A Test Of The Validity
Of The Screening Hypothesis
Versus The Human Capital Theory
Using The Wu-Hausman
Specification Test For Endogeneity

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Abstract

This paper tests for the validity of the screening hypothesis. The Wu-Hausman speci-fication test for endogeneity is conducted by estimating a Mincerian semi-log earnings equation with two different years of schooling measures included as independent vari-ables--one exogenous, and one endogenous. It is found that the exogenous formula-tion of years of schooling helps to explain the variance of the natural logarithm of earnings, while the endogenous formulation does not. These results indicate that schooling is used as a screening device.

I.   Introduction

*M*any empirical studies have confirmed that there is a positive relationship between years of schooling attained and the earnings levels of individuals. It is also universally accepted that the causation runs from schooling to earnings.

However, the debate still continues regarding the specific mechanism that causes schooling to affect earnings positively. There are two fundamental schools of thought regarding this issue. The oldest is the human capital theory which argues that schooling directly enhances one's skills, and positively affects one's job-related productivity, which in turn enhances earnings.

Readers with comments or questions are encour-aged to contact the authors via e-mail.

The newer school of thought which many believe is a serious challenge to the human capital theory is the screening hypothesis which argues that schooling is used as a market signal which allows employers to assess quickly and cheaply the productivity levels of potential em-ployees. According to the extreme variant of the screening hypothesis, schooling only identifies individuals according to their preexisting abilities since one's ability and educational attainment is positively correlated to a great extent. In addi-tion, schooling does not add to one's stock of potentially marketable skills, and subsequent job-related productivity. Schooling enhances earn-ings exclusively as a result of its use as a screening device.

There are profound implications if the screening hypothesis (especially in its most ex-

treme form) is found to be true. In this instance, it would be difficult to virtually impossible for one to justify the current public and private expenditures on the school system. One could convincingly argue that instead of supporting such an expensive educational system, it would be more worthwhile from an investment standpoint for a certain amount of these funds to be used elsewhere in the economy.

According to the extreme variant of the screening hypothesis, all that would need to be done in order to identify the ability levels of individuals would be to administer tests whose cost would be significantly below that of supporting the educational system as it exists today. It is demonstrated in Hunter and Hunter (1984) that the correlation between one's performance on an ability test and one's subsequent productivity is over 0.5 in many instances, which is found to be more than double the correlation between educational attainment and subsequent productivity. It is indicated in Mueser and Maloney (1991, p. 687) that "Tests are widely enough used that there must be benefits from testing in a wide range of jobs, and it seems likely that the benefits are appreciable for certain kinds of jobs and certain kinds of employers."

Given the profound nature of the implications if the screening hypothesis (especially its extreme variant) is valid, it is important to test empirically whether or not there is merit to the screening hypothesis.

There have been many articles, both theoretical and empirical, which have examined the validity of the screening hypothesis relative to the human capital theory, yet neither of these two schools of thought has been declared to be inoperative.

This study tests for the validity of the screening hypothesis using a new approach. The starting point is an examination of the Mincerian semi-log earnings equation which is the industry-standard when it comes to estimating empirically the rate of return on years of schooling not only within countries, but also from a global perspec-

tive, see Ram (1996). This estimating equation is highly tractable from an econometric standpoint, has highly desirable statistical properties as discussed in Mincer and Polachek (1974), and Welland (1978), and is rigorously derived from economic theory and principles, see Mincer (1974).

However, as analyzed in Gullason (1991) among other places, there is a potential fundamental problem associated with the use of the Mincerian semi-log earnings equation in obtaining estimates of the rate of return on years of schooling. In this equation, years of schooling is treated as an exogenous variable when, in fact, it has been argued convincingly in Griliches (1977), Bossière et al. (1985), Boumahdi and Plassard (1992), and Alderman et al. (1996), for example, that years of schooling is an endogenous variable and should be treated as such in empirical models designed to estimate the rate of return on years of schooling.

The amount of schooling one obtains is not determined by some government decree (if it was, years of schooling would certainly be an exogenous variable), but is a function of a wide variety of ability, family background, and socioeconomic background variables. In standard schooling attainment models, the goal of the individual is to acquire schooling up to the point where its rate of return is equal to those of alternative investment opportunities. In standard analyses, the returns to schooling consist exclusively of the enhanced stream of future earnings which schooling makes possible.

However, schooling is also desired for its consumption value, see Gullason (1989), and also since it raises the productivity of individuals in a wide variety of nonmarket activities, see Michael (1973), and Haveman and Wolfe (1984). However, these dimensions of benefits obtainable from schooling have yet to be adequately incorporated in a comprehensive empirical model designed to estimate the *total* rate of return on years of schooling.

How productive schooling is for the in-

dividual overall and at the margin relative to other investment opportunities will certainly be influenced by one's ability, family background, and socioeconomic background variables since these factors have an impact on how productive schooling will be in generating an enhanced future earnings stream. In this study, it will be assumed that individuals will obtain schooling up to the point where the rate of return on years of schooling is equal to that of other investment opportunities.

The issue of how schooling is treated in the Mincerian semi-log earnings equation (as an exogenous versus an endogenous variable) and how each variable formulation explains (or fails to explain) the variance of the natural logarithm of earnings will serve to provide new evidence regarding which school of thought better explains the schooling-earnings relationship--the human capital theory or the screening hypothesis.

If the human capital school of thought is valid, this means that schooling enhances one's job-related productivity, which in turn enhances earnings. Not only will employers value schooling because of this effect, but they will endeavor to understand the specific process of how the number of years of schooling is chosen by the individual based upon the individuals' ability, family background, and socioeconomic background variables. This would be important information to know since schooling is a more productive investment for individuals with a certain mix of ability and background variables, and is not as productive an investment for others.

In fact, individuals with the same number of years of schooling could have differing levels of productivity as a consequence of how and how much schooling was chosen within the context of the individual's ability, family background, and socioeconomic background variables. In some instances, there is the possibility that individuals could over or underinvest in schooling relative to the skill requirements of the jobs the individuals obtain and relative to the in-

dividuals' ability, family background, and socioeconomic background variables resulting in their being less productive on the job than otherwise identical individuals who obtain the most efficient amount of schooling from an investment standpoint. It is shown in Tsang (1987, p. 239) using data from 22 U.S. Bell Companies ". . . that overeducation was negatively and significantly related to firm output, . . . "

The human capital theory implies that the employer will go about evaluating one's educational background within the context of one's ability, family background, and socioeconomic background variables in order to make the best decisions possible regarding whom to hire. In the situation where two individuals have obtained the same amount of schooling, according to the human capital theory the employer would endeavor to find out which individual invested more efficiently in schooling, and hire that individual.

If this were not the situation, the screening hypothesis would be supported. In this instance, employers either do not consider how, how much, and why individuals attain the amount of schooling they do based on ability, family background, and socioeconomic background variables, or are simply ignorant of this process.

This would indicate that employers use years of schooling in isolation of the process of how individuals determine the amount of schooling to obtain based upon the individual's ability, family background, and socioeconomic background variables, and instead use years of schooling as a relatively quick and costless method of assessing the ability and other background characteristics of the individual that impact upon one's productivity on the job.

In reality, employers are not always going to have information such as one's father's education and the family income of one's parents, let alone have the ability to evaluate how these factors operate in the determination of how much schooling the individual obtains, and

whether or not individuals invested efficiently in schooling, factors which would allow employers to be able to forecast better the productivity of potential employees.

It is the ignorance or lack of concern of the various ability and background variables which determine the individual's choice of the amount of schooling to be attained which leads employers to consider only the years of schooling variable in isolation as the key factor in their determination of the potential future productivity of the individual. This is precisely how years of schooling is utilized by employers according to the screening hypothesis.

II. The Empirical Examination

The two alternatives which need to be examined together to determine which school of thought is more appropriate--the human capital theory or the screening hypothesis--is to enter years of schooling in the Mincerian semi-log earnings equation exogenously as has been done in numerous studies, and also to enter years of schooling as an endogenous variable recognizing that it is a function of ability, family background, and socioeconomic background variables in order to see which variable formulation better explains the variance of the natural logarithm of earnings.

For this purpose, System 1, which can be found in Table 1, is estimated using three-stage least- squares (3SLS). The empirical test conducted is the Wu-Hausman specification test for endogeneity. Also appearing in Table 1 are the variable definitions. The empirical results can be found in Table 2.

The data used in this study consist of both the twins and the adult offspring of the twins in the National Academy of Sciences-National Research Council (NAS-NRC) Twin and Adult Offspring Sample. A thorough description of this data can be found in Behrman et al., 1980. Only males are used in the empirical estimations in order to avoid the complexities which are associated with the process of model-

ing the demand for schooling on the part of females.

The earnings equation is typical of many others in the literature. AGE and AGE^2 are designed to capture cohort effects in the earnings determination process. The expected result is obtained--AGE positively affects earnings, but at a diminishing rate.

The empirical formulation of the demand-for-schooling equation is almost identical to that in Gullason (1991) in order for one to draw meaningful comparisons between these two studies. In this formulation, the demand for years of schooling is a function of appropriate ability, family background, and socioeconomic background variables. The major demand determinants are included in the demand-for-schooling function utilized in this study.

GPA1 is used as a proxy for ability. A higher ability level, *ceteris paribus*, will be associated with a higher level of schooling attainment. An increase in ability is one factor that would increase the demand for years of schooling because higher ability increases the benefit of every incremental year of schooling. By investing more in schooling as a result of a *ceteris paribus* increase in ability, the marginal returns to schooling will be equated with the marginal cost, resulting in a maximal amount of net benefits received from schooling. The coefficient estimate of GPA1 is positive and fairly significant. $(GPA1)^2$ is included to exhibit diminishing marginal returns to increases in this variable.

The coefficient estimates of TEDSP and TED are correctly signed. TED's estimated coefficient is larger and more statistically significant than that of TEDSP. Since the data used consists entirely of males, it can be argued that young boys typically use their fathers as role models and base their educational decisions predominantly on those made by their fathers.

The FAMSIZE variable represents a variety of important family characteristics. Its estimated coefficient is negative and is highly sig-

Table 1
System 1: **The Empirical Model Used in the Determination of the Most Appropriate
Way of Modelling Years of Schooling (as an Exogenous Versus an Endogenous Variable)
in Order to Obtain the Most Appropriate Rate of Return Estimate on Years of Schooling**

$\ln (E3E) = \alpha + \beta \ (ED) + \gamma \ (EDENDOG) + \delta \ (AGE) + \zeta \ (AGE)^2 + \varepsilon_i$

$EDENDOG = \eta + \theta \ (GPA1) + \varsigma \ (GPA1)^2 + \kappa \ (TEDSP) + \lambda \ (TED) + \mu \ (FAMSIZE) + \chi \ (R) +$
$\xi \ (TYFAM) + \rho \ (TYFAM)^2 + \tau \ (AGE) + \varepsilon_j,$

ε_i and ε_j are well-behaved disturbance terms.

$\ln (E3E)$ = the natural logarithm of earnings adjusted for experience.
ED = years of schooling (the exogenous formulation).
EDENDOG = years of schooling formulated as an endogenous variable (expressed as a function of ability, family background, and socioeconomic background variables).
AGE = age.
GPA1 = a measure of grade-point average.
TEDSP = years of schooling of the individual's mother.
TED = years of schooling of the individual's father.
FAMSIZE = number of people in the individual's family.
R = the prime interest rate charged by banks when the individual was 16 years old.
TYFAM = family income of the individual's parents.

Table 2
Empirical Results of the Estimation of System 1 Using Three-Stage Least-Squares (3SLS)

$\ln (E3E) = 4.79 + 0.076 \ (ED) - 2.25E\text{-}07 \ (EDENDOG) + 0.25 \ (AGE) - 0.004 \ (AGE)^2$
$\qquad\quad (3.67) \quad (3.64) \qquad (0.00) \qquad\qquad\qquad (2.65) \qquad\quad (2.30)$

$EDENDOG = 8.69 + 2.29 \ (GPA1) - 0.27 \ (GPA1)^2 + 0.05 \ (TEDSP) + 0.11 \ (TED) -$
$\qquad\qquad (3.34) \quad (1.93) \qquad (1.23) \qquad\qquad (0.86) \qquad\qquad (1.90)$

$\qquad\quad 0.26 \ (FAMSIZE) - 0.16 \ (R) + 0.00006 \ (TYFAM) - 3.35E\text{-}10 \ (TYFAM)^2 +$
$\qquad\quad (3.07) \qquad\qquad (1.58) \quad (2.28) \qquad\qquad (1.29)$

$\qquad\quad 0.03 \ (AGE)$
$\qquad\quad (0.78)$

Weighted R^2 for the system = 0.20.
N = 261.
Note: Absolute t-statistics are in parentheses.

nificant for two main reasons. The higher FAMSIZE is, the more the resources of the household have to be divided up among the family members if we assume that the elasticity of children with respect to family wealth is large. These resources include monetary ones that are needed to finance education, and the amount of time spent by the parents per child, among many others. These resources are positively correlated with the number of years of schooling that the offspring will eventually attain.

Another factor causing the FAMSIZE coefficient estimate to be negative and highly significant is discussed in Zajonc and Markus (1975). They state that as this variable increases, the intellectual atmosphere of the household decreases because of the presence of young children in the family. Older siblings usually end up spending a good deal of time teaching and taking care of the younger children, when before, parents assumed the bulk of this responsibility.

R is the prime interest rate that existed when the person in question was 16 years old. The age of 16 is the age at which students are first able to decide for themselves whether or not they wish to continue schooling. R measures the opportunity cost of financing education that is the rate of return that the individual would have realized had the individual invested these funds in financial markets instead. R can also be treated as a proxy for the direct cost of schooling. Since schooling is oftentimes financed by loans, the prime interest rate reflects the cost of borrowing these funds. The empirical results support one's original expectations for the most part. As the direct and opportunity costs of schooling increase, the demand for schooling decreases. This is the expected direction of the own-price effect when the underlying utility function is strictly increasing and strictly quasi-concave.

TYFAM's estimated coefficient is positive and highly significant. TYFAM can be used as a proxy to represent many background factors that increase the ultimate demand for schooling on the part of individuals. It measures the extent to which children will be surrounded by newspapers, books, magazines, and any other item that positively affects educational attainment. It also measures the amount of motivation and encouragement (direct and indirect) that the child receives to acquire additional years of schooling. Taubman (1989) also confirms a significant positive relationship between parental income and the educational attainment of the parent's offspring, and provides additional rationales for this finding. $(TYFAM)^2$ is also included to exhibit diminishing marginal returns to increases in this variable.

The size and statistical significance level of the coefficient estimate of AGE indicates no significant cohort effects in the demand for schooling.

III. A Comparison of ED and EDENDOG in Relation to How Each Explains the Variance of the Natural Logarithm of Earnings, and the Conclusions

From an econometric standpoint, the main focus is on the issue of which formulation of years of schooling (ED or EDENDOG) better explains the variance of the natural logarithm of earnings.

As can be seen in Table 2, when System 1 is estimated using 3SLS, the exogenous formulation of the years of schooling variable (ED) does explain some of the variance of the natural logarithm of earnings while the endogenous formulation of the years of schooling variable (EDENDOG) does not explain any of this variance. Therefore, the Wu-Hausman specification test for endogeneity indicates that one cannot reject the null hypothesis that years of schooling should be treated as an exogenous variable.

The implication is that employers either do not know and/or do not care about how ability, family background, and socioeconomic background variables are utilized by the individual in the determination of one's educational attainment. Instead, employers are using school-

ing in isolation of this process to assess relatively quickly and cheaply the productivity levels of potential employees. This is precisely consistent with the screening hypothesis.

According to the human capital theory, this process, and whether or not individuals realize the goal of investing in schooling until its rate of return is equal to those of other investment opportunities, *ceteris paribus*, impacts upon the individual's job-related productivity and subsequent earnings. Moreover, the employer would care about how this process works, and will utilize this information in the determination process of whom to hire. From the econometric results obtained, we know that this is not happening since EDENDOG does not explain any of the variance of the natural logarithm of earnings.

The results obtained in this study provide support for the screening hypothesis over the human capital theory.

IV.   Implications for Future Research

Future research should examine whether or not the same results are also obtained for females. It would also be interesting to perform the same analyses in this study by sex across individuals in occupations that differ according to the likelihood that screening takes place in them. It would be expected that in occupations where screening most likely takes place, the exogenous formulation of years of schooling should help to explain the variance of the natural logarithm of earnings while the endogenous formulation of years of schooling should not explain any of this variance. In occupations where screening most likely does not take place, one should obtain empirical results that are directly opposite of those obtained in this study.⌸

V.   References

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