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Loss of Future Income in the Case of Personal Injury of a Child: Parental Influence on a Child's Future Earnings

Lawrence M. Spizman and John Kane*

I. Introduction

Projecting the earning capacity of a wrongfully-injured minor child is problematic because there is no established earnings record that can be used to estimate the child's future income. In the absence of earnings data, economists use average income figures from governmental publications to determine what the minor child might have earned if the injury had not occurred. This procedure is inaccurate in predicting what a child's potential earnings are. Consequently, the judicial system will not know with any degree of accuracy what the 'fair value' of an award to a wrongfully-injured child should be. The purpose of this paper is to develop a method of estimating what a minor child with no work history would have earned had there been no injury, based on his demographic and familial characteristics. This is accomplished by using an ordered probit model in which the probability of attaining a given educational level is estimated from family background information. With demographic and familial characteristics identified, we can predict the potential lifetime earnings of a child who has these characteristics.[1]

Brookshire (1987) maintains that the alternative to creating what he calls the 'statistical person' is to make a projection that takes into consideration race, sex, age and the probable educational attainment of the minor had the minor not been injured. Marlin (1988) concurs that, if there is no work record upon which an estimate can be based, then the best gauge of future earnings is probable educational attainment. A crude way of predicting the child's chance of going to college, according to Marlin, is to ask the child's teachers to estimate the likelihood of the child going to college. This indirect evidence can easily be questioned in a court of law. Marlin, like Brookshire, suggests using average income census data (broken down by state, age, race, location in the state, and educational level) as an estimate for the earnings potential of the injured child. The important question (and one that has not been answered by forensic economists but which our model attempts to answer) is upon what assumed educational level, and hence income, the projections will be based.

Once we can calculate a monetary value of what a child would have earned, based on the predicted probability of that child's attaining a certain level of education, then the courts can make a more informed decision in awarding

* Economics Department, State University of New York at Oswego, Oswego, NY. The authors are grateful to T. Ireland and H. Peterson for their useful comments on an earlier draft of this paper.

[1] The estimates in our model assume a complete disability. If there is a partial disability the standard procedure of subtracting impaired earnings from unimpaired earnings is utilized.

damages. This method thus addresses a problem that Speiser (1988) raises when he discusses the need for a more precise statistical technique when estimating the expected income of a child. An advantage of the model is that parental poverty does not in all cases lead to lower expected earnings: if variables other than income suggest that the child would have attended college, awards for wrongfully-injured poor children may be higher than they would otherwise have been.

II. The Model

An individual's projected lifetime earnings are conventionally estimated using the individual's initial income, rate of income growth, and worklife expectancy. As mentioned above, for cases involving personal injury of a child, the simplest procedure is to assume that the individual would have had an earnings pattern similar to those of other individuals of the same race and sex. This procedure, however, ignores differences in family investments in their children.

Previous studies[2] have indicated the importance of educational attainment in explaining earnings differentials in the population. Willis (1987) indicates that family background and characteristics are among the best predictors of adult achievement or failure. Becker (1983), Schultz (1974), Leibowitz (1974), De Tray (1974) and Speiser (1988) all note that the quality of a child varies with parental characteristics and environmental factors. Willis (1973) and Becker (1981)[3] provide theoretical explanations for differential parental investments in child quality. The importance of family background variables in explaining alternative educational choices has been demonstrated by Manski and Wise (1983).

In this paper, the expected lifetime earning of a child is estimated using a two-stage procedure. In the first stage, the probability distribution over alternative levels of the child's expected educational attainment is estimated from observable family background information (e.g., race, sex, and parent's education) using an ordered probit model.[4] In the second stage, the child's expected lifetime earnings' stream is generated using the estimated probit equation.

The model assumes that each individual selects the level of education which maximizes the expected value of his lifetime earnings stream. It is assumed that this choice is affected by a vector of family background variables (X) that influence the costs and/or benefits of alternative educational options. An ordered probit specification is used to model this choice process. The optimal level of education for individual i is assumed to be determined by an unobserved latent variable Z_i. Since Z_i is unobserved, it must be estimated from the observed data. This is accomplished through the use of a maximum likelihood estimation procedure. Z_i is assumed to be a linear function of X_i, the observable family background variables, and a random error term (u_i) that captures the effect of

[2] For example, see Mincer (1974) and Willis and Rosen (1979).

[3] In particular, see Chapter 4.

[4] An ordered probit model describes an individual's choice among a set of alternatives that can be ranked from lowest to highest in an ordinal manner. Alternative levels of educational attainment provide such an ordinal ranking i.e., high school degree, some college, bachelor's degree, master's degree, Ph.D..

unobserved differences in ability and wealth. This relationship is given by equation 1).

$$Z_i = X_i\beta + u_i \tag{1}$$

where $u \sim N(0, 1)$ This equation captures the relationship between the unobserved latent variable Z_i and the observed family background variables.

It is assumed that each individual will select the optimal educational level according to the following decision rule:

Individual i acquires:

a high school diploma if $Z_i \leq 0$
1–3 years of college if $0 < Z_i \leq \mu_1$ [5]
a 4-year college degree if $\mu_1 < Z_i \leq \mu_2$
a Master's degree if $\mu_2 < Z_i \leq \mu_3$
a Ph.D. (or equivalent) if $Z_i > \mu_3$

While the latent variable Z_i is not observed, an indicator variable, Y_i, is the observed level of education which is equal to 0, 1, 2, 3 or 4 depending upon the respondent's highest level of educational attainment (0 = h.s. degree, 4 = Ph.D., M.D. or J.D.). This indicator variable represents the actual level of education that was selected by individuals in our sample.

Once the parameters of the ordered probit model (equation 1)) are estimated,[6] it is possible to use this equation to estimate the probability distribution over alternative levels of education (Y_i) for a child with certain family background characteristics, represented by the vector X_i.

To estimate these probabilities, define:

$$\hat{Z}_i = X_i\beta \tag{2}$$

The estimated probability of each alternative level of educational attainment is given in Table 1.

To compute the individual's expected lifetime earnings stream, these estimated probabilities can be combined with information about the alternative levels of lifetime income that would be achieved in each educational state. In particular, the expected value of lifetime earnings equals:

$$\sum_{i=1}^{5} [\text{Prob(education = state i)} \cdot \text{E(lifetime earnings} \mid \text{educational state i)}]$$

In this equation, the expected value of lifetime earnings in a given educational state (Y_i) could be estimated using one of the following methods:

[5] μ_i (i = 1,3) are unknown parameters which represent threshold values for Z_i These parameters are estimated along with the parameter vector β as part of the maximum likelihood estimation procedure.

[6] This model can be easily estimated using LIMDEP which contains built-in routines for this purpose. Since the likelihood function is a simple generalization of the probit model, estimates can also be easily computed using a nonlinear optimization package (such as GQOPT). Since the likelihood function is globally concave, convergence is usually obtained relatively rapidly.

All estimates presented here were estimated using the mainframe version of LIMDEP.

Table 1

Probabilities of Alternative Educational Levels

Outcome	Probability*
High School Degree	$\Phi(-\hat{Z}_i)$
1–3 Years of College	$\Phi(\mu_1 - \hat{Z}_i) - \Phi(-\hat{Z}_i)$
4 Year College Degree	$\Phi(\mu_2 - \hat{Z}_i) - \Phi(\mu_1 - \hat{Z}_i)$
Master's Degree	$\Phi(\mu_3 - \hat{Z}_i) - \Phi(\mu_2 - \hat{Z}_i)$
Ph.D. Degree (or equivalent)	$1 - \Phi(\mu_3 - \hat{Z}_i)$

* $\Phi()$ is the cumulative density of the standard normal distribution.

1. population averages based on education and sex, or
2. the results of population regression estimates[7] which use all available family background information.

While, in principle, regression techniques should provide the best estimates of lifetime earnings conditioned on educational choice, the efficient estimation of sample selectivity models of this type is computationally expensive. Thus, in the results presented below, we base our estimates of lifetime earnings streams on population averages. This methodology is quite consistent with the contemporary practice of forensic economics.

III. Data

The empirical results presented below are estimated using a sample of 7862 individuals who participated in the base year through the fifth follow-up surveys of the National Longitudinal Study of the High School Class of 1972.[8] The variables which are used to explain the level of educational attainment include race, parents' education, and geographical location. A detailed description of these variables appears in Table 2. Separate ordered probit equations are estimated for males and females.

All respondents in this sample were high school seniors in 1972. As a result, virtually all respondents (and all respondents in our subsample) completed high school. Because of this sample selection, it is not possible to estimate the probability that an individual will complete high school. All results presented below should be interpreted as conditional probabilities of acquiring more education given that high school has been completed. Thus these results cannot be directly used to estimate population probabilities. In particular, the estimated results would only be completely appropriate in the case of an individual who had a 100% probability of completing high school.

[7] These regression estimates should be corrected for sample selectivity bias. See Willis and Rosen (1979) or Maddala (1983) for a discussion of this procedure. In particular, it should be noted that for the middle three educational states (Y_2, Y_3, or Y_4), there will be two-sided truncation on the error process in the regression estimates. While consistent parameter estimates can be derived quite easily for this using a modified version of Heckman's (1976) two-stage estimator, efficient estimation requires a more complex maximum likelihood estimation procedure.

[8] While there were 12841 participants who responded to the fifth follow-up study, the remaining participants were missing information on key variables.

Table 2

Description of Variables

Variable Name	Description
Hispanic	= 1 if the respondent is Hispanic = 0 otherwise
Black	= 1 if the respondent is Black = 0 otherwise
Asian	= 1 if the respondent is Asian-American = 0 otherwise
RUR72	= 1 if the respondent lived in a rural area in 1972 = 0 otherwise
URB72	= 1 if the respondent lived in an urban area in 1972 = 0 otherwise
Mother's Education	
Less than High School	= 1 if the respondent's mother did not complete high school = 0 otherwise
Some College	= 1 if the respondent's mother has completed 1–3 years of college = 0 otherwise
College Degree	= 1 if the respondent's mother has a bachelor's degree = 0 otherwise
Graduate Degree	= 1 if the respondent's mother has completed some graduate education = 0 otherwise
Father's Education	
Less than High School	= 1 if the respondent's father did not complete high school = 0 otherwise
Some College	= 1 if the respondent's father has completed 1–3 years of college = 0 otherwise
College Degree	= 1 if the respondent's father has a bachelor's degree = 0 otherwise
Graduate Degree	= 1 if the respondent's father has completed some graduate education = 0 otherwise

These results, can, however, be adjusted to allow the estimation of population probabilities if they are combined with information concerning the probability of a given individual completing high school.[9] A crude estimate of this probability can be derived using Current Population Survey data on high school completion rates by race and sex. For example, if it can be shown that an individual with given characteristics has a 70% probability of completing high school, then the probabilities for other educational states can be adjusted by simply multiplying them by 0.7.

[9] An alternative procedure would involve the estimation of a similar model using a data set which includes individuals that have not completed high school. Census data could be used for this purpose.

Table 3

Ordered Probit Equation—Males

Variable	Coefficient	T-ratio
Constant	0.208	5.666***
Hispanic	−0.136	−1.522
Black	−0.041	−0.607
Asian	0.500	3.374***
RUR72	−0.223	−4.963***
URB72	0.098	1.879*
Mother's Education		
Less than H.S.	−0.256	−5.077***
Some College	0.234	4.681***
College Degree	0.261	3.817***
Graduate Degree	0.248	3.056***
Father's Education		
Less than H.S.	−0.152	−3.142***
Some College	0.230	4.416***
College Degree	0.444	7.041***
Graduate Degree	0.589	8.901***
μ_1	0.557	31.531***
μ_2	1.479	53.402***
μ_3	2.122	54.920***

* Significant at the .10 level.
** Significant at the .05 level.
*** Significant at the .01 level.

IV. Empirical Results

Tables 3 and 4 contain the estimates from the ordered probit equation for the male and female samples. Care must be used in interpreting these coefficients. If a coefficient has a positive sign (and is statistically significant), this indicates that an increase in the level of this variable results in a decrease in the probability that the individual will acquire only a high school education and an increase in the probability that the individual will acquire a Ph.D., M.D. or J.D. degree. It can also be noted that a significant positive coefficient indicates that an increase in the level of the variable will increase the probability that the individual will attend at least some college. The effect on the probability of each of the intermediate levels of education, however, cannot be determined simply by the sign of the coefficient.[10]

In examining these coefficients, it is interesting to note that most of the family background variables are highly significant. The estimated coefficients on the racial dummy variables for Black and Hispanic in both the male and female equations are insignificant. The rest of the family background variables appear to have reasonable signs. These results indicate that individuals are more likely to attend at least some college if:

1. they are from an urban area, and
2. their parents have more education.

[10] See Greene (1990, pp. 704–705) for a detailed discussion of this argument.

Table 4

Ordered Probit Equation—Females

Variable	Coefficient	T-ratio
Constant	0.232	5.662***
Hispanic	−0.162	−1.739*
Black	0.003	0.048
Asian	0.495	3.008***
RUR72	−0.097	−2.067**
URB72	0.097	1.877*
Mother's Education		
Less than H.S.	−0.311	−6.330***
Some College	0.245	4.767***
College Degree	0.457	6.136***
Graduate Degree	0.449	5.034***
Father's Education		
Less than H.S.	−0.110	−2.215**
Some College	0.247	4.608***
College Degree	0.314	4.531***
Graduate Degree	0.689	9.412***
μ_1	0.650	32.761***
μ_2	1.672	53.284***
μ_3	2.623	49.437***

* Significant at the .10 level.
** Significant at the .05 level.
*** Significant at the .01 level.

V. Examples

To demonstrate the usefulness of this procedure, let's consider two examples:

CASE A: A 4-year old boy is the victim of a wrongful injury in 1990. The boy's mother and father are black. Both parents have graduate degrees. The family resides in an urban area. For simplicity let us assume the boy will never be able to work.

CASE B: A 4-year-old boy is the victim of a wrongful injury in 1990. The boy's mother and father are white. Neither parent completed high school. The family resides in a rural area. We also assume that the boy will never be able to work.

CASE A

When the relevant information on race, parents' education and geographical location are inserted into the estimated ordered probit equation (Table 3), the estimated value of Z is 1.10.[11] This value (along with the estimated values of μ_1, μ_2, and μ_3) makes it possible to compute the probabilities of alternative levels of educational attainment using the formulas in Table 1. Table 5 contains these estimated probabilities. An examination of this table indicates that this individ-

[11] Using the coefficients in Table 3:

$$Z = 0.208 - 0.041 + 0.098 + 0.248 + 0.589$$

Table 5

Probabilities of Alternative Levels of Educational Attainment: Case A

Outcome	Probability
High School Degree	13.6%
1–3 Years of College	15.9%
4 Year College Degree	35.3%
Master's Degree	19.8%
Ph.D. Degree (or equivalent)	15.4%

ual has a 86.4% probability of attending at least some college (given that high school is completed). The most likely outcome is that this individual will acquire a B.A. or B.S. degree (35.3% probability). This individual has a 35.2% probability of acquiring a graduate degree of some type.

The lifetime earnings stream of an individual can be estimated by using mean earnings by sex, age, race and level of education to compute a time path for earnings.[12] In our computations, we use a discount rate of 2.55%. This discount rate is the one most commonly used by forensic economists (Brookshire, Slesnick and Lessne, 1990). In our estimates, we use the measure of worklife expectancy by educational state which was computed by Smith (1985).[13] The estimated present value of lifetime earnings in each educational state for which data is available is contained in Table 6.

Combining the information in Table 6 with the estimated probabilities appearing in Table 5, the expected value of lifetime earnings can be computed by summing the products of the probabilities and the projected earnings in each educational state.[14] In Case A, this results in an estimate of lifetime earnings equal to $535,401.

CASE B

For the child in Case B, when the relevant information on race, parents' education and geographical location are inserted into the estimated ordered probit equation (Table 3), the estimated value of Z is −0.42. When this value is inserted into the equations appearing in Table 1, the probabilities of alternative levels of educational attainment can be computed. These estimated probabilities appear in Table 7.

[12] In this study, this data was taken from p. 145 of *Money Income of Households, Families and Persons in the United States: 1987*. Mean earnings for each age category were assigned to the midpoint of each age interval. Earnings for the intervening years were computed using linear interpolation.

Unfortunately, this data is not broken down by race in this table. In those tables which contain race as a category, either the earnings of individuals under 25 are not reported or there are fewer educational categories.

[13] The worklife expectancy for high school graduates and those with some college is 39.9. The worklife expectancy for higher levels of educational attainment is 41.1. Thus, we assumed that individuals with high school degrees or 1–3 years of college worked from age 18 to age 57.9. Individuals with a bachelor's degree or more were assumed to work from age 18 to age 59.1.

[14] The probability of having 5+ years of college is equal to Prob(MA) + Prob (PhD).

Table 6

Present Value of Lifetime Earnings

Outcome	PV (Lifetime Earnings)
High School Degree	$361,355
1–3 Years of College	$410,504
4 Year College Degree	$570,994
5+ Years of College	$623,144

An inspection of this table indicates that if this child were to complete high school, he would have a relatively low probability of attending college (33.7%). The most likely outcome for this individual would be to complete his education with a high school degree.

To estimate the present value of this child's expected lifetime income stream, the probabilities appearing in Table 7 can be combined with the expected earnings information in Table 6. For this individual, the expected value of lifetime earnings is $405,665.

The difference in projected earnings between these two cases is entirely the result of differences in the probability of alternative levels of educational attainment. The lower lifetime earnings in Case B are the result of lower levels of parents' education and parents' geographical location.

VI. Conclusions

The results reported above strongly support the hypothesis that family background variables are important in explaining the level of education that would be attained by a child. Speculation as to what influence family background has on a child's future earnings can now be reduced. The method presented in this paper makes it possible to analyze the effect of family characteristics on a child's potential earnings. This makes it possible for the judicial system to grant a 'fair' monetary award to a wrongfully-injured child.

The results presented here are based on a sample which excludes those who left school prior to becoming high school seniors. A more complete analysis would include this group. The highly significant results reported in this paper strongly suggest that this procedure is of practical use to forensic economists and may be a fruitful avenue for future research.

Table 7

Probabilities of Alternative Levels of Educational Attainment: Case B

Outcome	Probability
High School Degree	66.3%
1–3 Years of College	17.4%
4 Years College Degree	13.5%
Master's Degree	2.3%
Ph.D. Degree (or equivalent)	0.5%

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