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Educational Financing and Lifetime Earnings

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This paper formulates and estimates a dynamic programming model of optimal educational financing decisions. The main purpose of the paper is to measure the effect of short-term parental cash transfers, received during school, on educational borrowing and in-school work decisions, and on post-graduation lifetime earnings. The estimated parameters of the model imply that parental cash transfers do not significantly influence post-graduation lifetime earnings. Long-term factors such as family background and prior human capital investments are more important. Parental cash transfers do, however, significantly determine the decision to borrow or work during school and the level of lifetime consumption.

1. INTRODUCTION

This paper formulates and estimates a dynamic programming model of optimal educational financing decisions. The main purpose of the paper is to measure the effect of short-term parental cash transfers, received during school, on educational borrowing and in-school work decisions, and on post-graduation lifetime earnings. The effect of short-term parental cash transfers is assessed relative to the effects of long-term factors such as family background and prior human capital investments. Knowledge of the relative importance of parental cash transfers and the determinants of the decision to borrow or work is important for predicting the impact of recent changes in education policy. Tuition tax credits are now available and will most probably lead to an increase in the level of parental cash transfers to offspring. Educational loan-forgiveness programmes that presumably influence borrowing decisions and post-graduation career choices are also expanding.[1]

Several recent studies have sought to measure the relative importance of parental cash transfers on lifetime outcomes. These studies generally examine the correlation between family income and schooling attainment (see, *e.g.* Cameron and Heckman (1998, 2001), Shea (2000), Keane and Wolpin (2001)). A key insight of these studies is that the well documented and strong correlation between family background and completed schooling levels does not necessarily constitute evidence that short-term parental cash transfers help relieve liquidity constraints thus enabling offspring to attain higher education levels. Family income could also represent long-term influences that foster scholastic ability and preferences for more schooling. Indeed, when some measure of offspring ability is included in the analysis the correlation between family income and completed schooling levels is either wiped out or reverses direction.

This study differs from the previous literature in at least three ways. First, instead of focusing on variation in the level of educational attainment with family income, the focus is on variation

1. Tax benefits for investments in higher education are available through the hope credit, the lifetime learning credit and various education IRAs. Although private loan-forgiveness programmes have existed for many years, a federal teacher loan-forgiveness programme has recently been instituted and student loan interest payments are now tax deductible.

in lifetime earnings with educational financing decisions and family background among a group of individuals that have approximately the same years and quality of schooling. All individuals in the sample have an undergraduate degree and completed 3 years of additional schooling at the same Law School. The effect of parental cash transfers is thus analysed on a different margin. Second, a direct measure of parental cash transfers is available in the data and is incorporated into the analysis. Due to data limitations, previous studies could only indirectly infer the level of parental financial support. Third, and perhaps most important, the accumulation of educational debt is explicitly modelled and treated as endogenous. The decision to incur educational debt takes into account the level of parental support, potential earnings in the labour market and the consequences of indebtedness for current and future utility.

The mechanisms by which parental cash transfers influence educational financing decisions and post-graduation lifetime earnings are fairly straightforward. Individuals that have decided to invest in higher education may have to supplement parental monetary support by working while in school and/or undertaking educational debt in order to fully finance the costs of attendance. An individual that chooses to work while in school may, as a result, be less academically successful due to less time and energy available for studying (see Ehrenberg and Sherman (1987), Eckstein and Wolpin (1999)). In the case of Law School graduates, lower scholastic achievement can affect career opportunities by lowering the arrival rate of job offers in high-paying legal jobs thus leading to lower post-graduation lifetime earnings. On the other hand, working while in school may offer a higher standard of living while studying and increase overall lifetime consumption and utility even given the decrease in lifetime earnings upon graduation. Moreover, employment during school may have investment value in the post-graduation labour market (see Ruhm (1997), Light (2001), Hotz, Xu, Tienda and Ahituv (2002)). The pay-off to work experience acquired while in school could partially compensate for the earnings loss due to lower scholastic achievement.

In contrast to an individual that decides to work while in school, an individual that chooses to undertake educational debt may be more academically successful than otherwise but will generally not achieve a high standard of living during his or her studies. This is mainly due to the institutional borrowing constraints inherent in federal student aid programmes and the relatively high cost of borrowing on the commercial market. An individual that undertakes debt, as opposed to working, will also have lower net consumption after graduation as soon as loan re-payment begins. However, the level of debt accumulated during school can influence the type of job that is accepted after graduation. Indeed, the presumption of many educational loan-forgiveness programmes in elite Law Schools in the U.S. is that Law School graduates are shying away from public service jobs because of initially low salaries and high educational debt service payments that lead to unacceptably low levels of early post-graduation consumption. Under the assumption that post-graduation borrowing constraints are binding, consumption smoothing considerations may induce graduates that decided to undertake educational debt to choose jobs with initially high salaries but with lower expected lifetime earnings.[2]

The theoretical framework, in which the effect of parental cash transfers is measured, assumes that individuals maximize the discounted present value of expected lifetime utility by making joint and sequential decisions on the level of educational indebtedness, whether to work while in school and the type of post-graduation employment. Individuals choose, at the beginning of each school year, whether to not work and not borrow, whether to not work and borrow half the costs of attendance (including tuition, fees and minimum living expenses), whether to not

2. If individuals suffer a decrease in lifetime earnings in order to smooth post-graduation consumption, then there must be an additional market failure which prevents firms from offering earnings profiles that match the individual's consumption needs. One possibility is that educational debt levels are unobserved or are very costly to monitor.

work and borrow the full costs of attendance, whether to work and not borrow and whether to work and borrow half the costs of attendance. The five options in the choice set are subject to a feasibility constraint. An option is not available if the student cannot generate sufficient funds to cover full attendance costs. If the student chooses not to work while in school, attendance costs must be met by a combination of parental transfers, initial assets, unobserved (to the researcher) assets accumulated during school and/or summers, and educational debt. If the student works, stochastic labour income is added to the pool of resources. The default option of borrowing full attendance costs and not working is assumed to always be available.

The decision problem the individual faces is formulated as a dynamic programming problem under uncertainty so that borrowing and work decisions fully take into account the expected consequences for scholastic achievement, future job opportunities and consumption levels while in school and during the post-graduation period. Consumption is assumed to generate contemporaneous utility through a CRRA function and the marginal utility of consumption is allowed to differ between the borrowing and working options in order to capture the disutility of work effort. The model of post-graduation labour market decisions is an expanded version of the framework developed in Sauer (1998), in which Law School graduates choose, in each year after graduation, between five employment sectors: a solo sector, a business sector, a non-profit sector, a non-elite private law firm sector and an elite private law firm sector.

The dynamic programming problem is solved numerically by backward recursion. The numerical solution is nested in a maximum likelihood procedure that recovers the structural parameters of the decision problem. Construction of the likelihood function is based on simulated event histories and assumes classification error in all reported discrete outcomes. The novel estimation procedure, recently introduced by Keane and Wolpin (2001) and further developed in Keane and Sauer (2002), "solves" the computational problem that arises when there are missing endogenous state variables. The observed continuous data on parental transfers, initial assets, educational debt, in-school employment earnings and accepted post-graduation wage offers are included in estimation via measurement error densities.

The results of the study suggest that parental cash transfers do not have a significant effect on post-graduation lifetime earnings. Family background and prior human capital investments are stronger determinants. Parental cash transfers do, however, significantly affect the decision to borrow or work. The effect depends on the level of transfers and on the individual's potential earnings in the labour market. Individuals with an intermediate level of transfers can be induced to work while in school when additional transfers combine with market wages to enable the student to reach higher lifetime consumption levels than can be achieved through less borrowing only. The parental income supplement in this case decreases post-graduation lifetime earnings since working while in school hurts scholastic achievement. On the other hand, in-school work experience increases wages in the post-graduation labour market. The net effect on post-graduation lifetime earnings when parental transfers induce in-school work turns out to be negligible.

Although parental cash transfers do not significantly affect post-graduation lifetime earnings, they do significantly affect lifetime consumption. Lifetime consumption increases with parental cash transfers for two reasons. First, individuals that are induced to work rather than borrow, and individuals that are not induced to work but rather borrow less, have lower post-graduation debt service payments and higher post-graduation consumption. Second, individuals that are induced to work increase in-school consumption levels over the in-school consumption levels that are attainable through only borrowing. The estimated parameters of the model imply that an extra dollar transferred from parent to offspring increases mean lifetime consumption by 1 dollar and 76 cents. The "additionality effect" of 76 cents can be decomposed into 14 cents of increased in-school consumption and 62 cents of increased post-graduation consumption.

The rest of the paper is organized as follows. Section 2 describes the data. Section 3 details the structure of the model as well as the solution and estimation method. Section 4 presents the main estimation results and discusses model fit. Section 5 measures the relative importance of short-term parental cash transfers and simulates the impact of a loan-forgiveness programme on educational borrowing and in-school work decisions, and on post-graduation career choices. Section 6 summarizes and concludes.

2. DATA

The data on Law School graduates are drawn from alumni surveys administered by the University of Michigan Law School (UMLS). UMLS has been collecting data from surveying all alumni since 1952 and combines alumni responses with information from Law School records. This paper uses information from the alumni surveys sent both 5 and 15 years after graduation to the classes of 1976 through 1981. The 15-year survey sent to the class of 1981 was the last 15-year survey available at the time this study began.

The 15-year alumni surveys provide detailed retrospective information on employment outcomes since graduation from Law School as well as average weekly hours worked during each Law School year. Starting with the class of 1976, data on sources of total financial support over 3 years of Law School became available. Specifically, the survey asks, "During Law School, approximately what percentages of your financial support came from the following sources? (fill in blanks with percentages, totalling 100%)." The options include (i) parental support, (ii) pre-Law School savings, (iii) veteran benefits, (iv) spousal support, (v) employment earnings, (vi) educational loans, grants and scholarships and (vii) other unspecified sources.

The reported percentages of financial support were converted into dollar figures by using data on the estimated total cost of 3 years of attendance for in-state and out-of-state UMLS students by class year. The total cost of attendance includes tuition, fees and living expenses. The UMLS cost data are reported in Appendix B, which is available on the *Review* website. The conversion from percentages to dollar figures assumes that the financial support referred to in the survey question is understood as total attendance costs as determined by UMLS.

A direct dollar measure of total educational debt upon graduation is also requested in a different question on the survey. This latter measure of debt is preferable to the converted debt measure since it is not confounded with grants and scholarships. However, the direct dollar measure of debt includes undergraduate debt as well. A similar concern is that total employment earnings include summer earnings while the model explains in-school employment earnings only. It should also be noted that parental support is interpreted as a pure transfer but could conceivably be a (relatively low interest) loan. For all of these reasons, it is quite essential that measurement error be incorporated into the estimation procedure.

The estimation sample contains a total of 658 white males that graduated within 3 years of entry to Law School and that were not transfer students. Appendix C, which is available on the *Review* website, reports the class size, the number of respondents to the more comprehensive 15-year survey and the size of the sample used in estimation by class year. In defining the estimation sample, it was not necessary to censor incomplete event histories or impute missing values. The estimation procedure is especially suited to handle the problem of missing endogenous state variables.[3]

3. Two per cent of the white male respondents were transfer students and 6% took more than 3 years to graduate. These individuals were excluded because including them would have considerably complicated the model and would probably not have changed the results given that they do not provide a strong source of identification.

TABLE 1

Descriptive statistics

Variable	Mean	S.D.	N	Symbol
Father's occupation at entry to Law School:				
Blue collar or other occupation	0·415	—	658	F_0
Attorney or other professional	0·173	—	658	F_1
Mgr., business owner or teacher	0·412	—	658	F_2
Out-of-state resident	0·602	—	658	OS
Ivy League BA	0·120	—	658	Ivy
Master's degree	0·090	—	658	MA
Age at entry to Law School	22·9	2·3	658	Age
Law School admissions test score	707	41·7	658	LSAT
Made law review	0·246	—	658	lr
Graduated in top 20% of class	0·391	—	658	$t20$
In-school work experience (years)	1·02	1·15	574	hr_t
Parental transfers:				tr_t^p
% > 0	0·606	—	650	
Total	16,934	10,156	394	
Initial assets:				tr_t^a
% > 0	0·480	—	658	
Total	12,643	8,574	311	
Educational debt:				db_t
% > 0	0·612	—	645	
Total	21,021	14,930	395	
Employment earnings:				w_t
% > 0	0·465	—	658	
Total	9637	6639	302	

Table 1 displays descriptive statistics and the symbols used in the model for corresponding variables. Three broad occupational categories of the father at the time of entry to Law School are defined in order to capture the individual's family background. There is no other information on family background in the data that can be usefully exploited. Most of the mothers in the sample are not working at the time of entry to Law School. The three occupational categories of the father are (i) attorney or other professional, (ii) manager, business owner or teacher, and (iii) blue collar or other occupation. Investments in human capital prior to entering Law School are represented by an indicator for having acquired a BA from an Ivy League institution, an indicator for having acquired a master's degree or higher, and age at entry to Law School. The maximum age at Law School entry is 48 but only 15% of the sample entered over the age of 24.

Scholastic achievement in Law School is captured by an indicator for having made law review after the first year and an indicator for having graduated in the top 20% of the class. Law review status and graduating percentile are supplied from Law School records. The figures show that 39% of the sample graduated in the top 20% of the class, highlighting the fact that survey respondents are disproportionately academically successful students. The minimum graduating percentile in the sample is 38.[4]

The data on sources of educational financing show that 61% of the sample received parental monetary support. The mean positive amount of parental support is 17,000 dollars which is slightly more than half the total 3-year attendance costs for out-of-state students. Sixty-one

4. There is no evidence to suggest that the relationship between parental transfers and lifetime earnings is significantly different among the bottom third of the class.

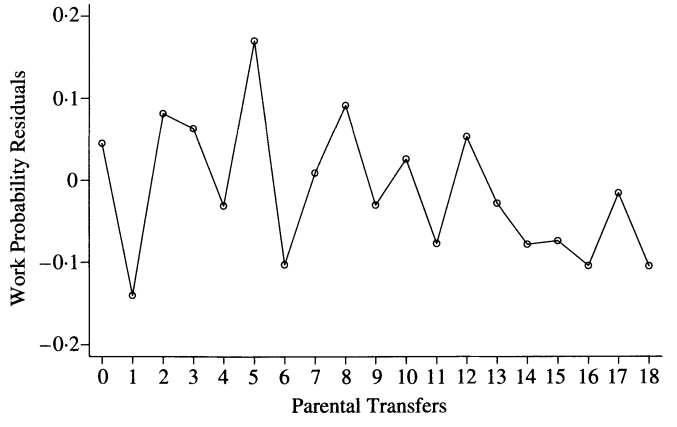

FIGURE 1
In-school work and parental transfers

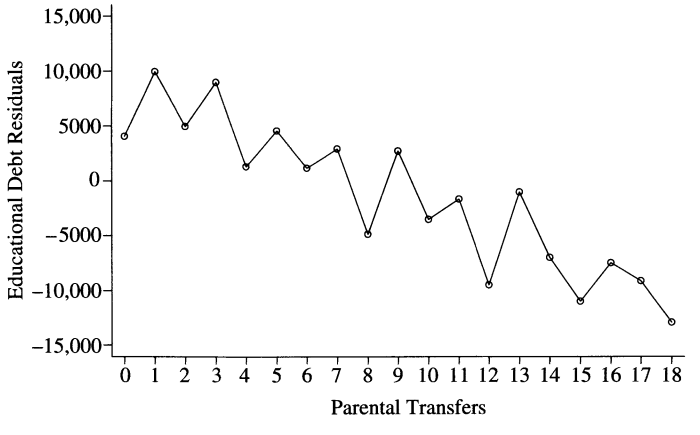

FIGURE 2
Educational debt and parental transfers

per cent of the sample also had positive educational debt. The mean positive amount of debt is 21,000 dollars. All dollar figures are in 1992 dollars.

Initial assets and employment earnings during Law School are relatively less important sources of financing. Initial assets are the sum of pre-Law School savings, veteran benefits, spousal contributions and other unspecified sources. Pre-Law School savings constitute 60% of initial assets. Employment earnings during Law School derive mostly from part-time work. The average number of hours worked per week during each Law School year is 8·9 and a negligible number of students worked more than 20 hours. For this reason, the model considers only no work and part-time work options. A student was classified as working in a particular Law School year if average weekly employment hours exceeded five.

Several additional aspects of the raw data are explored in Figures 1 and 2 and Table 2. Figure 1 displays the relationship between the propensity to work while in school and parental transfers. Mean residuals from a pooled OLS regression, in which an indicator for working during the Law School year is the dependent variable, are plotted against parental transfers measured in intervals

TABLE 2

OLS lifetime earnings regressions

	Log of lifetime earnings		
Variable	(1)	(2)	(3)
Constant	11·9172	11·9066	11·8207
	(0·0355)	(0·0397)	(0·0452)
Father attorney/prof.	0·0189	0·0064	−0·0191
	(0·0502)	(0·0516)	(0·0495)
Father mgr./teacher	0·0115	0·0025	−0·0042
	(0·0376)	(0·0381)	(0·0371)
Ivy League BA	0·1120	0·1091	0·1092
	(0·0544)	(0·0545)	(0·0526)
Master's degree	−0·0674	−0·0548	−0·0395
	(0·0644)	(0·0655)	(0·0629)
$I(age > 24)$	0·0304	0·0429	0·0307
	(0·0515)	(0·0602)	(0·0580)
Out-of-state resident	0·0073	0·0034	−0·0196
	(0·0357)	(0·0363)	(0·0352)
$I(LSAT > 737)$	−0·0402	−0·0409	−0·0686
	(0·0401)	(0·0402)	(0·0390)
Parental transfers		0·00166	0·00152
		(0·00174)	(0·00172)
Initial assets		0·00026	−0·00039
		(0·00146)	(0·00142)
Law review			0·2125
			(0·0404)
Top 20% of class			0·1092
			(0·0353)
In-school work exp.			0·0256
			(0·0151)
$RMSE$	0·3863	0·3865	0·3687
R^2	0·0328	0·0327	0·1193
N	523	521	508

Note: Parental transfers and initial assets are divided by 1000. The regressions also include controls for year of graduation. Robust standard errors are in parentheses.

of 1750 dollars. The covariates in the regression are father's broad occupational category, type of BA, master's degree status, age at entry to Law School, residency status, Law School admissions test score, initial assets, graduation year and an indicator for the first year of Law School. Figure 1 indicates that the propensity to work increases with parental transfers before declining. Including parental transfers directly in the pooled OLS regression yields a jointly significant cubic in parental transfers with negative linear and cubic terms and a strong positive quadratic term. A panel data probit model with random individual effects also produces a significant cubic in parental transfers with the same signs on the coefficients.

Figure 2 plots the mean residuals from an OLS regression, in which total educational debt is the dependent variable, against the intervals of parental transfers. The educational debt regression has the same covariates as described above, excluding parental transfers. In contrast to the propensity to work, educational debt consistently declines with parental transfers.

Adding parental transfers to the regression indicates that educational debt significantly decreases with parental transfers at an increasing rate. The significant negative association between educational debt and parental transfers also arises in a tobit regression.

Table 2 reports the results of three OLS regressions which have, as the dependent variable, the natural log of the discounted present value of accepted wages in years 1, 5 and 15 after graduation. The discount factor used in the present value calculations is 0·95. The specification in column (1) indicates 1·9% higher lifetime earnings for individuals with an attorney or other professional father and 1·2% higher lifetime earnings for individuals with a manager, business owner or teacher father. Individuals that are older than 24 upon entry to Law School earn 3% more and individuals with an Ivy League BA earn 11% more. This latter coefficient is the only one that is precisely estimated.

Column (2) adds parental transfers and initial assets to the regression. The coefficients on parental transfers and initial assets are small in magnitude and not precisely estimated. An increase of 1000 dollars in parental transfers is associated with 0·17% higher lifetime earnings. In levels, an extra dollar of parental transfers is associated with 30 cents higher lifetime earnings. Note that adding parental transfers weakens the coefficients on father's occupational category.

Column (3) adds indicators for having made law review, having graduated in the top 20% of the class and years of Law School work experience. Individuals that made law review have 21% higher lifetime earnings and individuals that graduated in the top 20% of the class have 11% higher lifetime earnings. The coefficients on these latter two variables are precisely estimated. Lifetime earnings are higher by 2·6% with each year of in-school work experience. The coefficient on in-school work experience is fairly precisely estimated. In this latter specification, the coefficient on parental transfers remains negligible and the coefficients on father's occupational category are further reduced.

The lifetime earnings effects reported in Table 2 are clearly biased. The amount of transfers received during school are most probably correlated with the offspring's potential lifetime earnings. The bias could be in either direction. Moreover, family background, the propensity to make law review, the propensity to graduate in the top 20% of the class and the accumulation of in-school work experience are all likely correlated with potential lifetime earnings. The model of optimal educational financing decisions specified in the following section serves to correct the associations in Table 2 for biases due to unobserved heterogeneity and self-selection.

3. MODEL

In this section, the basic structure of the model and the solution and estimation methods are discussed. The first subsection describes the decision-making environment in Law School. The second subsection describes the decision-making environment in the post-graduation labour market. The third subsection outlines the solution and estimation techniques. The model corresponds to the decision problem of a single individual. However, individuals are allowed to differ in observed and unobserved dimensions.

3.1. Law School

The choice set the individual faces, in each year of Law School, denoted as K^{ls}, is assumed to contain five elements: not working and not borrowing ($k = 1$), not working and borrowing half the costs of Law School attendance ($k = 2$), not working and borrowing the full costs of Law School attendance ($k = 3$), working and not borrowing ($k = 4$) and working and borrowing half the costs of Law School attendance ($k = 5$). Discretization of debt levels in the choice set increases tractability.

A choice k is feasible in year t only if financial resources, denoted as y_{kt}, are sufficient to cover the full costs of Law School attendance. The full costs of Law School attendance consist of tuition and fees, tc, plus minimum living expenses, $c\min$. The feasibility constraint is thus,

$$y_{kt} - (tc + c\min) \geq 0. \tag{1}$$

Total financial resources during the Law School year y_{kt} are assumed to derive from five possible sources: parental cash transfers, tr_t^p, initial assets, tr_t^a, stochastic unobserved assets, $tr_t^u e^{\varepsilon_{ut}}$, units of educational debt, where one unit is $0{\cdot}5(tc+c\min)$, and stochastic labour income, $\overline{w}_t e^{\varepsilon_{wt}}$. The choice dependent y_{kt}'s are specified as

$$\begin{aligned}
y_{1t} &= tr_t^p + tr_t^a + tr_t^u e^{\varepsilon_{ut}} \\
y_{2t} &= tr_t^p + tr_t^a + tr_t^u e^{\varepsilon_{ut}} + 0{\cdot}5(tc + c\min) \\
y_{3t} &= tc + c\min \\
y_{4t} &= tr_t^p + tr_t^a + tr_t^u e^{\varepsilon_{ut}} + \overline{w}_t e^{\varepsilon_{wt}} \\
y_{5t} &= tr_t^p + tr_t^a + tr_t^u e^{\varepsilon_{ut}} + \overline{w}_t e^{\varepsilon_{wt}} + 0{\cdot}5(tc + c\min).
\end{aligned} \tag{2}$$

Stochastic unobserved assets $tr_t^u e^{\varepsilon_{ut}}$ are meant to capture unobserved grants and scholarships, prior summer savings, and other monetary or in-kind transfers that affect borrowing and work decisions during the Law School year. The stochastic components of unobserved assets and employment earnings, ε_{ut} and ε_{wt}, are allowed to be contemporaneously correlated through a bivariate normal distribution, but are assumed to be mutually serially independent. Option $k = 3$ always satisfies the feasibility constraint in (1).[5]

Consumption c_{kt} corresponding to each choice k is specified as,

$$\begin{aligned}
c_{kt} &= c\min + y_{kt} - (tc + c\min), \qquad k = 1, 4 \\
c_{kt} &= c\min, \qquad k = 2, 3, 5.
\end{aligned} \tag{3}$$

Note that consumption c_{kt} can exceed $c\min$ only when the individual does not borrow. This restriction captures the institutional constraints inherent in federal student aid programmes. Total borrowing capacity is limited to tuition and fees plus living expenses (minimum consumption) and is reduced by the extent of outside resources. It is not unreasonable to assume that a university's financial aid office is aware of the outside resources available to the student. Students that apply for federal assistance must submit to the financial aid office their own or their parent's income tax returns, bank statements and investment records in each year that educational loans are requested. In addition, student applications for financial aid are randomly selected for verification by the Department of Education before educational loans are approved.

The model also assumes that it is prohibitively expensive to opt out of the federal student aid system and borrow more than full attendance costs on the commercial market. Commercial loans generally carry much higher interest rates than do loans available through the university, are quite limited in extent, and are considered outside resources by the financial aid office. In the year 2000, only 4·4% of all graduate and professional students borrowed on the commercial market (U.S. Department of Education, 2002). This percentage is likely to be even lower in the years 1976 through 1981. The restrictions that c_{kt} cannot exceed $c\min$ and that outside resources are "taxed" at a rate of 100%, when the individual is a borrower, are, therefore, reasonable.

5. It is assumed, for simplicity, that students can draw on their yearly resources in order to meet tuition payments. That is, possible time inconsistencies in the availability of resources and the tuition payment schedule are ignored.

The restrictions also aid in identification of the model, given the lack of data on individual consumption levels.[6]

The consumption restrictions imbedded in the model imply that it would never be optimal for a student to borrow full attendance costs when he needs to borrow only half, as long as there is a negative effect of accumulated debt on post-graduation consumption. Further, the combined borrowing and working option, $k = 5$, may be optimal even though consumption cannot exceed c min. This latter option allows individuals to diversify between the negative future effects of accumulated debt and the negative current and future effects of in-school work. In the non-borrowing options, $k = 1, 4$, consumption can exceed c min but the decision to save excess resources from year to year is not explicitly modelled. If data on student assets during the school year were available, the decision to optimally allocate resources over 3 years of Law School could have been incorporated.

The choice set allows for only two possible borrowing amounts in each year of Law School, half attendance costs and full attendance costs. This discretization is rough but does not contradict any observed data. Only total accumulated debt upon graduation is reported, not yearly borrowing amounts. One drawback of specifying two discretized borrowing levels is that a student may borrow "too much". That is, if a student's resources, before borrowing, add up to more than half attendance costs, and he chooses to borrow half attendance costs, then he would be borrowing too much in order to reach c min. Ideally, the choice set would contain a fine enough discretization of debt levels so that the student could borrow less than half and just enough to cover full attendance costs. The specification of only two borrowing amounts eases computational burden at the cost of larger predicted total debt levels and thus larger estimated measurement error in accumulated debt upon graduation.

Consumption in the chosen option in year t is assumed to generate contemporaneous utility u_t^k according to a CRRA function,

$$u_t^k = \frac{\mu_k}{\lambda} c_{kt}^{\lambda} \tag{4}$$

where $1 - \lambda$ is the coefficient of relative risk aversion. The marginal utility of consumption is a function of k in order to capture the disutility of work effort. μ_k is restricted to equal one for $k = 1, 2, 3$ and $\mu_4 = \mu_5$.

Each year in which the student chooses one of the working options an extra unit of in-school work experience is accumulated. Accumulated work experience during Law School, hr_t, obeys the law of motion,

$$hr_t = hr_{t-1} + d_4(t) + d_5(t) \tag{5}$$

where the choice variable, $d_k(t)$, is defined such that $d_k(t) = 1$ if option k at time t is chosen and $d_k(t) = 0$ otherwise. The initial condition is $hr_0 = 0$.

Accumulated work experience is treated as an input into the deterministic component of the in-school wage offer function in year t, $\overline{w}_t$, the probability of making law review after the first year of Law School, π^{lr}, and the probability of graduating in the top 20% of the class, π^{t20}. More specifically,

$$\begin{aligned} w_t &= \overline{w}_t(hr_t, A_1, A_2)e^{\varepsilon_t} \\ \pi^{lr} &= \pi^{lr}(hr_t, A_1, A_2) \\ \pi^{t20} &= \pi^{t20}(hr_t, A_1, A_2) \end{aligned} \tag{6}$$

6. See Appendix B, which is available on the *Review* website, for the values of tc and c min that are used in empirical implementation. tc is a deterministic function of an individual's residency status and class year. c min is a deterministic function of class year.

where $\overline{w}_t$ is an exponential function of its arguments, leading to a Mincer type wage function. π^{lr} and π^{t20} are logistic functions ensuring that the probabilities lie in the unit interval. The dummy variables A_1 and A_2 correspond to three different unobserved types of individuals in the population, or three different mass points of permanent unobserved heterogeneity. The number of mass points was not specified *a priori* but was rather determined empirically.

Each year in which the student chooses one of the borrowing options, units of debt are accumulated. Accumulated debt during Law School, db_t, obeys the law of motion,

$$db_t = db_{t-1} + d_2(t) + 2d_3(t) + d_5(t). \tag{7}$$

The initial condition is $db_0 = 0$.

Accumulated units of debt are an input into a function that generates total educational debt upon graduation. The total education debt function is

$$D_3 = (0{\cdot}5(tc + c\min) * db_3). \tag{8}$$

3.2. *Post-graduation*

The choice set an individual faces upon graduation from Law School, denoted as K^{ml}, is assumed to contain five employment sectors or seven alternative positions: a solo position ($k = 1$), a business position ($k = 2$), a non-profit position ($k = 3$), a non-elite associate position ($k = 4$), an elite associate position ($k = 5$), a non-elite partner position ($k = 6$) and an elite partner position ($k = 7$).[7]

Employment in a particular employment sector is feasible only if a job offer is received. The vector of first job offer probabilities is specified as,

$$\mathbf{P}(1) = \{1, P_{02}, P_{03}, P_{04}, P_{05}, 0, 0\} \tag{9}$$

where P_{0k} denotes the probability of receiving an offer to work in position k immediately upon graduation from Law School. The restrictions imply that recent Law School graduates can become sole proprietors with certainty, cannot directly enter the post-graduation labour market as partners, and face stochastic probabilities of offers in the other positions.

On-the-job offer probabilities, P_{jk}, $j, k \in K^{ml}$, form the matrix,

$$\mathbf{P}(t) = \begin{pmatrix} 1 & P_{12} & P_{13} & P_{14} & P_{15} & 0 & 0 \\ 1 & 1 & P_{23} & P_{24} & P_{25} & 0 & 0 \\ 1 & P_{32} & 1 & P_{34} & P_{35} & 0 & 0 \\ 1 & P_{42} & P_{43} & P_{44} & P_{45} & P_{46} & 0 \\ 1 & P_{52} & P_{53} & P_{54} & P_{55} & 0 & P_{57} \\ 1 & P_{42} & P_{43} & 1 & P_{45} & 1 & 0 \\ 1 & P_{52} & P_{53} & P_{54} & 1 & 0 & 1 \end{pmatrix} \tag{10}$$

for $1 \leq t \leq T - 1$, where T is the terminal period. The restrictions imply that attorneys can always become sole proprietors regardless of prior period position (column one). The zeros in columns six and seven imply that an attorney must spend the prior period as an associate before facing a non-zero partnership probability. Solo, business and non-profit attorneys can, like partners, always continue in their respective positions. The restrictions in the matrix are empirically motivated and do not contradict any data in the sample.

Each row vector of job offer probabilities, excluding the associate continuation probabilities, P_{44} and P_{55}, and the partnership probabilities, P_{46} and P_{57}, are assumed to be multinomial

7. The classification rules used to assign individuals in the data to post-graduation employment sectors are described in detail in Sauer (1998).

logistic in the individual's accumulated in-school work experience, hr_3, whether the individual made law review, lr, whether the individual graduated in the top 20% of the class, $t20$, and the individual's unobserved type. That is,

$$P_{jk} = P_{jk}(hr_3, lr, t20, A_1, A_2). \tag{11}$$

The multinomial logit assumption implies that only one offer will be received in each period and ensures that all arrival rates lie in the unit interval.

Promotion and dismissal in the non-elite and elite private law firm sectors take place within an up-or-out employment structure. The event of coming up for partnership review, at the beginning of year t, occurs with probability $P_{c4}(t)$ in the non-elite sector and probability $P_{c5}(t)$ in the elite sector. These probabilities are assumed to be zero for $t < 4$ and constant otherwise. When an associate comes up for review, he is either dismissed from the sector or promoted to partner. That is, P_{44} and P_{55} become zero and P_{46} and P_{57} become non-zero.[8]

The promotion probabilities P_{46} and P_{57} are assumed to be logistic functions of Law School scholastic achievement, unobserved type and cross experience in the post-graduation labour market,

$$\begin{aligned} P_{46} &= P_{46}(lr, t20, x_{2t}, A_1, A_2) \\ P_{57} &= P_{57}(lr, t20, x_{1t}, A_1, A_2). \end{aligned} \tag{12}$$

x_{2t} denotes actual accumulated experience in the elite sector and x_{1t} denotes actual accumulated experience outside of the elite sector. It is important to distinguish elite sector experience since it is thought to have considerable investment value in other sectors of the market.

x_{1t} and x_{2t} evolve according to the following law of motion:

$$\begin{aligned} x_{1t} &= x_{1,t-1} + d_1(t) + d_2(t) + d_3(t) + d_4(t) + d_6(t) \\ x_{2t} &= x_{2,t-1} + d_5(t) + d_7(t). \end{aligned} \tag{13}$$

The initial conditions are $x_{10} = x_{20} = 0$.

Work experience in the post-graduation labour market, work experience during Law School, scholastic achievement in Law School and unobserved type also enter into the post-graduation wage offer function in each position k in year t,

$$\begin{aligned} \ln \overline{w}_{kt} = {} & \beta_{k0} + \beta_{k1} hr_3 + \beta_{k2} lr + \beta_{k3} t20 + \beta_{k4} A_1 + \beta_{k5} A_2 \\ & + \beta_{k6} x_{1t} - \beta_{k7} x_{1t}^2 + \beta_{k8} x_{2t} - \beta_{k9} x_{2t}^2 + \varepsilon_{kt}. \end{aligned} \tag{14}$$

The stochastic component ε_{kt} is an alternative-specific productivity shock. Productivity shocks are assumed to be multivariate normal but are mutually serially independent.

Post-graduation consumption at time t in position k is specified as,

$$c_{kt} = w_{kt} - g(D_3) \tag{15}$$

where $g(\cdot)$ is a function which transforms total educational debt upon graduation from Law School, D_3, into yearly debt service payments. The $g(\cdot)$ function that is empirically implemented assumes a loan term of 10 years, a real yearly interest rate of 5·3% and equal yearly payments. Given the lack of data on post-graduation asset levels it is assumed that no saving and no further borrowing occurs after graduation.[9]

8. O'Flaherty and Siow (1995) model up-or-out employment structures in a similar way. Spurr (1987) notes the importance of distinguishing the timing and rate of promotion in small and large private law firms.

9. Further borrowing after graduation might take the form of lengthening the term of the loan. Lengthening the term to 15 years does not considerably change the results. The possibilities of larger than required debt-service payments and loan default are not incorporated into the model due to lack of data.

Consumption in the post-graduation labour market, as in Law School, generates contemporaneous utility according to the CRRA function in (4). Even though there is no borrowing or saving after graduation, specification of a non-linear utility function is important because linear utility, or pure wealth maximization, would necessarily imply that educational debt has no effect on post-graduation career choices. The CRRA utility function after graduation has different μ_k terms than during Law School in order to capture the disutility of work effort over post-graduation employment sectors. The identifying restriction is $\mu_k = 1$ for $k = 3$. Estimated disutilities are thus relative to the disutility of work effort in the non-profit sector.

3.3. Solution and estimation method

Individuals are assumed to maximize expected lifetime utility by choosing in each period, until a known terminal period T, one of the feasible discrete alternatives in the time-dependent choice sets, K^{ls} and K^{ml}. The maximized objective function at any time t, $V_t(\Omega_t)$, is given by

$$V_t(\Omega_t) = \max_{\{d_k(t)\}} E\left[\sum_{\tau=t}^{T} \sum_{K^{ls},K^{ml}} \delta_{A_j}^{\tau-t} u_t^k d_k(\tau) \,\middle|\, \Omega_t\right] \tag{16}$$

where E is the expectations operator, Ω_t is the state space at time t and δ_{A_j}, $j = 0, 1, 2$, is the subjective discount factor. The discount factor is allowed to differ by unobserved type in order to incorporate heterogeneity in rates of time preference. The elements of Ω_t are F_0, F_1, F_2, Ivy, MA, $I(age > 24)$, OS, $I(LSAT > 737)$, $I(tr_t^p > 0)$, $I(tr_t^a > 0)$, A_0, A_1, A_2, lr, $t20$, hr_t, db_t, x_{1t}, x_{2t}, $d_k(t-1)$, ε_{ut}, ε_{wt} and ε_{kt}. The maximization of the objective function is achieved by choice of the optimal sequence of feasible control variables $\{d_k(t)\}$, $k \in K^{ls}, K^{ml}$, given current realizations of the stochastic elements of the model.

The maximization problem can be recast in a dynamic programming framework by specifying the value function, $V_t(\Omega_t)$, as the maximum over alternative-specific value functions, $V_t^k(\Omega_t)$, that satisfy Bellman (1957) equations. That is,

$$\begin{aligned} V_t(\Omega_t) &= \max[V_t^1(\Omega_t), \ldots, V_t^{K^i}(\Omega_t)], \qquad i = ls, ml \\ V_t^k(\Omega_t) &= u_t^k + \delta_{A_j} E(V_{t+1}(\Omega_{t+1}) \mid d_k(t) = 1, \Omega_t) \end{aligned} \tag{17}$$

where the expectation is taken over the joint distribution of the random elements of the model.

Since it is difficult, in general, to find analytic solutions to dynamic programmes of this type, the model is solved numerically by backward recursion. The solution consists of generating $E(V_t(\Omega_t))$, or the $E\max_t$ function, for every combination of state space elements and choices at time t. The terminal period, T, is fixed at 15 years after graduation from Law School for each individual and the terminal period alternative-specific $E\max_T$ is assumed to be proportional to u_T^k (Rust, 1987). The proportionality constant, α_T, is estimated along with the other parameters of the model.

Calculation of the multivariate integrals in the $E\max_t$ function is accomplished by Monte-Carlo integration, which uses 50 draws of the random elements of the model. The state space is not too large as to necessitate interpolation and/or regression techniques (Keane and Wolpin (1994, 1997), Rust (1997)) to recover the $E\max_t$ function. That is, a full numerical solution to the dynamic programme is feasible. Given $E\max_t$, the alternative-specific value functions are known up to the current period random shocks.

The model is estimated by simulated maximum likelihood (SML). The SML procedure that is employed assumes classification error in all reported discrete outcomes. Assuming classification error enables a relatively small set of unconditional simulated event histories to be used to construct the likelihood contributions for each individual in the sample. The same

3000 simulated event histories are used to build the likelihood contribution for each of the 658 graduates. In the presence of classification error, each simulated event history is, with positive probability, the individual's true event history. This helps circumvent the usual problem in frequency simulation of zero probability events reported in the data. The use of unconditional simulations to form the likelihood, rather than conditional simulations, also "solves" the problem of missing endogenous state variables.

The classification error process in discrete outcomes is assumed to be unbiased, implying that the reported choice in time t is, on average, equal to the true choice in time t. This assumption, which is akin to mean zero measurement error, yields classification error rates that are linear in the true choice probability (see Keane and Wolpin (2001), Keane and Sauer (2002)),

$$\begin{aligned} \pi_{kkt} &= E + (1 - E)\Pr(d_k(t) = 1) \\ \pi_{\tilde{k}kt} &= (1 - E)\Pr(d_k(t) = 1). \end{aligned} \tag{18}$$

π_{kkt} is the classification error rate that enters the individual's likelihood contribution in time t whenever choice k is simulated and choice k is reported. When choice $\tilde{k}$ is simulated and choice k is reported, the relevant classification error rate is $\pi_{\tilde{k}kt}$. E is an estimable parameter and is interpreted as the base classification error rate.

The true choice probability $\Pr(d_k(t) = 1)$ in (18) is computed using a kernel-smoothed frequency simulator over simulated choices in period t. The kernel is a logistic function of the difference between each alternative-specific value function and the maximum over alternative-specific value functions in period t. The bandwidth parameter in the kernel was fixed *a priori* at 25.

The likelihood contribution for each individual is constructed by computing the product of classification error rates for each simulated event history and then averaging over the total number of simulations. If a choice is missing in period t, there is no contribution to the product of classification error rates in that period. The likelihood contribution also includes the observed continuous data on parental cash transfers, initial assets, educational debt, Law School employment earnings and post-graduation accepted wages by multiplying the classification error rates by measurement error densities. Measurement error in observed continuous outcomes is assumed to be lognormally distributed with zero mean and estimable variance. Lognormality ensures that theoretically positive outcomes remain positive.

The likelihood contributions also incorporate the joint probability of initial conditions. The observed initial conditions in the model are F_0, F_1, F_2, Ivy, MA, $I(age > 24)$, OS and $I(LSAT > 737)$, $I(tr_t^p > 0)$ and $I(tr_t^a > 0)$. The values of these variables are simulated together with the event histories. The probabilities of the observed initial conditions are denoted as λ_{f_0}, λ_{f_1}, λ_{f_2}, λ_{ivy}, λ_{ma}, λ_{age}, λ_{os} and λ_{lsat}, λ_{tr^p}, λ_{tr^a}, respectively, and are estimated along with the other parameters of the model.

The unobserved initial conditions in the model are the unobserved types A_0, A_1 and A_2. The type probabilities, denoted as π^{A_j}, $j = 0, 1, 2$, serve as weights for the type-specific likelihood contributions. The type probabilities are specified to be multinomial in observed initial conditions, *i.e.*

$$\pi^{A_j} = \pi^{A_j}(F_1, F_2, Ivy, MA, I(age > 24), OS, I(LSAT > 737)), \qquad j = 0, 1, 2. \tag{19}$$

This specification incorporates heteroscedasticity in the distribution of mass points (Heckman and Singer, 1984) and is the avenue through which family background and prior human capital investments determine the rate of time preference, scholastic ability and potential earnings during Law School and in the post-graduation labour market. Note that the full set of observed

TABLE 3

Estimated marginal type probabilities by father's occupation

	Pr(Type 0)	Pr(Type 1)	Pr(Type 2)
Father attorney/prof.	0·138	0·358	0·504
Father mgr./teacher	0·340	0·212	0·448
Father blue collar	0·405	0·326	0·269

characteristics, except for graduation year, appear in the type probabilities. The effect of family background on lifetime outcomes, through the type probabilities, is net of the correlation of family background with prior human capital investments, parental cash transfers and initial assets.[10]

Non-zero parental cash transfers and initial assets are assumed to be log-linear functions of family background, age at Law School entry, residency status and unobserved type,

$$\begin{aligned} tr_t^p &= tr_t^p(F_1, F_2, I(age > 24), OS, A_1, A_2) \\ tr_t^a &= tr_t^a(F_1, F_2, I(age > 24), OS, A_1, A_2). \end{aligned} \tag{20}$$

This system of equations represents the reduced form of a more general, possibly intra-family, optimization problem that jointly determines the amount of resources available to the student while in school. The student is assumed to take parental cash transfers and initial assets as given when deciding among the feasible options in the choice set during Law School. Parental transfers and initial assets are thus considered as endowments.

It is further assumed that total parental transfers and initial assets are evenly divided over the 3 years of Law School. This latter assumption is necessary since data on yearly contributions are not available. In this specification, parents do not explicitly react to the work decisions of offspring, but may vary their total contributions based on the offspring's unobserved type. The offspring's unobserved type partially determines whether he is a borrower or a worker. The imbedded reduced form system in (20) is essentially a selection-corrected, non-parametric multivariate tobit.

Maximization of the log-likelihood function proceeds by updating the parameter space, re-solving the dynamic programme and re-simulating initial conditions and event histories for each iteration of the optimization algorithm. Standard errors are obtained by computing numerical derivatives and the outer product approximation to the Hessian. A general outline of the estimation algorithm is given in Appendix D, which is available on the *Review* website.

4. ESTIMATION RESULTS

This section discusses specific parameter estimates of interest and model fit. The full set of parameter estimates (149 in total) and their t-values are reported in Appendix A.

4.1. Initial conditions

The estimated parameters of the type probabilities reveal a strong relationship between family background and unobserved type. Table 3 presents the estimated marginal type probabilities by father's occupation at the time of entry to Law School. Among individuals with an attorney or other professional father, the probability of being type 2 is 0·50. The probability of being type 2 is

10. Graduation year is not an important covariate in the raw data. Directly entering the full set of observed initial conditions into the various functions in the model is much less parsimonious and leads to identification problems.

0·45 among those with a manager, business owner or teacher father and 0·27 among individuals with a blue-collar or other occupation father. The ordering of the type 0 probability by father's occupation is reversed. The heteroscedasticity in the distribution of mass points by father's occupation is thus quite evident. It will also be shown below that the individual's unobserved type is a strong determinant of lifetime earnings. Type 2 individuals have significantly higher lifetime earnings than type 1 individuals and type 1 individuals have significantly higher lifetime earnings than type 0 individuals. Selection on unobservables is an important feature of the data and this selection is significantly related to family background.

The relative importance of family background and prior human capital investments in determining an individuals unobserved type can be summarized by their marginal effects on the combined probability of being either type 1 or type 2. The estimated marginal effects are 0·27 for individuals with an attorney or other professional father, 0·06 for individuals with a manager, business owner or teacher father, 0·12 for individuals with an Ivy League BA, 0·09 for individuals with an MA, 0·04 for individuals that are older upon entry to Law School and 0·06 for individuals that scored in the top quintile of the $LSAT$.

The estimates of the parental cash transfer function indicate that resources available to parents, as proxied by father's occupation at the time of entry to Law School, strongly determine the level of transfers. An individual with an attorney or other professional father receives 92% more transfers and an individual with a manager, business owner or teacher father receives 42% more transfers than an individual with a blue-collar or other occupation father, respectively. It is interesting to note that without explicitly using data on parental transfers, Keane and Wolpin (2001) also found that parental transfers are strongly positively correlated with parental resources.

The estimated parental transfer function also indicates that out-of-state students, who are subject to higher tuition costs, receive 13% more transfers. Type 1 and type 2 individuals receive 1·5% more and 10% more transfers than type 0 individuals, respectively. This can be interpreted as parents investing more in offspring with higher lifetime earnings potential. Students that are older upon entry to Law School receive 57% less transfers, suggesting a partial substitution of financing resources between parents and offspring. Substitutability between parental support and offspring assets has been found before in other contexts (see Rosenzweig and Wolpin, 1994).

The partial substitution of resources becomes more evident when one examines the effect of age at entry to Law School on initial assets. Initial assets are 70% higher among older students. This is to be expected since older students are more likely to be married and may have worked and saved for re-entry to school. Out-of-state students have higher initial assets by 2·4% suggesting greater savings in anticipation of higher tuition costs. Type 1 and type 2 individuals have higher initial assets than type 0 individuals by 5·8 and 6·4%, respectively.

4.2. Law School and beyond

The estimated annual in-school wage offer function indicates substantial heterogeneity in part-time earnings capacity. Type 1 and type 2 individuals receive 46 and 15% higher wage offers, respectively. The return to actual in-school work experience while in school is 3·5% per year.

The probability of making law review after the first year of Law School is significantly affected by unobserved type and in-school work experience. The estimated marginal effects are 0·13 and 0·25 for type 1 and type 2 individuals, respectively. Working during the first year of Law School decreases the probability of making law review by 5%. The marginal effects on the probability of graduating in the top 20% are 0·23 and 0·41 for type 1 and type 2 individuals, respectively. However, accumulated in-school work experience does not significantly decrease the probability of this latter measure of scholastic achievement. Significant negative effects of in-school work experience may only exist at lower graduating percentiles.

TABLE 4

Actual and predicted Law School choice distribution

	No work Don't borrow	No work Borrow half	No work Borrow full	Total	Work Don't borrow	Work Borrow half	Total
Year 1							
Actual	—	—	—	0·790	—	—	0·210
Predicted	0·274	0·302	0·218	0·794	0·206	0·000	0·206
Year 2							
Actual	—	—	—	0·629	—	—	0·371
Predicted	0·193	0·249	0·215	0·657	0·343	0·000	0·343
Year 3							
Actual	—	—	—	0·569	—	—	0·431
Predicted	0·191	0·137	0·219	0·547	0·368	0·085	0·453

TABLE 5

Actual and predicted Law School transition matrix

	No work	Work
No work		
Actual	0·782	0·218
Predicted	0·792	0·208
Work		
Actual	0·134	0·866
Predicted	0·100	0·900

Table 4 displays the borrowing and work decisions in each year of Law School, in the actual data and in the simulated data produced by the model at the maximum likelihood estimates. The actual choice proportions can be calculated only for the total number of individuals in the No Work and Work options in each year. The model can, however, predict the proportions of individuals in the different debt subcategories in each year. The actual figures show that 21% of the sample work during the first year of Law School. In the second year of Law School there is a 16% increase in the proportion of Law School students working. In the third year of Law School an additional 6% choose to work. Given that the majority of the data on Law School outcomes are 3-year totals, this yearly variation in the proportion of individuals working is quite important for identification.

The model is capable of reproducing the sharp increase in the proportion working between years 1 and 2 and the more moderate increase in year 3. The sharp increase from year 1 to 2 is mostly explained by the high value of making law review in the post-graduation labour market and the significant negative effect of working on the chances of making law review. Once the first year law review constraint is relaxed, there is a large increase in the proportion working. Note that part of the sharp increase in the proportion working could be due to the first year of Law School simply being more demanding in terms of time and energy than subsequent years.

The more moderate increase in the proportion working from year 2 to 3 is due to the positive correlation between productivity and asset shocks. Individuals that began working in year 2 and that receive simultaneous negative productivity and unobserved asset shocks in year 3, can no longer fully finance attendance costs by working and not borrowing. They, instead, choose to work and borrow rather than borrow only. It is the investment value of in-school work experience

TABLE 6

Actual and predicted educational debts, Law School earnings and Law School scholastic achievement

	No debt	Less than $15,000	$15,000–$30,000	More than $30,000	Mean debt > 0
Actual	0·388	0·226	0·273	0·113	21,021
Predicted	0·479	0·218	0·256	0·047	20,165
	Earnings > 0		Mean earnings	Law review	Top 20
Actual	0·465		9637	0·246	0·391
Predicted	0·508		11,242	0·242	0·432

in the post-graduation labour market, and not current consumption levels, that generates the persistence in the in-school working decisions of these latter individuals.

The overall ability of the model to reproduce the pattern of transitions between the No Work and Work options is illustrated in Table 5. Shocks to unobserved assets and productivity are important determinants of these transitions. The estimated mean of unobserved assets, over 3 years of Law School, is more than 20% of total out-of-state attendance costs. The relatively high estimated mean of unobserved assets and the sensitivity to its stochastic component suggest that summer employment is an important factor in the decision to work while in school.

The level of parental cash transfers and the disutility of work effort also substantially influence educational borrowing and in-school work decisions. Simulations of the model reveal that type 1 and type 2 individuals with an intermediate level of parental transfers quite often abandon borrowing and choose to work when they receive increases in parental support. The higher level of parental transfers combined with market wages allows these individuals to reach higher current consumption and utility levels that outweigh the disutility of work effort. This somewhat perverse income effect arises since working is the avenue through which individuals increase consumption over the limited consumption that is achievable through borrowing. Increases in parental transfers for individuals with low levels of resources generally leads to less borrowing only.

The result that type 1 and type 2 are the individuals that are most likely to be induced to work with an increase in parental transfers also highlights that selection into in-school work is positively related to part-time earnings potential and scholastic ability. Type 1 and type 2 receive significantly higher part-time wage offers and have significantly higher starting probabilities of making law review. Selection into work is also (weakly) related to differential impatience in consumption. The estimated discount factors for type 1 and type 2 are 0·95 and 0·86, respectively. The discount factor for type 0 individuals is normalized to 0·95.[11] The lower discount factor for type 2 individuals helps "convince" them to work despite their lower part-time earnings capacity relative to type 1 individuals. A factor which is also important in this regard is the willingness to substitute consumption intertemporally. $\hat{\lambda}$ in (4) is estimated to be 0·23, which is relatively high and more in line with the $\hat{\lambda}$ of 0·52 found in Keane and Wolpin (2001), than the $\hat{\lambda}$ of approximately -2 typically found in the life cycle consumption literature (see Hubbard, Skinner and Zeldes, 1994).

Table 6 presents some additional dimensions of model fit. The first panel illustrates the fit of the model to the distribution of educational debt upon graduation from Law School. The mean

11. Discount factors are theoretically identified in finite-horizon dynamic programmes (see Wolpin, 1987), but are often practically difficult to estimate. The normalization and minimum consumption restrictions aid in empirical identification.

TABLE 7

Actual and predicted post-graduation choice distribution and mean accepted wages

	Solo	Business	Non-profit	Non-elite	Elite
Year 1					
Choices					
Actual	0·005	0·044	0·096	0·403	0·452
Predicted	0·010	0·026	0·117	0·398	0·450
Wages					
Actual	19,432	46,559	35,006	36,826	49,252
Predicted	30,643	43,011	37,791	37,187	47,088
Year 5					
Choices					
Actual	0·018	0·114	0·119	0·396	0·355
Predicted	0·022	0·102	0·134	0·360	0·382
Wages					
Actual	43,680	55,546	40,309	53,337	62,427
Predicted	44,449	65,806	46,229	55,679	70,147
Year 15					
Choices					
Actual	0·047	0·188	0·119	0·368	0·278
Predicted	0·054	0·170	0·088	0·374	0·313
Wages					
Actual	65,642	138,859	69,850	136,358	200,331
Predicted	54,774	128,865	64,044	138,314	171,404

Note: Wages are in 1992 dollars.

positive debt level in the sample is reproduced quite well. The middle of the distribution of debt is also fit well but there are misses in the tails. The proportion with zero debt is overpredicted and the proportion with very high levels of debt is underpredicted. The model is also capable of reproducing the proportion of individuals with positive labour earnings over 3 years of Law School but somewhat overpredicts mean positive earnings. The proportion of individuals that make law review and graduate in the top 20% of the class is reproduced quite accurately.

The estimated post-graduation wage offer functions indicate that having made law review increases wage offers in private law firms by 10·5%. Having graduated in the top 20% of the class increases wage offers by a more modest 3·1%. The estimated coefficients also imply that working 2 years during Law School raises wage offers after graduation by roughly 1·2%. This is considerably less than the 10–14% returns to working 2 years during college estimated by Light (2001). However, there is an additional pay-off to in-school work experience in this model. It significantly raises the probability of getting job offers in the non-profit sector.

Table 7 displays the fit of the model to the choice distribution and mean accepted wages in each sector in years 1, 5 and 15 after graduation. The model reproduces, fairly accurately, the yearly choice frequencies, yearly transitions and the timing of transitions. The changing order of mean accepted wages across sectors in each year is also reproduced quite well. The fit to post-graduation outcomes is not substantially different from that reported and explained in Sauer (1998), despite the different class years and added complexity of the model estimated in the current study.

The estimated model reveals considerable selection into different post-graduation employment sectors. In year 15 after graduation, 65% of those working in the elite sector

(mostly as partners) are type 2, 23% are type 1 and 12% are type 0. Type 1 and type 2 constitute 88% of the elite sector, but only 67% of the sample. Of those working in the elite sector in year 15, 53% made law review and 58% graduated in the top 20% of the class. The corresponding sample proportions are 25 and 39%, respectively. The composition of individuals in the non-profit sector is substantially different. Of those working in the non-profit sector in year 15, 70% are type 0, 99·6% did not make law review and 75% did not graduate in the top 20% of the class.

It is important to note that, in this model, the estimated effects of in-school work experience and scholastic achievement are causal, conditional on the model being able to capture all the relevant aspects of decision making and conditional on the identification structure. Working in favour of a causal interpretation is the tight parametrization of decision rules and the liberal appearance of unobserved discrete individual effects. The discrete individual effects are random but are not forced to follow any parametric distribution. Working against a causal interpretation is the unidimensionality of both unobserved heterogeneity and in-school work experience. Overall, human capital/signalling effects are reasonably distinguished from the effects of ability and/or preferences.

4.3. Measurement error

The estimate of E in equation (18) implies that the probability that a low probability discrete outcome is correctly classified is approximately 0·82. The probability that higher probability discrete outcomes are correctly classified increases linearly above 0·82 as the true probability of the event itself grows. Misclassification is thus not an essential feature of the data. The estimated measurement error standard deviations for continuous educational financing outcomes and for post-graduation accepted wages offers are 0·785 and 0·377, respectively. These estimated standard deviations are relatively larger than the estimated standard deviations of shocks to unobserved assets and productivity. The extent of measurement error is similar in magnitude to that found in Keane and Wolpin (2001). Incorporating measurement error in continuous outcomes is empirically important.

5. DISCUSSION

5.1. The relative importance of short-term parental cash transfers

The relative importance of short-term parental cash transfers implied by the model can be assessed by computing linear projections of predicted lifetime earnings and consumption on the observed covariates in Table 2 and unobserved type. The effects of the covariates displayed in Table 8 incorporate the behavioural restrictions imposed on the data and are corrected for unobserved heterogeneity and self-selection. The linear projections use, as data, the 3000 simulated event histories generated at the maximum point of the SML procedure.

Column (1) of Table 8 displays the results of regressing the natural log of predicted lifetime earnings on observed initial conditions. The dependent variable is constructed by discounting, using a discount factor of 0·95, simulated accepted wages back to the first year after graduation from Law School. The results indicate that having an attorney or other professional father increases lifetime earnings by 4·4% and having a manager, business owner or teacher father increases lifetime earnings by 2·7%. These returns are considerably higher than the corresponding estimates in Table 2.

The returns to pre-Law School human capital investments in Column (1) are 1·8, 1 and 1·3% for having an Ivy League BA, having an MA and being relatively older upon entry to Law School, respectively. The returns to parental transfers and initial assets are both negligible.

TABLE 8

Predicted lifetime earnings and consumption regressions

Variable	Log of lifetime earnings (1)	(2)	(3)	Log and level of lifetime consumption (4)	(5)
Constant	13·5677	13·4834	13·4521	13·2643	582,405
	(0·0088)	(0·0091)	(0·0086)	(0·0086)	(5479)
Father attorney/prof.	0·0441	0·0015	−0·0014	−0·0027	−3667
	(0·0112)	(0·0104)	(0·0096)	(0·0096)	(6160)
Father mgr./teacher	0·0266	0·0077	0·0016	0·0019	111
	(0·0081)	(0·0076)	(0·0068)	(0·0068)	(4353)
Ivy League BA	0·0184	−0·0058	−0·0004	−0·0004	−5
	(0·0107)	(0·0099)	(0·0089)	(0·0089)	(5696)
Master's degree	0·0100	0·0105	0·0060	0·0054	2202
	(0·0129)	(0·0120)	(0·0108)	(0·0108)	(6887)
$I(age > 24)$	0·0126	−0·0027	−0·0040	−0·0055	−2834
	(0·0107)	(0·0099)	(0·0089)	(0·0088)	(5691)
Out-of-state resident	−0·0128	0·0025	0·0002	−0·0156	−11,194
	(0·0075)	(0·0069)	(0·0062)	(0·0062)	(3950)
$I(LSAT > 737)$	0·0195	0·0095	0·0089	0·0087	5784
	(0·0083)	(0·0076)	(0·0069)	(0·0069)	(4390)
Parental transfers	0·00067	0·00008	0·00026	0·00250	1·76
	(0·00042)	(0·00038)	(0·00035)	(0·00035)	(0·22)
Initial assets	0·00054	−0·00001	0·00001	0·00239	1·63
	(0·00054)	(0·00050)	(0·00045)	(0·00045)	(0·29)
Type 1		0·1155	0·0777	0·0825	52,664
		(0·0087)	(0·0085)	(0·0085)	(5449)
Type 2		0·1936	0·1321	0·1308	85,585
		(0·0082)	(0·0081)	(0·0081)	(5185)
Law review			0·1877	0·1863	132,917
			(0·0072)	(0·0072)	(4621)
Top 20% of class			0·0389	0·0390	27,948
			(0·0064)	(0·0064)	(4115)
In-school work exp.			0·0063	0·0185	12,097
			(0·0030)	(0·0030)	(1883)
$RMSE$	0·1984	0·1822	0·1639	0·1633	100,000
R^2	0·0150	0·1700	0·3288	0·3541	0·3895
N	3000	3000	3000	3000	3000

Note: Parental transfers and initial assets are divided by 1000 in Columns (1) through (4). Robust standard errors are in parentheses.

The model explains the weak returns to parental transfers through an in-school labour supply effect that leads to lower scholastic achievement and greater work experience. The return to in-school work experience fully compensates for the loss in earnings due to lower scholastic achievement.

Column (2) adds the unobserved type dummies. Given the strong correlation between family background and unobserved type, the effect of family background is wiped out. The effects of parental cash transfers and initial assets are also further reduced in magnitude. The effect of unobserved type is quite substantial. Type 2 individuals have 19·4% higher lifetime earnings and type 1 individuals have 11·6% higher lifetime earnings than type 0 individuals.

Column (3) adds the scholastic achievement measures and accumulated in-school work experience. Making law review and graduating in the top 20% of the class increase lifetime earnings by 18·8 and 3·9%, respectively. The returns to accumulated in-school work experience is 0·6% per year. Note that these latter three returns are all considerably smaller than the corresponding estimates in Table 2. Running this specification in levels shows that an additional dollar transferred from parent to offspring increases lifetime earnings by 25 cents. This is smaller than the corresponding estimate of 30 cents in the raw data. The returns to unobserved type are reduced to 7·8 and 13·2% for type 1 and type 2, respectively.

Column (4) repeats the specification in Column (3) but uses the natural log of lifetime consumption, discounted back to the first year of Law School, as the dependent variable. The results indicate that parental transfers and in-school work experience significantly increase lifetime consumption. An increase of 1000 dollars in parental transfers increases lifetime consumption by 2·5%. An extra year of in-school work experience increases lifetime consumption by 1·8%. The strong effects of parental transfers and in-school work experience are due to increased in-school labour supply and decreased post-graduation debt burdens.

Column (5) repeats the specification in Column (4) in levels. The estimated coefficient on parental transfers is 1·76. An extra dollar transferred from parent to offspring increases the lifetime consumption of offspring by 1 dollar and 76 cents. An additional regression, not shown in the table, replaces the level of lifetime consumption with the level of post-graduation lifetime consumption only. The estimated coefficient on parental cash transfers is 1·62. The "additionality effect" of 76 cents can thus be decomposed into 14 cents of increased in-school consumption and 62 cents of increased post-graduation consumption. This decomposition is not very sensitive to either the number of simulated event histories used in the linear projections nor the discount factor used to calculate the dependent variable.

5.2. *The effect of educational debt on career choices*

The estimated model can also be used to examine the hypothesis, underlying many loan-forgiveness programmes, that educational debt affects career choices. This hypothesis can be examined by simulating the outcomes of a counterfactual loan-forgiveness programme. The experiment is counterfactual since all of the individuals in the sample graduated before the UMLS loan-forgiveness programme was instituted.

Loan-forgiveness programmes in many elite Law Schools in the U.S. provide subsidies to Law School graduates that have educational debt and that choose employment in the non-profit sector. The loan-forgiveness programme simulated in this subsection grants a subsidy, equal in amount to the individual's yearly debt service obligation, whenever a job in the non-profit sector within the first 10 years of graduation is accepted. The yearly subsidies do not have to be repaid if the individual decides to subsequently leave the sector.[12]

The results of the simulation are reported in Table 9. The figures show that the programme induces a substitution effect of more borrowing during Law School. This is a sensible result considering that loan-forgiveness reduces the price of borrowing to the extent that the student expects to work in the non-profit sector after graduation. The effect is most pronounced on those students that previously worked and did not borrow. These students are now more likely to not work and borrow half of the attendance costs in each year of Law School. As a result, average

12. The University of Chicago, Columbia University, Cornell University, Georgetown University, Northwestern University, The University of Pennsylvania, Stanford University, The University of Southern California, The University of Virginia, and Yale University all require employment in the non-profit sector for loan-forgiveness programme eligibility. The programmes at Harvard University, The University of Michigan and New York University are slightly more general in that they provide assistance on the basis of income level only. See Vernon (1989) for details.

TABLE 9

Loan-forgiveness simulation choice distributions

	Law School						
	No work Don't borrow	No work Borrow half	No work Borrow full	Total	Work Don't borrow	Work Borrow half	Total
Year 1							
Baseline	0·274	0·302	0·218	0·794	0·206	0·000	0·206
Forgive	0·274	0·334	0·219	0·827	0·173	0·000	0·173
Year 2							
Baseline	0·193	0·249	0·215	0·657	0·343	0·000	0·343
Forgive	0·193	0·284	0·217	0·693	0·307	0·000	0·307
Year 3							
Baseline	0·191	0·137	0·219	0·547	0·368	0·085	0·453
Forgive	0·191	0·145	0·238	0·575	0·341	0·085	0·425

	Post-graduation				
	Solo	Business	Non-profit	Non-elite	Elite
Year 1					
Baseline	0·010	0·026	0·117	0·398	0·450
Forgive	0·010	0·026	0·117	0·398	0·450
Year 5					
Baseline	0·022	0·102	0·134	0·360	0·382
Forgive	0·022	0·101	0·151	0·347	0·380
Year 15					
Baseline	0·054	0·170	0·088	0·374	0·313
Forgive	0·054	0·169	0·100	0·365	0·312

positive indebtedness in the sample increases by 5%. The predicted movement out of work and into borrowing when borrowing becomes relatively cheaper is consistent with the findings of Leslie (1984) and Keane and Wolpin (2001) in different contexts.

The figures also show that loan-forgiveness has virtually no effect on the first job choice distribution. Law School graduates that previously entered the non-profit sector, mainly type 0 individuals that did not make law review, continue to enter the sector. However, they enter with more debt. These same types also continue to enter private law firms immediately after graduation whenever a job offer is received. The loan-forgiveness subsidies are not enough of an incentive to forgo the considerable investment value of private law firm experience. There are, however, more job transitions to the non-profit sector by year 5 after graduation as type 0 individuals with poor promotion prospects in private law firms exit their jobs earlier and transit to the non-profit sector more often. By year 15 after graduation, participation in the non-profit sector is higher by 1·2%. In terms of the baseline percentage of those in the non-profit sector, participation increases by 13·6%.

The effect of loan-forgiveness on non-profit sector participation is not substantially different from the effect found in Sauer (1998). However, allowing educational debt to be endogenous, in contrast to this previous study, sheds considerable light on the costs of loan-forgiveness. The costs of loan-forgiveness are clearly higher when debt is treated as endogenous and individuals are allowed to borrow more in reaction to the programme. Nonetheless, costs are kept under control since subsidies are tied to a relatively low-paying type of post-graduation employment.

It is important to note that the modest increases in non-profit sector participation and educational debt levels are most probably lower bound effects. Educational loan-forgiveness programmes should differentially attract more "non-profit" types of individuals to apply to Law School, enter Law School, incur educational debt and enter the non-profit sector after graduation. Parents might also reduce the amount that they voluntarily contribute to their offspring's education in reaction to the programme, perhaps leading to further increases in educational debt levels.

6. CONCLUSION

In this paper a dynamic programming model of optimal educational financing decisions is formulated and estimated. The study measures the effect of short-term parental cash transfers, received during school, on educational borrowing and in-school work decisions, and on lifetime outcomes. The relative importance of parental cash transfers is analysed on a different margin than previous studies and a direct measure of parental financial support is incorporated into the analysis. The accumulation of educational debt is explicitly modelled and treated as endogenous.

The estimated parameters of the model imply that short-term parental cash transfers do not significantly influence lifetime earnings. The reason is that parental cash transfers encourage in-school work among some individuals. In-school work experience hurts scholastic achievement but has a significant pay-off in the post-graduation labour market. The negligible overall effect implies that the returns to in-school work experience fully compensate for the loss in lifetime earnings due to lower scholastic achievement.

Although parental cash transfers do not significantly affect post-graduation lifetime earnings, they do significantly affect lifetime consumption. When individuals can optimally use parental transfers as a wage subsidy, they achieve higher levels of consumption while in school and after graduation. When individuals borrow less with increases in parental transfers, they achieve higher levels of post-graduation consumption only. An extra dollar transferred from parent to offspring is estimated to increase mean lifetime consumption by 1 dollar and 76 cents. The additionality effect of 76 cents is decomposed into 14 cents of increased in-school consumption and 62 cents of increased post-graduation consumption.

The estimated parameters of the model also suggest that educational debt has only a modest influence on post-graduation career choices. A simulated counterfactual loan-forgiveness programme that subsidizes debt payments in return for accepting a job in the non-profit sector increases non-profit sector participation by 1·2% in year 15 after graduation. Mean indebtedness also increases by 5% as the cost of borrowing is reduced and some individuals choose to borrow more instead of working.

The policy implications of the study are that, in the short run, tuition tax credits and other government incentive schemes aimed at encouraging parents to finance a greater proportion of education costs will not have large effects on the career choices and post-graduation lifetime earnings of offspring. Expanding loan-forgiveness programmes will also not substantially affect post-graduation outcomes. However, expanding loan-forgiveness will lead to more student indebtedness.

Due to data and computational limitations, the model in this paper could not explicitly take into account the decision to optimally allocate resources over different school years nor the decision to work and save during summers. A more complete model would incorporate these decisions as well as the decision of parents to alter contributions in reaction to the educational borrowing and work decisions of their children. Future research could also examine the effect of loan-forgiveness on the decisions to acquire and complete different levels and types of education.

A. SML PARAMETER ESTIMATES AND t-VALUES

TABLE A.1

Initial conditions

Unobserved type probability and endowment level parameters				
Variables	π^{A_1}	π^{A_2}	$\ln(tr_t^p)$	$\ln(tr_t^a)$
Constant	−0·114	−0·434	8·150	8·134
	(−0·32)	(−1·24)	(53·98)	(45·78)
F_1	1·186	1·648	0·916	0·128
	(2·19)	(2·98)	(3·71)	(0·54)
F_2	−0·284	0·731	0·420	−0·013
	(−0·71)	(2·01)	(2·44)	(−0·08)
Ivy	0·035	0·592		
	(0·05)	(1·16)		
$I(age_0 > 24)$	−0·343	0·338	−0·572	0·703
	(−0·56)	(0·72)	(−2·29)	(2·13)
MA	−0·971	−0·061		
	(1·63)	(−0·09)		
OS	−0·334	−0·400	0·130	0·024
	(−0·92)	(−1·17)	(0·87)	(0·16)
$I(LSAT \geq 737)$	0·458	0·466		
	(1·10)	(1·21)		
A_1			0·015	0·058
			(0·07)	(0·28)
A_2			0·096	0·064
			(0·47)	(0·35)

Observed type and endowment probability parameters								
λ_{f_1}	λ_{f_2}	λ_{ivy}	λ_{age}	λ_{ma}	λ_{os}	λ_{lsat}	λ_{tr^p}	λ_{tr^a}
−0·815	0·045	−1·800	−1·7299	−2·361	0·474	−1·117	0·444	−0·033
(−2·84)	(0·16)	(−6·56)	(−7·00)	(−7·95)	(1·65)	(−3·81)	(1·68)	(−0·12)

Note: t-Values are in parentheses. π^{A_j} and λ_{f_j} are multinomial logits. λ_{ivy}, λ_{ma}, λ_{age}, λ_{os}, λ_{lsat} λ_{tr^p} and λ_{tr^a} are binomial logits. The estimates in the bottom panel are the constant terms that enter the logistic transformations.

TABLE A.2

Unobserved asset, Law School wage offer and scholastic achievement parameters				
Variable	$\ln(tr_t^u)$	$\ln(\overline{w}_t)$	π^{lr}	π^{t20}
Constant	7·759	8·315	−2·148	−1·301
	(2·50)	(48·17)	(−20·08)	(−1·90)
hr_t		0·035	−0·354	0·001
		(2·22)	(−3·15)	(0·53)
A_1		0·458	1·050	1·050
		(2·28)	(2·25)	(2·25)
A_2		0·152	1·524	1·524
		(1·60)	(2·97)	(2·97)

TABLE A.2—continued

Law School error distribution, utility function and discount factor parameters						
$\ln(L_{11})$	L_{21}	$\ln(L_{22})$	$\ln(1-\mu_4)$	λ	δ_{A_1}	δ_{A_2}
−2·116	0·061	−2·694	−1·960	0·228	0·946	0·856
(−0·92)	(1·59)	(−1·50)	(−1·98)	(48·17)	(2·01)	(2·52)
Measurement error, classification error and terminal value function parameters						
$\ln(\sigma_{ls})$	$\ln(\alpha_{ls})$	$\ln(\sigma_{ml})$	$\ln(\alpha_{ml})$	E	α_T	
−0·242	8·038	−0·976	0·108	0·821	2·859	
(−9·50)	(108·58)	(−74·20)	(2·56)	(141·42)	(1·09)	

Note: t-Values are in parentheses. π^{lr} and π^{t20} are binomial logits. The L_{ij}'s are the Cholesky elements for the bivariate normal distribution $(\varepsilon_{ut}, \varepsilon_{wt})$. σ_{ls}^2 is the common measurement error variance for the observed continuous data on initial assets, parental transfers, educational debts and in-school earnings. σ_{ml}^2 is the common measurement error variance for post-graduation accepted wage offers. α_{ls} and α_{ml} are shift parameters for misclassified continuous data pertaining to Law School outcomes and post-graduation outcomes, respectively. E is the common base classification error rate for all discrete outcomes in the model. α_T is the common terminal value proportionality constant.

TABLE A.3

Post-graduation wage offer, error distribution and utility function parameters					
Variable	Solo	Business	Non-profit	Non-elite	Elite
Constant	10·330	10·664	10·530	10·441	10·681
	(93·57)	(148·18)	(152·09)	(353·84)	(360·00)
A_1				0·026	0·026
				(0·52)	(0·52)
A_2				0·054	0·054
				(1·31)	(1·31)
lr				0·105	0·105
				(3·21)	(3·21)
$t20$				0·031	0·031
				(0·99)	(0·99)
hr_3			0·007	0·005	0·005
			(0·24)	(0·37)	(0·37)
x_{1t}	0·106	0·104	0·052	0·103	0·078
	(1·12)	(3·14)	(2·17)	(48·16)	(4·38)
x_{1t}^2	−0·005	−0·003	−0·001	−0·009	
	(−0·75)	(−1·30)	(−0·40)	(−3·37)	
x_{2t}	0·105	0·124	0·081	0·122	0·098
	(1·87)	(4·70)	(2·15)	(4·35)	(4·25)
x_{2t}^2	−0·011	−0·003	−0·001	−0·002	−0·001
	(−1·17)	(−0·92)	(−0·07)	(−0·43)	(−0·40)
$Part.$				0·080	0·070
				(353·53)	(106·59)
$\ln(L_{kk})$	−1·785	−1·785	−3·253	−4·191	−3·868
	(−12·97)	(−12·97)	(−1·89)	(−1·81)	(−2·14)
L_{2k}	−0·157				
	(−6·01)				

TABLE A.3—continued

Variable	Solo	Business	Non-profit	Non-elite	Elite
L_{3k}	0·034 (0·48)	0·054 (0·89)			
L_{4k}	−0·013 (−0·33)	−0·006 (−0·16)	−0·001 (−0·02)		
$\ln(1-\mu_k)$	−0·895 (−0·16)	−2·862 (−0·40)		−2·788 (−131·03)	−2·881 (−1·31)

Note: t-Values are in parentheses. The L_{jk}'s are the Cholesky elements for the joint normal distribution ε_{kt}, $k = 1, \ldots, 7$.

TABLE A.4

Post-graduation offer probability parameters						
Variable	Business	Non-profit	Non-elite associate	Elite associate	Non-elite partner	Elite partner
Constant	1·018 (1·51)	2·109 (1·37)	2·676 (2·15)	2·676 (2·15)	0·557 (1·75)	−1·970 (−1·67)
A_1		−0·070 (−0·95)	0·1643 (1·26)	0·5590 (1·89)	1·394 (2·15)	0·683 (1·79)
A_2		0·108 (1·05)	1·268 (1·91)	1·364 (2·17)	1·515 (2·61)	2·832 (2·87)
lr		0·695 (2·03)	2·257 (2·22)	2·257 (2·22)	3·255 (3·10)	6·018 (4·25)
$t20$		0·474 (1·94)	0·314 (1·68)	0·314 (1·68)	0·515 (1·51)	1·677 (1·86)
hr_3	0·016 (1·20)	0·016 (1·20)	0·016 (1·20)	0·016 (1·20)		
$I(t \geq 4)$	−0·070 (−0·34)	−0·070 (−0·34)	−0·070 (−0·34)	−0·070 (−0·34)		
Solo	−7·190 (−1·64)	−7·190 (−1·64)	−7·190 (−1·64)	−7·190 (−1·64)		
Business		−8·185 (−1·75)	−8·185 (−1·75)	−8·185 (−1·75)		
Non-profit	−3·521 (−1·35)		−3·639 (−1·36)	−5·735 (−1·61)		
Non-elite	−3·786 (−1·29)	−3·638 (−1·32)		−6·415 (−1·51)		
Elite	−2·673 (−1·89)	−2·078 (−1·99)	−1·997 (−2·05)			
x_{1t}					0·332 (1·05)	
x_{2t}						0·027 (0·98)
P_{ck}					−2·931 (−2·01)	−3·275 (−2·52)

Note: t-Values are in parentheses. The first job offer probabilities and on-the-job offer probabilities are multinomial logits. The probability of coming up for review and the partnership probabilities are binomial logits. The estimates corresponding to P_{ck} are the constant terms that enter the logistic transformations.

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