the importance of litigation skills acquired in the nonprofit sector.

Table 5 presents the estimated parameters of the wage offer functions along with their standard errors, the estimated standard deviations of technology shocks, and the estimated dollar values of the benefit terms.[23] The estimates show that experience in the elite sector always has a lower return for sole proprietors, suggesting that the general and specific training acquired in the elite sector is not particularly valuable in this position. Experience in the elite sector, however, always has a higher return in the business sector. This result is not surprising given that the clients of elite private law firms are mostly large businesses. In the nonprofit sector, the first 6 years of elite experience have a higher return, but the return falls off rapidly. Too much specific training in the elite sector thus penalizes earnings. In the nonelite associate position, elite experience has a higher return after 5 years have been accumulated. Thus only specific training is advantageous. Elite experience always has a lower return for nonelite partners and a higher return for elite associates and elite partners.[24]

The estimated benefit terms vary greatly by position. All estimates are relative to the nonprofit sector for identification and indicate that benefits in this sector have the highest market value. The most negative estimates are in the business and elite sectors. The importance of factors such as retirement contributions, work hours, and work environment in determining these values cannot be assessed given the limitations of the data.

B. Model Fit

As shown in tables 1 and 2 and figures 1–3, there are no statistically significant differences between actual and predicted choice distributions, actual and predicted transition matrices, and actual and predicted hazard functions.[25] Table 3 shows predicted mean accepted

[23] Joint estimation of choices and wages corrects the wage function parameter estimates for selectivity bias. The wage function parameters are adjusted for unobserved heterogeneity through the effect on future job offer probabilities and hence current choices.

[24] Returns to experience outside of the elite sector are restricted to be the same in the elite associate and partner positions because of a singularity in the data. The contemporaneous correlation between associate and partner shocks is .213 in the nonelite sector and .258 in the elite sector. All other correlations either were not significantly different from zero or were restricted to be zero.

[25] The goodness-of-fit statistics have not been adjusted for the fact that the parameters of the model have been estimated. The Wilcoxon χ^2_1 values for the nonprofit, nonelite, and elite sector hazard functions are 1.16, 2.71, and 0.06, respectively. The associated p-values are .28, .12, and .81.

TABLE 5

Wage Offer Function and Benefit Term Parameter Estimates

Parameters	Solo	Business	Nonprofit	Nonelite Associate	Elite Associate	Nonelite Partner	Elite Partner
β_{0k}	9.914	10.353	10.274	10.274	10.364	10.278	10.371
	(.112)	(.057)	(.025)	(.020)	(.039)	(.052)	(.152)
β_{1k}	.1110	.0891	.0621	.0895	.0947	.1134	.0947
	(.0144)	(.0053)	(.0047)	(.0059)	(.0096)	(.0029)	(.0096)
β_{2k}	−.0029	−.0009	−.0012	−.0017	−.0017	−.0012	−.0017
	(.0005)	(.0002)	(.0002)	(.0004)	(.0007)	(.0001)	(.0007)
β_{3k}	.0350	.1005	.1493	.0899	.1262	.0913	.1358
	(.0144)	(.0093)	(.0378)	(.0236)	(.0096)	(.0072)	(.0126)
β_{4k}	−.0014	−.0013	−.0136	−.0016	−.0025	−.0015	−.0018
	(.0014)	(.0005)	(.0060)	(.0017)	(.0008)	(.0006)	(.0003)
$(\sigma_{kk})^{1/2}$	.487	.389	.246	.221	.220	.507	.525
	(.016)	(.016)	(.004)	(.006)	(.012)	(.028)	(.094)
b_k	−751	−29,511	0	−497	−33,501	−16,446	−35,320
	(540)	(10,244)		(822)	(12,092)	(3,417)	(11,690)

Note.—Standard errors are in parentheses. $(\sigma_{kk})^{1/2}$ is the estimated standard deviation of the alternative-specific technology shock. The b_k's are in 1987 dollars.

TABLE 6

PREDICTED CHOICE DISTRIBUTIONS BY ATTORNEY TYPE

Year	Solo	Business	Nonprofit	Nonelite	Elite
1	.081 (.008)	.231 (.012)	.392 (.108)	.129 (.507)	.167 (.365)
2	.081 (.006)	.247 (.006)	.392 (.103)	.124 (.519)	.156 (.367)
3	.081 (.004)	.280 (.008)	.430 (.099)	.081 (.519)	.129 (.371)
4	.102 (.008)	.306 (.018)	.452 (.083)	.081 (.519)	.059 (.373)
5	.140 (.014)	.328 (.028)	.446 (.069)	.054 (.535)	.032 (.355)
6	.156 (.018)	.333 (.032)	.446 (.059)	.043 (.556)	.022 (.335)
7	.172 (.018)	.344 (.037)	.435 (.041)	.038 (.580)	.011 (.323)
8	.183 (.020)	.355 (.037)	.419 (.034)	.038 (.590)	.005 (.320)
9	.194 (.020)	.355 (.041)	.398 (.028)	.048 (.602)	.005 (.310)
10	.226 (.018)	.355 (.041)	.371 (.024)	.043 (.611)	.005 (.306)
11	.242 (.018)	.371 (.043)	.355 (.018)	.027 (.617)	.005 (.304)
12	.247 (.018)	.371 (.043)	.360 (.016)	.022 (.613)	.000 (.310)
13	.258 (.018)	.376 (.045)	.349 (.016)	.016 (.609)	.000 (.312)
14	.269 (.018)	.382 (.049)	.328 (.012)	.022 (.609)	.000 (.312)
15	.285 (.016)	.382 (.069)	.317 (.008)	.016 (.600)	.000 (.308)

NOTE.—Figures are row percentages calculated separately for 186 type 1 attorneys and 507 type 2 attorneys in each year. Row percentages for type 2 attorneys are in parentheses.

wages to be quite close to actual values in year 1. Differences increase somewhat over time. Predicted standard deviations generally reproduce the larger variation in the solo, business, and partner positions.

V. Discussion

A. *The Importance of Unobserved Heterogeneity in Abilities*

The differences in the career choices of type 1 and 2 attorneys are clearly illustrated in the predicted choice distributions by type in table 6. The table shows 70 percent of type 1 attorneys entering the solo, business, and nonprofit sectors immediately after graduation. The proportion in these sectors rises to 98 percent in year 15. In contrast, 87 percent of type 2 attorneys first enter the nonelite and elite sectors, with over 90 percent in these two sectors in year 15. The proportion of type 2 attorneys in the nonprofit sector steadily approaches zero.

Differences in attorney type are essential in explaining the nonmonotonic shape of the hazard functions. The reason for the rise and subsequent fall in the elite sector hazard rates is as follows. Immediately on graduation, type 1 attorneys face $\overline{V_2} > \overline{V_5} > \overline{V_4} > \overline{V_3} > \overline{V_1}$, where $\overline{V_k}$ is the average value function in position k. If offers do not arrive in the most preferred sector (business) but do arrive in the elite sector, then they are accepted. At the beginning of the

second year, the ranking remains the same, implying that if business offers arrive, type 1 attorneys exit. At the beginning of the third year, $\overline{V_2} > \overline{V_5} \approx \overline{V_3} > \overline{V_4} > \overline{V_1}$. Business offers are again accepted, and depending on the value of the shock, nonprofit offers are accepted as well. By the beginning of the fourth year, $\overline{V_2} > \overline{V_3} > \overline{V_4} > \overline{V_5} > \overline{V_1}$, implying that business offers, nonprofit offers, and nonelite offers are all accepted. There is thus an increasing number of type 1 attorney exits over these periods. The threat of dismissal and the drop in offer probabilities beginning with the fifth year cause the gradual reduction in $\overline{V_5}$ relative to the other $\overline{V_k}$'s.

At the beginning of the fifth year, many type 1 associates who do not receive offers in previous periods are dismissed, generating the hazard function peak. The hazard rates subsequently decline since the sector contains a greater proportion of type 2 attorneys who have monotonically decreasing hazard rates beginning in year 5. The fall in the hazard rates is driven by the up-or-out mechanism and the result that type 2 attorneys prefer the elite sector throughout the horizon.

The reason for the rise and subsequent fall in the nonelite sector hazard rates is quite similar.[26] The nonprofit hazard rates, however, do not steadily rise before the peak since $\overline{V_3}$ fails to fall in relative value over time because of the absence of a dismissal threat. The global peak in the hazard function occurs when the probability that type 2 attorneys receive offers in the private law firm sectors increases. The second peak occurs as type 1 attorneys begin to exit for the solo sector.

Given the importance of unobserved heterogeneity in explaining the career choices of attorneys, it would be instructive to determine the relationship between background characteristics and attorney type. With Bayes's rule, the probability that an attorney is type 2 conditional on observed choices ($\mathbf{d}$), accepted wages ($\mathbf{w}$), and estimated parameters ($\hat{\boldsymbol{\Theta}}$) can be expressed as

$$\Pr(A = 1|\mathbf{d}, \mathbf{w}, \hat{\boldsymbol{\Theta}}) = \frac{\hat{\pi}\mathcal{L}_i^*(\hat{\boldsymbol{\Theta}}|\mathbf{d}, \mathbf{w}, A = 1)}{\hat{\pi}\mathcal{L}_i^*(\hat{\boldsymbol{\Theta}}|\mathbf{d}, \mathbf{w}, A = 1) + (1 - \hat{\pi})\mathcal{L}_i^*(\hat{\boldsymbol{\Theta}}|\mathbf{d}, \mathbf{w}, A = 0)}, \quad (11)$$

where $\mathcal{L}_i^*(\hat{\boldsymbol{\Theta}}|\mathbf{d}, \mathbf{w}, A)$ is the conditional likelihood contribution evaluated at the estimated parameters and $\hat{\pi}$ is the estimated uncondi-

[26] Type 2 nonelite associates always prefer the elite sector, but most do not receive offers and choose to remain in the sector.

TABLE 7

ATTORNEY TYPE LOG ODDS REGRESSION

	Parameter Estimate	Standard Error
Intercept	−11.935	11.655
Undergraduate GPA	8.880	7.187
Undergraduate GPA^2	−1.328	1.102
Graduate degree	−1.444	.682
Moot court participation	.736	.574
Top 25% law school class	1.068	.359
Law class 1973	.347	.436
Law class 1974	.030	.495
Law class 1975	−.138	.472
Parent attorney	.645	.521
Educational debt	.306	.343

NOTE.—R^2 = .032. Standard errors are not adjusted for the fact that the dependent variable has been estimated.

tional probability of being a type 2 attorney.[27] The conditional probability of being a type 1 attorney is simply $1 - \Pr(A = 1|\mathbf{d}, \mathbf{w}, \hat{\boldsymbol{\Theta}})$. Forming the log odds of these posterior probabilities for each attorney and regressing them on a selected set of observable attorney characteristics yields the results in table 7.[28]

The estimates show that, ceteris paribus, an increase in an attorney's undergraduate grade point average increases the log odds the attorney is type 2 at a decreasing rate. Having been a moot court participant, having graduated in the top 25 percent of the class, and having an attorney parent all increase the log odds. These findings are consistent with the high-ability interpretation for type 2 attorneys. The achievement of a graduate degree prior to entering law school has a negative impact. This result could arise if those who switched fields are lemons. That is, a switch occurred because of a perceived limited chance of success in the original field. There is little correlation between attorney type and graduating class or the presence of educational debt.[29]

B. Loan Forgiveness

The estimated parameters of the model can be used to analyze loan forgiveness programs in terms of their effect on attorney supply deci-

[27] Probability $\hat{\pi} = .73$. This high estimate of the unconditional probability of being a type 2 attorney is probably due to the elite status of the University of Michigan Law School. The standard error of the estimated intercept term in the logistic function is .234.

[28] The standard errors have not been adjusted for the fact that the dependent variable in the regression has been estimated.

[29] There is also no correlation if a high debt indicator replaces the indicator of nonzero debt.

TABLE 8

EFFECT OF LOAN FORGIVENESS PROGRAM ON CHOICE DISTRIBUTION

Year	Solo	Business	Nonprofit	Nonelite	Elite
1	.027 (.024)	.071 (.072)	.185 (.196)	.405 (.402)	.312 (.306)
2	.026 (.023)	.071 (.077)	.180 (.195)	.413 (.405)	.310 (.300)
3	.024 (.020)	.081 (.083)	.187 (.204)	.401 (.396)	.306 (.296)
4	.033 (.027)	.095 (.097)	.182 (.206)	.401 (.391)	.289 (.279)
5	.048 (.041)	.108 (.109)	.170 (.191)	.406 (.399)	.268 (.260)
6	.055 (.050)	.113 (.111)	.163 (.182)	.418 (.409)	.251 (.247)
7	.059 (.054)	.120 (.119)	.147 (.175)	.434 (.418)	.240 (.234)
8	.064 (.057)	.123 (.119)	.137 (.168)	.442 (.428)	.235 (.229)
9	.066 (.058)	.126 (.124)	.127 (.154)	.453 (.442)	.228 (.221)
10	.074 (.059)	.126 (.126)	.117 (.150)	.459 (.444)	.225 (.220)
11	.078 (.065)	.131 (.130)	.108 (.140)	.459 (.445)	.224 (.220)
12	.079 (.067)	.131 (.131)	.108 (.133)	.454 (.446)	.227 (.223)
13	.082 (.071)	.134 (.135)	.105 (.127)	.450 (.442)	.228 (.225)
14	.085 (.074)	.138 (.138)	.097 (.117)	.452 (.444)	.228 (.227)
15	.088 (.075)	.153 (.154)	.091 (.111)	.443 (.437)	.225 (.223)

NOTE.—Figures are row percentages predicted by the model (693 attorneys in each year) and the loan forgiveness program (683 attorneys in each year). Loan forgiveness program row percentages are in parentheses.

sions. As an illustration, yearly debt payments are subtracted from the benefit terms in all positions but the nonprofit position for the first 15 years after graduation. Table 8 shows that this produces a 1.1 percent increase in the number of attorneys choosing the nonprofit sector immediately after graduation. The increased proportion, however, is due almost entirely to additional type 1 entrants. Type 2 attorneys continue to enter the sector only if offers in private law firms are not received and exit as soon as these offers arrive, despite the increased return to nonprofit sector employment. By year 15, there are 2.7 percent more attorneys in the nonprofit sector since fewer type 1 attorneys exit for the solo sector.[30]

VI. Conclusion

In this paper a dynamic structural model of the career choices of attorneys was estimated using unique data on several cohorts of graduates from the University of Michigan Law School. The theoretical framework integrates and expands previous work by Weisbrod (1983), Spurr (1987), Goddeeris (1988), and O'Flaherty and Siow (1995) by considering the future-oriented job choice decisions of attorneys among five employment sectors. The employment sectors

[30] According to representatives of the University of Michigan Law School, there was no loan forgiveness program in effect for this sample of graduates. If they did indeed face some type of limited loan forgiveness, part of the influence would already be captured in the $\widehat{b}_k$'s.

are found to be differentiated by pecuniary and nonpecuniary returns, promotion and dismissal probabilities, and the extent of transferability of human capital.

The estimation results show, in particular, that while partnership probabilities in the elite (large private law firm) sector are lower than in the nonelite (small private law firm) sector, elite experience has investment value in alternative sectors of the market. Elite associates face both higher job offer probabilities and higher alternative wage offers depending on the number of years of experience accumulated and the sector to which the experience is transferred. The nonprofit sector, in comparison to the business and solo sectors, offers lower wages but higher nonpecuniary benefits and higher probabilities of receiving job offers in private law firms. The disaggregation of the choice set is important in uncovering these effects. Self-selection among the five sectors, based on unobserved ability type and expected future returns, is also shown to be a critical element in generating the sector-specific nonmonotonic separation hazards observed in the data. The self-selection mechanism has implications for policy interventions in the market for lawyers, such as loan forgiveness programs.

Several extensions of the model would be desirable. First, learning about attorney ability type, as in O'Flaherty and Siow (1995), could be introduced. This would help distinguish, in one model, the relative contributions of learning and unobserved heterogeneity in producing nonmonotonic hazard functions. Second, incorporating a theory of law firm decision making, as in Ferrall (1990) or Rebitzer and Taylor (1995), would help better specify the determinants of job offer and promotion probabilities. Third, including data on female attorneys (Wood et al. 1993; Biddle and Hamermesh 1996) might reveal gender differences in both job and wage offers while holding ability constant. Finally, this type of model can be easily modified to explain the career choices in other labor markets that are characterized by specialty sectors with different institutional arrangements.

Appendix

The standard solution method for finite-horizon dynamic programs is backward recursion. To outline the solution method, denote a particular set of values for the deterministic components of the state space at time t as $\bar{S}(t)$, and consider an attorney entering the last decision period, $t = T$, with $\bar{S}(T)$. Given a draw from the assumed multivariate normal distribution of technology shocks, the seven terminal value functions can be calculated. Consider now an attorney in period $T - 1$ with $\bar{S}(T - 1)$. To compute the

value functions in this period, expected future returns must be calculated for each of the seven possible alternatives, that is,

$$\int_{\epsilon_{1T}} \cdots \int_{\epsilon_{7T}} \max[V_1(S(T)), \ldots, V_7(S(T))] \times f(\epsilon_{1T}, \ldots, \epsilon_{7T}; \eta)\, d\epsilon_{1T} \cdots d\epsilon_{7T}. \quad \text{(A1)}$$

To overcome computational difficulties, (A1) is approximated by Monte Carlo integration, that is,

$$\frac{1}{D}\sum_{d=1}^{D} \max[V_1^d(S(T)), \ldots, V_7^d(S(T))]: \quad \text{(A2)}$$

D draws from the joint distribution of technology shocks at time T are taken and the maximum values are averaged. The value functions at time $T-1$ can then be calculated with a single random draw on technology shocks in the current period. Moving backward in time, one can perform analogous computations for every $t = 0, \ldots, T-2$. The procedure above requires calculation of the value functions for every feasible $\bar{S}(t)$, $t \in T$.

The solution of the dynamic program serves as input into estimating the parameters of the model. To see this, consider the probability of choosing the elite sector immediately on graduation from law school as an example (suppressing arguments Θ, A, and $\bar{S}(1)$, for convenience):

$$\begin{aligned}
\Pr[w_{51}, d_5(1) = 1] &= f(w_{51})P_{05} \\
&\times [(1 - P_{02})(1 - P_{03})(1 - P_{04}) \Pr(V_5 > V_1 | w_{51}) \\
&+ (1 - P_{02})(1 - P_{03})P_{04} \Pr(V_5 > V_1, V_5 > V_4 | w_{51}) \\
&+ (1 - P_{02})P_{03}(1 - P_{04}) \Pr(V_5 > V_1, V_5 > V_3 | w_{51}) \\
&+ (1 - P_{02})P_{03}P_{04} \Pr(V_5 > V_1, V_5 > V_3, V_5 > V_4 | w_{51}) \\
&+ P_{02}(1 - P_{03})(1 - P_{04}) \Pr(V_5 > V_1, V_5 > V_2 | w_{51}) \\
&+ P_{02}(1 - P_{03})P_{04} \Pr(V_5 > V_1, V_5 > V_2, V_5 > V_4 | w_{51}) \\
&+ P_{02}P_{03}(1 - P_{04}) \Pr(V_5 > V_1, V_5 > V_2, V_5 > V_3 | w_{51}) \\
&+ P_{02}P_{03}P_{04} \Pr(V_5 > V_1, V_5 > V_2, V_5 > V_3, V_5 > V_4 | w_{51})],
\end{aligned} \quad \text{(A3)}$$

where $f(w_{51})$ is the lognormal density function. Each V_k, the expected present discounted value of wealth in position k until the end of the horizon ($T = 35$), is provided by the numerical solution to the dynamic program for a given draw of technology shocks in $t = 1$. Choice probabilities are constructed by repeatedly drawing current-period technology shocks and using a kernel smoothing function (see Albright, Lerman, and Manski 1977; McFadden 1989; Pakes and Pollard 1989; Rust 1992). Construction of the likelihood function follows the method described in Eckstein and Wolpin (1989*b*) for serially uncorrelated errors with a correction for unobserved heterogeneity. Standard errors are calculated using the outer product of numerical first derivatives. Keane and Wolpin (1994) discuss properties of

the estimator when expected future returns are approximated by Monte Carlo integration. Further details on the estimation of this particular model are in Sauer (1995).

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