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McMaster University

DEPARTMENT OF ECONOMICS

The Effect of High School Effort on Future Earnings

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ABSTRACT

This essay examines the role of studying in determining future wages. Much of the returns to education literature focuses on the extensive margin by determining the benefit of an extra year of schooling. This essay examines the intensive margin. This essay also analyzes other determinants of wages, and how they relate to an individual's studying behavior and education level decisions. The results from estimating a structural model indicate only a negligible relationship between earnings and studying. A second finding suggests ignoring parental income as a determinant of wages considerably overstates the returns to education.

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I. Introduction

The positive correlation between years of education and earnings is a well established result in the labor economics literature. However, the mechanism by which schooling determines labor income is unclear. In order to learn more about this relationship, many studies focus on the background characteristics of youth. Researchers examine the effects of school quality, family permanent income, ability and a variety of other variables on achievement, education and income. However, decisions of the young beyond participating in education are ignored. In particular, papers overlook the student's decision of how much time to spend studying. This essay estimates a structural model that accounts for student effort, along with background variables such as family income and skill.

Studies often examine the connection between earnings and school quality. The relationship between earnings, achievement and school quality variables such as teacher-student ratio and school expenditure remains inconclusive. In a partial survey, Card and Krueger (1994) find that a 10 percent increase in school expenditures is associated with 1 to 2 percent higher earnings. However, Hanushek's survey of the literature (1986, 1991) finds no relationship between school quality variables and achievement. Betts (1996) extends the number of school quality variables by focusing on the amount of homework assigned to students. His findings suggest that the standard school quality variables have only a small effect on achievement. However, a student's achievement does improve as the amount of homework assigned increases. Betts argues this result implies that the extra homework will not only increase achievement, but also future earnings. This paper builds on Betts' study by quantifying the effect of studying on future wages.

Section II of this paper provides a model that uses a consumer choice framework to postulate the relationship between student background variables, studying and future wages. The model suggests that family income and skill have positive effects on studying. It also finds that high school students study harder in order to increase educational opportunities which in turn increases future wages. Section III outlines the empirical approach used to recover the effects of inputs on studying, and the effect of studying on future earnings. Section IV provides a description of the data and descriptive statistics. From these descriptive statistics one sees that without accounting for selection, individuals who study more receive higher future wages. Section V contains the results from estimating the model described in Section III. Results indicate that there are small returns to studying. Also, the effect of income on studying is negligible for both males and females. However, neglecting family income as a determinant of wages causes one to overestimate the returns to schooling. Section VI provides concluding remarks.

II. Model

To motivate the empirical work of this paper, I propose the following model. Agents live for three periods. Over the three periods, agents care about consumption, leisure and years of schooling. In period t, leisure and consumption are denoted by l_t and c_t, respectively. The years of schooling is denoted by Q. The agent discounts the next periods utility of consumption and leisure by a factor of β. The education of the agent's parents, P, and the neighborhood of the agent, N, also affect the agent's utility. In each period t, agents maximize the objective function in Equation (1) conditional on the information set Ω_t, over the choice set B_t.

$$\max_{B_t} \; E((\tau_1 P + \tau_2 N)Q + \sum_{t=1}^{3} \beta^t (c_t + \kappa_1 l_t - \kappa_2 l_t^2)) \mid \Omega_t) \tag{1}$$

$$B_1 = \{c_1, l_1\},\; B_2 = \{c_2, l_2^*, Q\;\},\; B_3 = \{c_3, l_3^*\}$$

The first period, agents face a choice set of consumption and leisure. In period two, agents choose consumption, expected leisure[2], and years of schooling. The third period agents choose consumption and expected leisure.

Agents maximize Equation (1) subject to the following time constraints:

$$T_1 = s_1 + l_1, \; T_2 = h_2 + l_2 + t(Q), \; T_3 = h_3 + l_3.$$

In the first period agents spend their time endowment, T_1, engaged in study, s_1, and leisure. The second period, agents occupy their time with work, h_2, leisure and school, t(Q). The third period agents allocate their time between work and leisure.

The maximization of Equation (1) is also subject to a consumption constraint.

$$c_1 + \beta c_2 + \beta^2 c_3 = Y + \beta(Y + w_2 h_2 - K(Q,g,\epsilon_2)) + \beta^2(Y + w_3 h_3).$$

The agent saves at interest rate r, where $\beta = 1/(1+r)$. The present discounted value of consumption equals the present discounted value of non-labor income plus earned income minus the monetary cost of schooling. Agents receive the same non-labor income, Y, in all three periods. This non-labor income signifies a fixed proportion of the permanent income of the agent's family. Allowing the non-labor income to vary over periods only complicates the model without changing any of the results of the paper. Agents earn income in periods two and three. The earnings are denoted $w_t h_t$ for t=2,3. $K(Q,g,\epsilon_2)$ is the monetary cost of education. K(•) is increasing in Q, implying that the cost of education is increasing with the education level. K(•) is decreasing in the agents Grade Point Average (GPA), g. This has the following interpretation; as students increase their GPA they are more likely to obtain scholarships and the consumption cost of education decreases. ϵ_2 corresponds to the unobserved costs of education that the researcher does not see, and that are unknown to the agent until the beginning of the second period.

[2] Agents only choose expected leisure in the second and third periods because I assume that there is some employer discretion in hours worked. This is denoted by the *s on l_2 and l_3.

The first period represents time spent in high school. In the first period, studying, skill, A, a vector of investment goods, X, non-labor income, Y, and motivation, m determine, Grade Point Average, g.

$$g = \pi_0 + \pi_1 s_1 + \pi_2 X + \pi_3 A + \pi_4 Y + \pi_5 m + \epsilon_1 \qquad \textbf{(2)}$$

Non-labor income, Y, is a proxy for unobserved investments made by parents. Assume g is an increasing, linear function of s_1, X, Y, A and m.[3] The agent knows Y, X, A and m which make up the first period information set, Ω_1. The researcher observes Y, X, and A but does not observe m. Neither the researcher nor the agent observes ϵ_1 which represents a teacher discretion element of g.

The second period represents early adulthood, ages 18-26. In the second period the agent realizes g and the exogenous second period wage, w_2. The agent then chooses an expected number of hours to work, h_2^*, and an amount to save or borrow. The agent chooses expected hours of work instead of hours in order to allow for some employer discretion over the actual hours worked. The employer discretion term is η_2 ($h_2^* = h_2 + \eta_2$). η_2 is unknown to the agent and has a mean equal to zero.[4] The agent also chooses education level in the second period. Education is subject to costs of time and money. I assume the monetary and time costs of education, K(•) and t(•), take on the following functional forms:

$$K(Q,g,\epsilon_2) = K_1 Q^2 - Q(K_2 g + \epsilon_2), \;\; t(Q) = t_1 + t_2 Q \qquad \textbf{(3)}$$

[3] Betts (1996) did not find non-linearities in the relationship between homework assigned and achievement. However, GPA has a minimum and a maximum. Therefore, GPA cannot always be a linear function of determinates. However, I assume linearity holds by approximation in the interior.

[4] Likewise, $h_3^* = h_3 + \eta_3$. η_3 is unknown to the agent and has a mean equal to zero.

I assume K_1, K_2 and t_2 are positive parameters. Equation (3) implies the time cost of education increases with the number of years of schooling. Also, the monetary cost of education increases with years of schooling. The equation also implies that increased GPA will decrease the price of extra years of schooling, and the discount will be larger the more education the individual consumes.

The utility that an agent receives from Q is dependent on P, the education of the agent's parents, and N, the neighborhood or community of the agent. I include P in the utility function because students with highly educated parents might feel obligated to have a high amount of education and will increase their utility as they fulfill this obligation. Likewise, N is included because a student from a rural community might not feel as obligated to go to college as a student from a suburban community.

The third period corresponds to adulthood, ages 26 and over. In the third period agents realize the third period wage, w_3.

$$w_3=\gamma_0+\gamma_1 Y+\gamma_2 Q+\gamma_3 A+m+\epsilon_3 \tag{4}$$

w_3 is a linear and increasing function of skill, A, motivation, m, the quantity of education, Q, non-labor income, Y, and ϵ_3. ϵ_3 represents an error in the knowledge of the employer concerning their judgement of the ability of the worker. It is unobserved by the researcher and not observed by the agent until the beginning of the third period. I include non-labor income as a component in the wage equation on the basis that this income is supposed to represent the wealth of an agent's family. Students coming from rich families will benefit from both the high consumption and the connections that come along with this wealth. In other words, agents with high non-labor income know the "right" people and use this advantage to obtain higher wages.

Solving the model recursively one obtains Demand Equations (5)-(8).

$$h_3 = \frac{-\kappa_1 + 2\kappa_2 T_3 + w_3}{2\kappa_2} + \nu_3 \tag{5}$$

$$Q = \alpha_0 + \alpha_1 g + \alpha_2 Y + \alpha_3 A + \alpha_4 P + \alpha_5 N - \alpha_6 w_2 + \alpha_7 m + \alpha_8 \epsilon_2 \tag{6}$$

$$h_2 = \rho_0 - \rho_1 g - \rho_2 Y - \rho_3 A - \rho_4 P + \rho_5 N + \rho_6 w_2 - \rho_7 m - \rho_8 \epsilon_2 + \nu_2 \tag{7}$$

$$s_1 = \delta_0 + \delta_1 X + \delta_2 Y + \delta_3 A + \delta_4 P + \delta_5 N + \delta_6 m \tag{8}$$

The α, ρ and δ parameters in Equations (6), (7) and (8) are functions of β, the K, t, τ, κ, π and γ parameters, the time endowments and the mean of w_2. The υ terms in Equations (5) and (6) represent an employer discretion term in the hours the agents work, and are proportional to the η terms. Equations (5)-(8) are the solutions to a maximization problem when the following second order condition holds:

$$4K_1\kappa_2 > \beta\gamma_2^2 + \beta K_2^2\pi_1^2 \tag{9}$$

It is precisely when this second order condition holds that increasing Y, A or P causes studying and the quantity of education obtained to increase.

With the demand equations one sees the role of studying in the decision-making process of students. Students sacrifice current leisure to study. They study in order to increase GPA. By increasing GPA, students improve their educational opportunities. The more education the student obtains, the higher the student's future wage. However, wage is not only a function of years of schooling, it is also a function of skill, connections and motivation. The agent takes these qualities as exogenous. If these attributes are "low" then the model shows that it is not in the best interest of the student to increase schooling or study time. This is due to the convexity of the indirect utility function in wages. The empirical section of this paper examines if the relationships found in this section hold true in the data.

Many assumptions were made to obtain these relationships. The functional form assumptions yield linear demand curves. Also, the results that studying and the quantity of education increase with family income are due to the fact that g and w_3 increase with income. This is because the utility function is linear in consumption. Hence, there are no income effects on labor supply. Therefore, this model is not driven by the story that students from poorer families receive less education because of consumption constraints. These caveats aside, it is not difficult to derive the result that studying increases with income. The following set of equations provide the sufficient conditions for studying to increase with income.

$$\frac{\partial Q}{\partial Y} > 0 \qquad \textbf{(10)}$$

$$\frac{\partial^2 K}{\partial Q \partial g} < 0 \qquad \textbf{(11)}$$

$$\sum_i sign\left(\frac{\partial x_i}{\partial Y}\right) \cdot \frac{\partial^2 U}{\partial x_i \partial l_1} \leq 0 \qquad \textbf{(12)}$$

x_i is the Marshallian demand of the i^{th} good other than first period leisure. Condition (10) states that education is a normal good. Condition (11) states that the benefits from increasing GPA increase as the quantity of education increases. If these two conditions hold then the marginal benefit of an extra unit of studying increases at every level of studying when income increases. These two conditions are plausible. It seems likely that an increase in GPA would allow a student to obtain more scholarship money at a four-year college than they could obtain at a two-year college. Also, education can be derived as a normal good under flexible functional forms. If condition (12) holds then the marginal cost of studying decreases at every level of studying when income increases. In the specification of this paper the separability of utility over goods and time ensures that (12) holds.[5]

III. Empirical Model

This section presents the method with which I estimate the structural parameters of the theoretical model. The parameters of Equations (13)-(18) are to be estimated.

[5] Such strong assumptions are not necessary for (12) to hold. Overall, the result that studying increases with income is not sensitive to many of the functional form choices of this paper.

$$s_1 = \delta_0 + \delta_1 X + \delta_2 Y + \delta_3 A + \delta_4 P + \delta_5 N + \xi_1 \quad \textbf{(13)}$$

$$g = \pi_0 + \pi_1 s_1 + \pi_2 X + \pi_3 A + \pi_4 Y + \xi_2 \quad \textbf{(14)}$$

$$Q = \alpha_0 + \alpha_1 g + \alpha_2 Y + \alpha_3 A + \alpha_4 P + \alpha_5 N - \alpha_6 w_2 + \xi_3 \quad \textbf{(15)}$$

$$h_2 = \rho_0 - \rho_1 g - \rho_2 Y - \rho_3 A - \rho_4 P - \rho_5 N + \rho_6 w_2 + \xi_4 \quad \textbf{(16)}$$

$$w_3 = \gamma_0 + \gamma_1 Y + \gamma_2 Q + \gamma_3 A + \xi_5 \quad \textbf{(17)}$$

$$h_3 = \frac{-\kappa_1 + 2\kappa_2 T_3 + w_3}{2\kappa_2} + \xi_6 \quad \textbf{(18)}$$

$$\xi_1 = \delta_6 m,\ \ \xi_2 = \pi_5 m + \epsilon_1,\ \ \xi_3 = \alpha_7 m + \alpha_8 \epsilon_2, \xi_4 = -\rho_7 m - \rho_8 \epsilon + \nu_2, \xi_5 = m + \epsilon_3, \xi_6 = \nu_3$$

$$\xi \sim N(0,\Sigma)$$

One problem estimating this model is that study time is not observed explicitly in the data. I only observe the interval in which the study time of an individual lies. In order to estimate the study equation, I use a grouped data regression model. The grouped data regression model is similar to an ordered probit. The difference is that threshold values are observed in the grouped data regression case and they are not in the ordered probit. When estimating an ordered probit one scales such that the error term is distributed normal with mean zero and variance one. The scaling is not necessary in the grouped data regression model, and the variance term is estimated within the model. For the GPA equation a dummy variable is included for each study interval. To estimate Equations (14)-(18) consistently, I use three-stage least squares (3SLS) because it is asymptotically efficient.

The use of 3SLS requires exclusion restrictions equal to the number of endogenous variables appearing in the right hand side of the equations. The GPA equation includes the study variable. The model assumes P and N do not affect GPA. Also, P and N are correlated with s_1, but not with ξ. Therefore, P and N are appropriate instruments for this equation. In other words, parent's education and neighborhood effects a student's study behavior, but do not provide a direct investment into the student's GPA. In years of schooling and second period hours worked equations, I need to make exclusion restrictions for g. In these cases, the vector X is an appropriate instrument. Thus, household investments such as subscribing to a newspaper encourage children to learn and obtain better grades in high school. However, they do not directly affect the choice of obtaining more schooling. Q is an endogenous variable that appears as a determinant of wages. Appropriate instruments for Q are P, N, and w_2. Therefore, a parent's education affects a child's schooling, but does not affect the child's wages.[6] Lastly, in the third period hours worked equation, wage requires an instrument. The model assumes skill affects earnings, but does not affect hours worked. Without these exclusion restrictions, one could not identify any of the

[6] A more complete discussion of parent's education as an instrument for years of schooling in a wage equation appears in Rischall (1998).

effects I seek to estimate. Furthermore, the validity of my estimates depend on the validity of these assumptions.

Beyond these assumptions, when one recursively solves the model one finds relationships among the parameters of the model that must hold, otherwise the model is misspecified. An overidentifying restriction of the model is $\gamma_1/\gamma_3 = \alpha_2/\alpha_3 = \rho_2/\rho_3$.

$$\alpha_2 = \frac{\beta\gamma_2\gamma_1}{4\kappa_2 K_1 - \beta\gamma_2^2},\ \ \alpha_3 = \frac{\beta\gamma_2\gamma_3}{4\kappa_2 K_1 - \beta\gamma_2^2},$$

$$\rho_2 = \frac{\kappa_2 t_2\beta\gamma_2\gamma_1}{4\kappa_2 K_1 - \beta\gamma_2^2},\ \ \rho_3 = \frac{\kappa_2 t_2\beta\gamma_2\gamma_3}{4\kappa_2 K_1 - \beta\gamma_2^2}.$$

This restriction is used to test the specification of this model.

IV. Data and Descriptive Statistics

The data come from the National Longitudinal Study Class of '72 (NLS72) data set. This survey contains observations on individual students, including how much they study, their GPA and their family characteristics. The panel includes variables on educational attainment and wage data for 14 years after the students leave high school. The sample excludes respondents whose high school curriculum was primarily vocational-technical.[7] I make this restriction because the GPA equation for these students should be fundamentally different from the equation for students with primarily academic curricula. 366 observations are lost because of this restriction. Variable definitions are contained in Table 1 and

[7] I have also estimated the model with the vocational-technical students. Results are available upon request.

summary statistics are provided in Table 2. I will discuss the variables that deserve special attention within the text.

Study represents the average amount of time the student spends studying in a week and is s_1 of the theoretical model. It is the dependent variable of Equation (13) and is expected to have a positive coefficient as an explanatory variable of Equation (14).

GPA represents the high school grade point average of the student on a 0 to 100 scale, and is g of the theoretical model. It is the dependent variable of Equation (14) and is expected to have a positive coefficient as an explanatory variable in Equation (15), and a negative coefficient as an explanatory variable in Equation (16).

Education represents the quantity of education a student has attained measured in years and is Q of the theoretical model. It is the dependent variable of Equation (15) and is expected to have a positive coefficient as an explanatory variable in Equation (17).

Wage2 represents the hourly wage of the respondent in 1976 measured in 1986 dollars, and is w_2 of the theoretical model. It is expected to have a negative sign as an explanatory variable in Equation (15) and a positive sign as an explanatory variable in Equation (16). In some cases an hourly wage is not given by a respondent. In those cases **Wage2** is converted to an hourly rate by dividing by average hours worked per week. This could cause problems with division bias.

Hour2[8] represents the number of hours a respondent worked during a typical week in 1976, and is h_2 of the theoretical model. It is the dependent variable of Equation (16).

Wage3 represents the hourly wage of the respondent in 1986 measured in 1986 dollars, and is w_3 of the theoretical model. It is the dependent variable of Equation (17), and is expected to have a positive coefficient as an explanatory variable in Equation (18). It should be noted that I omitted 26 observations

[8] An equation where **Hour2** is the dependent variable has also been estimated. The estimates are not of interest. The equation was estimated for efficiency reasons. The results are available upon request.

based on the answer to the **Wage3** question. An observation was omitted if a respondent reported earning over $400 per hour or over $10000 every week or $10000 every two weeks. Also, the observation was omitted if the respondent reported earning over $20000 per month. In some cases an hourly wage is not given by a respondent. In those cases **Wage3** is converted to an hourly rate by dividing by average hours worked per week. This could cause problems with division bias. However, instrumenting for **Wage3** in Equation (18) takes care of this problem.

Hour3 represents the number of hours a respondent worked during a typical week in 1986, and is h_3 of the theoretical model. It is the dependent variable of Equation (18).

Family Income represents the 1972 income of the student's family measured in thousands of 1986 dollars, and proxies for Y of the theoretical model. It is expected to have a positive sign as an explanatory variable in Equations (13)-(17). Ideally the **Family Income** variable should be the family's permanent income. However, the 1972 income is all that is available in the data set.

Momhs, Momcol, Momadv, Dadhs, Dadcol and **Dadadv** are all dummy variables that represent the education attained by the parents of the student. These variables make up the vector P. The **Mom** and **Dad** prefixed variables represent education level attained by the student's mother and father respectively. The **hs** suffix implies the parent graduated high school. The **col** suffix implies the parent has graduated from a four-year college. The **adv** suffix implies the parent has an advanced degree. The omitted category is for parents that have not completed high school. These are explanatory variables in Equations (13), (15) and (16). They are expected to have positive coefficients in all regressions and the magnitudes should be increasing in education level.

Skill is measured by the mosaic score the student received on a standardized test given to all respondents. This variable is a proxy for A of the theoretical model. It is an explanatory variable in Equations (13)-(17) and it is expected to have a positive sign in all equations.

Table 3 compares the amount of time respondents study in high school versus the future wages they receive. The table indicates that among females the mean wage increases across study intervals. Likewise, the median and twenty-fifth percentile wages increase across study intervals. The only point where wages decrease across study intervals is in the tenth percentile. The tenth percentile wage for females who study more than 10 hours is less than the tenth percentile wage for women who study zero to five hours. Also, the table indicates that the wage distribution for females who study zero to five hours per week is similar to the wage distribution for those that study five to ten hours. The largest difference in the two distributions is 51 cents per hour.

The results are similar for males. The mean wage increases across study intervals. Likewise, the seventy-fifth and ninety-fifth percentile wages increase across study intervals. The only points where the wages decreases over the study intervals occur in the lower tails. As with the females, the wage distribution of the males who study zero to five hour per week is similar to the wage distribution of those who study five to ten hours per week. However, the difference becomes large at the higher tails.

Tables 4 and 5 contain the correlations and covariances of the endogenous variables and **Family Income** for the male and female subsamples, respectively. The matrices are consistent with the theoretical model. **Education** and **GPA** are positively correlated with all endogenous variables with the exception of **Hour2**. This is consistent with the model. The same is true for **Study**[9] with the exception of **Hour2** being positively correlated with **Study** in the female case. **Study** and **Family Income** are negatively correlated in both the male and female cases. The only other correlations that are inconsistent with the model are the correlation between **Wage3** and **Hour3**. These correlations are predicted by the model to be positive. In both the female and male sub-samples they are negative. However, this result is typical in the labor supply literature and could be the result of division bias.

The matrices capture the recursive quality of the model. Studying is strongly related to GPA.

[9] For Tables 4 and 5 the study variable used is a dummy variable where 1 indicates the student studies more than 5 hours per week.

GPA is strongly related to the amount of schooling the student attains, and negatively related to the amount of hours the student works in the second period. Lastly, the quantity of education is positively related to the future wages of the student. Tables 3, 4 and 5 have shown that there is a positive relationship between studying and future wages and a positive relationship between family income and future wages. The next section presents the estimates the empirical model described in Section III. If one believes the assumptions of the theoretical model then the estimates can be used to describe the effect of studying on future wages.

V. Results

Table 6 contains the coefficient estimates from estimating the study equation by the grouped data regression model. I estimate the equation for males and females under two specifications. The first specification is the standard specification of Sections II and III. The second specification includes the additional assumption that family income has no effect on future wages and GPA, that is $\pi_4 = \gamma_1 = 0$. Given the specification of the theoretical model, this implies that family income should have no effect on any of the agent's choices. In other words, this assumption will imply that $\delta_2 = \alpha_2 = \rho_2 = 0$. I estimate the model under this specification because the only way family income affects studying in my model is through it affecting future wages and GPA. Income has been excluded to test this assumption.

For the study equation, the results from the two specifications are similar. All coefficient estimates are of the same order of magnitude with the exception of **Dadcol** for males. However, there are many differences across gender. For males all of the variables of P with the exception of **Dadhs** and **Momadv** have the expected sign. These coefficient estimates are all small and statistically insignificant. Parent education may or may not have a large effect on the amount of time a student spends studying. For the females, only the coefficient on **Momadv** has the expected sign. These estimates, although for the most part statistically insignificant, are much larger in magnitude. Taking the estimates at face value, they imply differences in study levels ranging from one to 54 minutes per week. The sign on the coefficient estimate for **Family Income** also differs across gender. However, both these estimates are fairly imprecise, and even taking this imprecision into account, family income has little effect on studying. The estimates imply increasing family income by $1000 will cause studying to change by about a minute and a half per week. Thus family income does not have a large impact on a student's effort. However, investments such as subscribing to a newspaper have a large positive effect on studying. Lastly, the coefficient estimate on **Skill** has the correct expected sign, and is roughly the same across genders.

Table 7 contains the results from estimating the GPA equation by 3SLS. Again, the results do not differ a great deal across specification, although the coefficient estimates for the investment variables tend to be higher when **Family Income** is omitted. However, there are large differences across gender. In particular, the coefficient estimates for the **Study** variables are much larger for men than they are for women. Increasing studying from the 0 to 5 hours per week range to the 5 to 10 hour per week range is associated with an increase of more than a grade and a half for males. For females, the same change in study level is associated with a negligible decline in GPA. Also, for males an increase of family income by $6500 is associated with an increase of GPA by more than half a grade. An increase in income has only a negligible effect for women. Overall, the estimates are consistent with the theoretical model. The only estimates with the wrong expected sign are the ones for **Newspaper**.

Table 8 contains the results from estimating the education level equation by 3SLS. Again, the results from the two specifications are similar, and most of the major differences are across gender. Almost all estimates have the correct sign with respect to the theoretical model. However, for women, the coefficient estimates for **Wage2** and **Skill** have the wrong sign. Taken at face value, the estimates imply that a full grade increase in GPA is associated with an increase of between a half and three quarters of a year of schooling. For both genders, the coefficient estimate on **Family Income** is unsubstantial. An extra $10000 in income is only associated with an extra month of education.

Table 9 contains the results from estimating the third period wage equation by 3SLS. The one aspect that should be noted is the striking difference between the sets of estimates when **Family Income** is excluded. Excluding **Family Income** causes one to obtain an upward biased estimate of the returns to education. Although the estimate of the returns to education is not statistically significant when **Family Income** is included, the estimate implies a 4.5% return to an extra year of education for males at the mean wage. This estimate is smaller than OLS estimates of the returns to education. Also, when including the family income variable for males, the results indicate that an increase in income by $1000 is associated with an seven cent per hour increase in wages. For an employee who works forty hours per week, fifty weeks per year, this is an increase of $90 per year in wages. Likewise, an extra $1000 in family income for a full time female worker is associated with an increase in income on the order of $240 per year. The results indicate that family income is a determinant of future wage that should not be ignored. Also, excluding family income inflates the importance of education and race as determinant of wage.

One surprising result from Table 9 is the small positive coefficient estimate on the **White** variable for males. One would expect the wage gap to be much larger. However, this result is consistent with O'Neill (1990) and Neal and Johnson (1996). O'Neill finds that after controlling for an individual's Armed Forces Qualification Test score (AFQT), the wage gap between whites and blacks decreases significantly. Controlling for AFQT is analogous to controlling for the **Skill** measure in this paper. Without controlling for AFQT blacks are predicted to earn 88% of the earnings level of whites, all else being equal. However, after controlling for AFQT blacks are predicted to earn 97% of the earnings level of whites, all else being equal. Similarly, Neal and Johnson find that controlling for the AFQT score explains most of the black-white wage differential. They find that controlling for in-home investments such as reading materials explains a large portion of the gap between white and black AFQT scores.

Another surprising result is the large estimate of the effect of family income on wages considering the estimated effects of family income on other variables have been small and statistically insignificant.

This would seem to indicate that family income as a determinant of future wage is not the driving force that the theoretical model suggests. However, if κ_2 of the theoretical model is large relative to the product of γ_1 and γ_2 then family income will only have a negligible effect on the choices of agents.[10]

Table 10 contains the results from estimating the third period hours worked equation. From this equation one obtains estimates of the labor supply elasticity which are positive, but very close to zero. This is consistent with the findings of the labor supply literature. Furthermore, from these coefficient estimates one can obtain an estimate of κ_2. The coefficient on **Wage3** equals $1/2\kappa_2$. Using this formula, one estimates the value of κ_2 for males to be 1.24, and the value of κ_2 for females to be 7.35. These are much larger than the product of γ_1 and γ_2. Thus, small coefficient estimates on **Family Income** in the other regressions are not surprising.

Using the results from Tables 7 through 10, one can see the link between studying and future wage. A male student who increases studying from 0-5 hours per week to 5-10 hours per week would increase GPA by more than a grade and a half. This grade increase is associated with almost an extra one and a quarter years of education, and an extra $0.75 per hour in future wage. This translates into an extra $1505 per year income for an employee who works forty hours per week, fifty weeks per year. Assume that this return comes from an extra ten hours of studying per week all throughout high school (144 weeks) and consider receiving the same return for 35 years and discounting future income at a rate of .95 per year then the return of an extra hour of studying is $9.42. Hence, for males, there is evidence of a fairly substantial return for studying while in high school. However, this estimate is imprecise due to large standard errors in all the estimated equations.

A female student who increases studying from 0 hours per week to 0-5 hours per week would increase GPA by more than a grade and a half. This grade increase is associated with almost an extra year

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[10] The estimates of γ_1 and γ_2, are the coefficient estimates of **Family Income** and **Education** in Table 9.

of education, and an extra $1.02 per hour in future wage. This translates into an extra $2044 per year income for an employee who works forty hours per week, fifty weeks per year. Assume that this return comes from an extra five hours of studying per week all throughout high school (144 weeks) and consider receiving the same return for 35 years and discounting future income at a rate of .95 per year then the return of an extra hour of studying is $20.49. Hence, for females, there is evidence of a fairly substantial return for studying while in high school. Again, this estimate is imprecise due to large standard errors in all the estimated equations. Also, the estimates imply that if a female increases studying above 5 hours then the returns to studying decline.

Despite the apparently large returns, imprecision of estimates is a problem in interpreting the results from this model. Many coefficient estimates have the wrong sign. Furthermore, the positive estimate of the returns to studying is dependent on all of the links between studying and wages having positive signs. In other words, studying has a positive effect on GPA. GPA has a positive effect on years of education, and years of education has a positive effect earnings. Although, all of the estimated effects are positive, none of them are statistically significant.[11] This leads one to believe, that there is really no effect of studying on future wages.

However, this assumes that the only effect studying has on wages comes through the indirect mechanism that I have modeled. It is possible that studying has a direct effect on earnings. To see if this is the case, I estimate models where studying has a direct effect on earnings along with years of education. The estimated returns to studying from these models are negative and statistically insignificant.

Now the question becomes whether the small returns to studying of the original model are due to imprecise estimates of small parameters, or due to a misspecified model. In order to attempt to answer this

[11] This a particularly interesting result when considering that the estimate for the return to an extra year of schooling is not statistically significant. Rischall (1998) uncovers the assumptions that drive this result, and argues why this result reasonable.

question, the overidentifying assumptions are used to test the specification of the model. Previously, it was noted that a restriction of the model is $\gamma_1/\gamma_3 = \alpha_2/\alpha_3 = \rho_2/\rho_3$. This restriction is tested. In order to do this, a Wald test is used under the null-hypothesis, $\gamma_1/\gamma_3 = \alpha_2/\alpha_3 = \rho_2/\rho_3$. For males, the Wald statistic equals 0.041. For females, the Wald statistic equals 0.186. In both cases the Wald statistic is distributed chi-square with two degrees of freedom. Neither null can be rejected at a five percent level.

VI. Conclusion

The goal of this paper is to uncover the effect of study behavior on future wages and the determinants of a high school student's study behavior. The model I use shows that there is an indirect link between studying and future wages. Studying increases grade point average, which increases educational attainment, which increases future wages. An examination of the data shows that people who study more have higher earnings. Also, the indirect relationships hold in the data. Studying is positively correlated with GPA. GPA is highly correlated with years of schooling and years of schooling is highly correlated with future wages. However, when estimating the model accounting for selection, one finds that none of the estimated effects are statistically significant. Thus, the results indicate studying has only a small effect on earnings. The correlations from the examination of the data, are driven by the fact that highly motivated students study more and earn more.

Another result indicates that income has a substantial effect on future earnings, and that assuming it has no effect greatly overestimates the returns to a year of education. Overall, the main points that can be drawn from this paper are effort level in high school is an unimportant determining factor of future wages, and ignoring family income in the wage equation overestimates the returns to education.

Table 1
Variable Definitions

Variable	Definition
Study	The average amount of time the student spends studying in a week and is s_1 of the theoretical model. The question used in the survey is, "approximately what is the average amount of time you spend on homework a week?" The respondent could answer one of the following: (1) No homework is ever assigned. (2) I have homework, but I don't do it. (3) Less than 5 hours per week. (4) Between 5 and 10 hours per week. (5) More than 10 hours per week. For those who responded (1) or (2), I treat as studying 0 hours per week. Studying 0 hours per week is the omitted dummy variable when estimating Equation (14).
GPA	High school grade point average of the student on a 0 to 100 scale, and is g of the theoretical model.
Education	Quantity of education a student has attained measured in years and is Q of the theoretical model.
Wage2	The hourly wage of the respondent in 1976 measured in 1986 dollars, and is w_2 of the theoretical model.
Hour2	The number of hours a respondent worked during a typical week in 1976, and is h_2 of the theoretical model.
Wage3	The hourly wage of the respondent in 1986 measured in 1986 dollars, and is w_3 of the theoretical model.
Hour3	The number of hours a respondent worked during a typical week in 1986, and is h_3 of the theoretical model.

Table 1 Continued
Variable Definitions

Family Income	The 1972 income of the student's family measured in thousands of 1986 dollars, and proxies for Y of the theoretical model.
Skill	The mosaic score the student received on a standardized test given to all respondents. This variable is a proxy for A of the theoretical model. According to the NLS72 user guide, "Mosaic Comparisons (116 items, 9 minutes). A test which measures perceptual speed and accuracy through items which require that small differences be detected between pairs of otherwise identical mosaics or tile-like patterns. A deliberately speeded test, it has three separately timed sections consisting of increasingly more complex mosaic patterns."
White	Indicator of whether the respondent is white.
Momhs	Indicator that the highest the level of education the mother of the respondent has attained is a high school degree.
Momcol	Indicator that the highest the level of education the mother of the respondent has attained is a college degree.
Momadv	Indicator that the respondent’s mother received an advanced degree.
Dadhs	Indicator that the highest the level of education the father of the respondent has attained is a high school degree.
Dadcol	Indicator that the highest the level of education the father of the respondent has attained is a college degree.
Dadadv	Indicator that the respondent’s father received an advanced degree.
Newspaper	Indicator that the respondent’s family subscribes to a newspaper.
Encyclopedia	Indicator that the respondent’s family owns an encyclopedia.
Magazine	Indicator that the respondent’s family owns a magazine subscription.
Typewriter	Indicator that the respondent’s family owns a typewriter.
Small Town	Indicator that the individual attended high school in a small town.
City	Indicator that the individual attended high school in a city.
Rural	Indicator that the individual attended high school in a rural neighborhood.

Table 2
Summary Statistics

	Males		Females	
Variable	Mean	Std Dev	Mean	Std Dev
Study (0-5)	0.55	0.50	0.40	0.49
Study (5-10)	0.30	0.46	0.46	0.50
Study (MT 10)	0.05	0.22	0.10	0.31
GPA	81.44	7.11	85.25	7.26
Education	15.44	1.55	15.46	1.54
Wage2	8.51	9.18	7.90	6.74
Hour2	38.52	12.98	34.48	11.15
Wage3	13.46	8.59	10.76	7.39
Hour3	45.11	10.37	37.36	11.66
White	0.91	0.28	0.86	0.35
Family Income	33.01	13.48	31.87	14.17
Dadhs	0.53	0.50	0.50	0.50
Dadcol	0.14	0.35	0.14	0.35
Dadadv	0.12	0.33	0.14	0.35
Momhs	0.68	0.47	0.65	0.48
Momcol	0.10	0.30	0.10	0.30
Momadv	0.06	0.23	0.06	0.24
Skill	49.15	14.83	51.64	14.97
Newspaper	0.92	0.27	0.92	0.27
Encyclopedia	0.93	0.25	0.92	0.27
Magazine	0.94	0.24	0.94	0.24
Typewriter	0.85	0.35	0.88	0.33
Rural	0.19	0.40	0.17	0.38
Small Town	0.27	0.45	0.29	0.45
City	0.24	0.43	0.28	0.45
Suburb	0.29	0.46	0.26	0.44
# obs	1254		1062	

Table 3
Wage Distribution by Study Time

			Wage3:	**Females**			
			percentile				
Study	10	25	50	75	90	mean	# obs
None	4	6.05	8	10.5	14.29	8.53	57
0-5	4.7	6.5	9.16	12.5	16	10.32	530
5-10	5	6.89	9.67	12.5	16	10.8	557
MT 10	4.34	7.91	10.51	13.33	17.5	11.89	118
			Wage3:	**Males**			
Study	10	25	50	75	90	mean	# obs
None	5	7.92	10.45	14.8	18.5	12.12	161
0-5	6.24	8.75	12	16	20	12.91	786
5-10	6.25	9.19	12	16.5	22	13.96	405
MT 10	5.33	9.03	14.63	18.64	25.13	15.78	68

Table 4
Correlations and Covariances Between Endogenous Variables and Family Income
Correlations in Upper Triangle
Sample: MALE # obs = 1254

	Study	GPA	Education	Hour2	Wage3	Hour3	Family Income
Study	0.23	0.30*	0.20*	-0.07	0 .08*	0.03	-0.01
GPA	1.02	50.58	0.42*	-0.14*	0.17*	0.05	0.13*
Education	0.15	4.62	2.41	-0.26*	0.17*	0.02	0.20*
Hour2	-0.44	-12.95	-5.27	168.48	-0.04	0.17*	0.01
Wage3	0.33	10.30	2.27	-4.91	73.85	-0.18*	0.14*
Hour3	0.13	3.38	0 .25	22.91	-16.05	107.44	0.07
Family Income	-0.08	12.50	4.24	1.13	16.00	9.65	181.65

* correlation estimate is significant at a .01 level (one-tailed test)

Table 5
Correlations and Covariances Between Endogenous Variables
Correlations in Upper Triangle
Sample: FEMALE # obs = 1062

	Study	GPA	Education	Hour2	Wage3	Hour3	Family Income
Study	0.25	0.19*	0.18*	0.01	0.07	0.03	-0.01
GPA	0.69	52.73	0.39*	-0.04	0.09*	0.01	0.13*
Education	0.14	4.36	2.36	-0.18*	0.19*	0.06	0.21*
Hour2	0.08	-3.61	-3.05*	124.24	-0.004	0.03	-0.05
Wage3	0.26	4.97	2.13	-0.31	54.58	-0.05	0.11*
Hour3	0.17	0.87	1.04	3.59	-3.94	136.07	0.01
Family Income	-0.10	13.60	4.53	-7.50	11.18	1.36	200.87

* correlation estimate is significant at a .01 level (one-tailed test)

Table 6
Dependent Variable: Study
Estimation Technique: Grouped Data Regression Model

	Male (1)	Male (2)	Female (1)	Female (2)
Constant	2.954*	2.923*	5.250*	5.269*
	(0.71)	(0.71)	(0.74)	(0.74)
Family Income	-0.015	---	0.005	---
	(0.01)	---	(0.01)	---
White	-0.578	-0.666	-0.240	-0.207
	(0.39)	(0.38)	(0.35)	(0.35)
Dadhs	-0.187	-0.240	-0.145	-0.128
	(0.29)	(0.29)	(0.31)	(0.31)
Dadcol	0.128	-0.034	-0.850	-0.807
	(0.41)	(0.39)	(0.44)	(0.43)
Dadadv	0.523	0.358	-0.533	-0.466
	(0.42)	(0.41)	(0.46)	(0.43)
Momhs	0.372	0.326	-0.748*	-0.740*
	(0.32)	(0.32)	(0.32)	(0.32)
Momcol	0.415	0.332	-0.900	-0.871
	(0.46)	(0.46)	(0.49)	(0.48)
Momadv	-0.036	-0.124	0.284	0.298
	(0.54)	(0.54)	(0.58)	(0.58)
Skill	0.016*	0.016*	0.009	0.009
	(0.01)	(0.01)	(0.01)	(0.01)
Encyclopedia	0.191	0.145	-0.403	-0.402
	(0.42)	(0.42)	(0.42)	(0.42)
Magazine	-0.199	-0.248	-0.265	-0.247
	(0.44)	(0.44)	(0.47)	(0.47)
Newspaper	1.093*	1.021*	0.744	0.769
	(0.42)	(0.41)	(0.44)	(0.44)
Typewriter	0.241	0.194	0.705*	0.718*
	(0.31)	(0.31)	(0.36)	(0.36)
Small Town	-0.356	-0.421	0.322	0.320
	(0.31)	(0.31)	(0.35)	(0.35)
City	-0.192	-0.257	0.082	0.088
	(0.32)	(0.32)	(0.35)	(0.35)
Suburb	-0.205	-0.313	0.149	0.164
	(0.32)	(0.31)	(0.36)	(0.36)
σ	3.284*	3.288*	3.266*	3.267*
	(0.08)	(0.08)	(0.09)	(0.09)
# obs	1254	1254	1062	1062

* estimate is significant at a 5% level. (standard errors in parentheses)

Table 7
Dependent Variable: GPA
Estimation Technique: 3SLS

	Male		**Female**	
	(1)	(2)	(1)	(2)
Constant	60.750*	63.722*	63.192*	62.236*
	(15.70)	(17.37)	(23.51)	(24.08)
Study (0-5)	10.859	7.606	15.514	16.884
	(20.01)	(22.15)	(26.39)	(26.83)
Study (5-10)	27.905	24.523	14.130	15.053
	(17.97)	(20.18)	(23.93)	(24.66)
Study (MT 10)	37.137	38.874	6.092	5.705
	(28.75)	(33.23)	(24.99)	(25.83)
Family Income	0.082*	---	0.018	---
	(0.03)	---	(0.02)	---
White	1.243	1.958	3.140*	3.260*
	(1.40)	(1.60)	(0.94)	(0.93)
Skill	0.054	0.056	0.100*	0.103*
	(0.04)	(0.04)	(0.02)	(0.02)
Encyclopedia	0.560	1.162	0.528	0.481
	(1.54)	(1.54)	(1.12)	(1.15)
Magazine	0.147	0.245	0.374	0.457
	(1.45)	(1.48)	(1.11)	(1.16)
Newspaper	-3.140	-2.281	-1.471	-1.213
	(1.73)	(1.72)	(1.09)	(1.15)
Typewriter	0.168	0.468	0.899	0.980
	(0.98)	(0.97)	(1.21)	(1.28)
# obs	1254	1254	1062	1062

Instruments for **Study** variables: **Dadhs, Dadcol, Dadadv, Momhs, Momcol, Momadv, City, Suburb, Small Town, Wage2.** * estimate is significant at a 5% level. (standard errors in parentheses)

Table 8
Dependent Variable: Education
Estimation Technique: 3SLS

	Male		**Female**	
	(1)	(2)	(1)	(2)
Constant	8.352	6.743	9.414	8.241
	(8.16)	(7.16)	(5.61)	(5.35)
GPA	0.072	0.093	0.060	0.077
	(0.11)	(0.09)	(0.07)	(0.07)
Family Income	0.006	---	0.009*	---
	(0.01)	---	(0.004)	---
White	0.076	0.111	-0.071	-0.054
	(0.15)	(0.15)	(0.25)	(0.25)
Dadhs	0.159	0.191	0.141	0.183
	(0.11)	(0.11)	(0.12)	(0.12)
Dadcol	0.480*	0.528*	0.056	0.180
	(0.22)	(0.23)	(0.17)	(0.17)
Dadadv	0.451	0.487	0.542*	0.669*
	(0.27)	(0.27)	(0.17)	(0.17)
Momhs	0.278	0.275	0.441*	0.453*
	(0.17)	(0.17)	(0.12)	(0.12)
Momcol	0.503*	0.492*	0.786*	0.809*
	(0.24)	(0.24)	(0.21)	(0.21)
Momadv	0.322	0.375	0.537*	0.612*
	(0.20)	(0.20)	(0.24)	(0.23)
Skill	0.006	0.004	-0.002	-0.003
	(0.01)	(0.01)	(0.01)	(0.01)
Wage2	-0.005	-0.002	0.010	0.010
	(0.01)	(0.01)	(0.01)	(0.01)
Small Town	0.225	0.315*	0.246	0.239
	(0.17)	(0.14)	(0.16)	(0.15)
City	0.403*	0.493*	0.141	0.164
	(0.20)	(0.17)	(0.18)	(0.18)
Suburb	0.387*	0.508*	0.187	0.239
	(0.16)	(0.13)	(0.15)	(0.14)
# obs	1254	1254	1062	1062

Instruments for **GPA: Encyclopedia, Typewriter, Magazine, Newspaper**
* estimate is significant at a 5% level. (standard errors in parentheses)

Table 9
Dependent Variable: Wage3
Estimation Technique: 3SLS

	Male		Female	
	(1)	(2)	(1)	(2)
Constant	-1.135	-17.857*	-6.703	-16.821*
	(9.74)	(8.26)	(9.54)	(8.03)
Education	0.613	1.869*	1.098	1.838*
	(0.69)	(0.57)	(0.66)	(0.54)
Family Income	0.073*	---	0.045*	---
	(0.03)	---	(0.02)	---
White	0.144	0.499	-2.408*	-2.208*
	(0.81)	(0.86)	(0.70)	(0.71)
Skill	0.053*	0.041*	0.022	0.020
	(0.02)	(0.02)	(0.02)	(0.02)
# obs	1254	1254	1062	1062

Instruments for **Education: Dadhs, Dadcol, Dadadv, Momhs, Momcol, Momadv, City, Suburb, Small Town, Wage2, Encyclopedia, Typewriter, Magazine, Newspaper.** * estimate is significant at a 5% level. (standard errors in parentheses)

Table 10
Dependent Variable: Hour3
Estimation Technique: 3SLS

	Male		Female	
	(1)	(2)	(1)	(2)
Constant	39.678*	41.384*	36.632*	36.559*
	(2.27)	(2.41)	(2.58)	(2.73)
Wage3	0.404*	0.277	0.068	0.074
	(0.17)	(0.18)	(0.24)	(0.25)
# obs	1254	1254	1062	1062

Instruments for **Wage3: Dadhs, Dadcol, Dadadv, Momhs, Momcol, Momadv, City, Suburb, Small Town, Wage2, Encyclopedia, Typewriter, Magazine, Newspaper, Skill, White, Family Income** (Note: **Family Income** is only used as an instrument in specification 1.) * estimate is significant at a 5% level. (standard errors in parentheses)

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