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Economic Returns to Higher Education: Signaling v. Human Capital Theory; An Analysis of Competing Theories

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Abstract

This study, in concert with previous studies, attempts to separate out the independent effects of the signaling and human capital mechanisms, arguing that individuals utilize higher education to signal a broad set of inherent productivity enhancing characteristics, which are unobserved by employers. I argue that several past studies, namely Chevalier (2004), have focused too narrowly on measures of inherent intelligence as representative of an individual's signaled productivity-enhancing characteristics and that estimates of the signaling effect might have been downwardly biased as a result.

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I. Introduction

A decision to pursue higher education involves an informal analysis on part of the individual in educational pursuit of the costs of education as measured against the expected value of the returns to that education. Determining the expected economic returns of such an investment has, largely as a result of its societal relevance, been an important and significant topic of research for economists. Chevalier et al (2004), in review of several different studies, estimates returns to education (as measured by increases in wage and salary) at near 10% per additional year of schooling. Since the correlation has been established, we may be confident that additional education results, on average, in elevated wages in the labor market. It follows, then, that an individual—with both psychic and monetary costs of education in mind (Spence 1973)—invests accordingly.

Two theories exist, which attempt to explain the causal relationship between education and earnings. These theories hypothesize about the specific mechanism through which education affects earnings. Human capital theory argues intuitively that education endows an individual with productivity-enhancing human capital, and that this increased productivity results in increased earnings in the labor market. Competitive market theory does, after all, require that laborers receive a wage equal to their marginal product. Signaling theory proffers an oppositional argument, which holds that education only reflects inherent human capital. This inherent human capital, not education itself, is what increases productivity and leads to higher wages.

From an individual's perspective it matters very little which theory is most correct. After all, individuals can do little more than optimize their private utility within a given system. Whether higher education endows an individual with human capital, or acts merely as a signal of existing human capital, the fact remains that wages are an increasing function of educational attainment. In other words, an individual's decision to pursue higher education depends on nothing more than the established positive correlation between education and earnings, upon which both signaling theory and human capital theory depend.

From a broader societal perspective, in contrast, the efficiency implications of the two theories differ considerably. If higher education is acting only as a signal and is not contributing independently to an individual's productivity-enhancing human capital, then there are several interesting implications; education is a very expensive and time consuming signal. Additionally, it might not be a very effective signal; one must consider the possibility that an individual decides not to pursue higher education because of financial constraints or for the simple fact that they irrationally perceive lower expected returns to higher education than comparable students. The implication is that education may not screen the most productive individuals, in which case it would be beneficial to find a more suitable, less costly signal.

This study, in concert with previous studies, attempts to separate out the independent effects of the signaling and human capital mechanisms, arguing that individuals utilize higher education to signal a broad set of inherent productivity-enhancing characteristics, which are unobserved by employers. I argue that several past studies, namely Chevalier (2004), have focused too narrowly on measures of inherent intelligence as representative of an individual's signaled productivity-enhancing characteristics and that estimates of the signaling effect might have been downwardly biased as a result.

II. Theory and Review of Literature

The fundamental difficulty in distinguishing between signaling and human capital theory, as hinted at above, is that both models imply a positive correlation between years of education and labor market earnings. Thus, as Riley (2001) argues, simply estimating an average earnings function is not likely to shed much light on the screening role of education. Economists have been forced to utilize round-about, rather informal, statistical tests, most of which depend on the assumption that some individuals, or groups of individuals, are likely to depend more on education as a signal/screen than others (Chevalier 2004). This assumption is based on the idea that signals/screens are used in principal-agent relationships where asymmetries of information exist and are not easily resolved. More to the point, signals are most prevalent for individuals who have productivity-enhancing skills or aptitudes that are not easily determined by employers. Under such circumstances, education (which is highly correlated with productivity measures) signals the existence of inherent human capital, thereby resolving the information asymmetries. Resolving such information asymmetries reduces turnover rates and prevents employers from incurring additional recruitment and training costs. Employers, as a result, have an incentive to utilize signals to identify productive individuals and to screen employees accordingly.

Because certain groups of individuals are presumed to utilize signals in order to resolve information asymmetries, whereas others are not, economists have been able to run various tests, which exploit this distinction and reveal, or at least hint at, the effects (or lack thereof) of signaling. Some proponents of signaling theory point to the lower returns to education of self-employed work relative to private sector work as evidence of the effects of signaling. The argument is that returns to self-employment can only represent returns to human capital; after all, there are no information asymmetries when a person employs himself and, as a result, there is no need for signals. Any difference, then, between returns to education for those self-employed and returns for those privately employed must be the result of signaling. Brown and Sessions (1999) found higher levels of education and higher returns for individuals employed privately as compared to self-employed individuals, which supports the signaling hypothesis. Opponents of signaling offer a counter-argument and point to a selection bias, which Brown and Sessions (1999) do not account for. The assumption made by Brown and Sessions (1999) in their study is that individuals know that they will be self-employed when they make their educational decisions (Chevalier 2004). If this assumption fails, then individuals might possibly be educating in expectation of the need to signal in the future, because they do not know at the time that they will be self-employed. This might explain (independent of signaling theory) the lower returns to education for the self employed observed by Brown and Sessions (1999).

In another attempt to prove signaling theory, economists point to "sheepskin effects" as evidence that education acts as a signal. Human capital theory suggests that the number of years in education (and, as is implicit in that education, the human capital acquired) is what matters, not the degree. Sheepskin effects refer to the independent effect that certificates of qualification appear to have even after controlling for years of education. In a study carried out by Hungerford and Solon (1987), discontinuities in returns were observed for certificated years, suggesting that certificates of completion have economic returns independent of years of education. This finding confirms the predictions of signaling theory. It does seem, though, that failure to earn a qualification, even controlling for years of education, simply reveals a lack of ability (learned or not) that could be responsible for the lower returns. In other words, individuals that dropped out before receiving a qualification might be those individuals who overestimated their returns to schooling and quit when they discovered their mistake.

Just as a certificate of completion might signal to employers a higher level of ability, resulting in higher earnings, the time taken to complete a degree also carries with it certain ability implications. Groot and Oosterbeck (1994) predict, firstly, "that more rapid completion of a degree signals greater ability and should therefore lead to higher earnings, and [secondly], that years spent in education without obtaining a degree should not increase earnings." Utilizing an extended earnings function, they calculated independent returns to effective years (years nominally required to attain a certain degree), skipped years, repeated years, and inefficient years (years completed but not necessary for attainment of a degree) of schooling. They discovered that skipped years (a supposed signal of high ability) had a significantly negative influence on future earnings, a result which runs contrary to signaling theory. Additionally, they found no evidence that repeated years (a supposed signal of low ability) had any negative effect on earnings, a result which also runs contrary to the predictions of signaling theory. Signaling theorists, as we might expect, have a counter-argument, which Groot and Oosterbeek (1994) acknowledge in their study. The counter-argument is that the weak correlation between skipped years and IQ (p= .06), suggests that employers are right not to accept skipped years as a signal for productivity. In other words, they argue that if skipped years is not a good measure of productivity (as "proven" by the weak correlation), then employers would not accept it as a signal, and it should not, therefore, be expected to figure into the determination of earnings. This of course assumes that IQ is a good productivity measure (which it probably is not) and still fails to account for the negative coefficient on the "skipped years" variable.

As illustrated in reviewing the above studies, evidence for signaling theory is countered with evidence for human capital theory, and each side seems to have no problem in justifying the other side's findings in terms of their own theory. Additionally, the informal statistical tests conducted require, at times, dubious assumptions (see above discussion of Brown and Sessions (1999)), further contributing to the overall inconclusiveness of the studies.

A seemingly more intuitive test, which has been conducted by several economists, including Chevalier (2004), utilizes ability controls in an attempt to isolate the effects of inherent, productivity-enhancing aptitudes. If productivity is a result of inherent aptitudes—as hypothesized by signaling theory—Chevalier (2004) reasons that controlling for ability using aptitude tests should reveal lower returns to education. The National Child Development Survey (NCPS) kept detailed records on individuals born during a particular week in 1958, tracking their early development with aptitude tests given at ages 7, 11, and 16, and later recording earnings data as adults. Controlling for ability using these test scores (the earliest test scores being the best measure because they exclude the possible ability-enhancing effects of education), the study reveals that innate ability has a minimal effect on returns to education (10.7% returns as compared to 10% returns for women when controlling for ability, with similar results for men). Chevalier (2004) concludes from this that education creates ability or human capital, which then determines wages, and that the signaling effect of education is minimal.

Chevalier (2004) makes a very critical and limiting assumption in his study, which is that ability, as measured by an aptitude test, encapsulates the inherent productivity-enhancing traits of an individual. I argue that the administered aptitude tests reveal little more than a limited measure of inherent intelligence, and we should not be surprised, therefore, to find a weak correlation between these tests scores and earnings. Inherent intelligence is only one of the many inherent productivity-enhancing traits signaled by educational achievement. When attempting to determine the effects of signaling, therefore, one must control for a more representative measure of an individual's inherent productivity. This raises an important question: Which measure of productivity does an individual signal with his or her education? Certainly, intelligence figures into the signal, but, as discussed above, intelligence alone is worth very little. Another important determinant of educational success and, as follows, labor market productivity, is work ethic, or effort, or some other motivational measure. I argue that these two measures, in aggregate, determine an individual's productivity, are signaled by educational achievement, and result in higher earnings in the labor market. Controlling for both inherent intelligence and motivation should, therefore, result in lower returns to education.

The problem, of course, is that most measures of motivation or effort are inextricably linked with educational achievement. Consider that GPA is a measure of effort, intelligence, and the skills and knowledge gained through education. A positive correlation between GPA and wages (productivity), therefore, tells us nothing about the mechanism behind the increase in wages; we are unable to determine whether the higher earnings are a result of acquired human capital or inherent intelligence and work ethic, and, as a consequence, we are unable to distinguish between signaling and human capital theory.

Chevalier (2004) encountered this complication in a second round of ability-control tests, which he conducted. He used data from the International Adult Literacy Survey (IALS), which records earnings and ability as measured at the time of a given job interview. Chevalier (2004) observed, in contrast to previous tests, a significant decrease in returns to education when using IALS ability-controls (10.6% returns as compared to 7.7% returns with ability controls). There are two explanations for this decrease. The first is a human capital explanation, which Chevalier (2004) assumes when he states, "As we might expect, using ability controls taken at later ages confounds the effects of education on ability scores." In other words, he argues that ability tests taken at later ages are more strongly correlated with wages (productivity) because of the human capital acquired during education; this acquired human capital results in higher test scores and higher productivity in the labor market.

An alternative explanation, and one which I will attempt to confirm in this study, is consistent with signaling theory. The signaling explanation, in paralleling Chevalier's argument, goes as follows: As we might expect, using ability controls taken at later ages confounds the effects of work-ethic/motivation on ability scores. In other words, the argument is that ability scores taken at later ages are more strongly correlated with wages (productivity), because the ability scores reflect the acquisition of human capital, which in turn reflects the work ethic and inherent intelligence of individuals. But, and this is critical, it is the natural intelligence and work ethic of the individual, not the resulting human capital, which leads to greater productivity and higher earnings in the labor market. And it is this intelligence and work ethic, which an individual signals through educational achievement.

To confirm either of these two arguments, we must first find a way to separate the effects of inherent effort and intelligence from the human-capital enhancing effects of education. In other words, we must find measures of intelligence and effort/motivation which are not confounded with the effects of education. Controlling for intelligence and effort/motivation using these measures should, I hypothesize, result in a more accurate estimation of the signaling effect.

III. Data and Empirical Model

While the NCDS provides an excellent measure with which to control for inherent intelligence (aptitude tests taken at age 7), the dataset does not provide a measure for effort/motivation that is not confounded by the effects of education. The National Longitudinal Survey of Youth (NLSY), in contrast, provides a proximate measure for motivation that is independent of educational achievement but does not offer as reliable a measure with which to control for inherent intelligence; the choice is between Armed Forces Qualification Tests (AFQT) taken by individuals between the ages of 14 and 21, and IQ tests taken at similar ages by a relatively small proportion of the total sample population (937 of 12,634). Still, because this study requires a measure for *both* inherent intelligence and motivation, I utilize the NLSY as a data-source.

The NLSY proxy for motivation derives from the Rotter Scale, which asks participants to choose the statement from the following pair of statements which best represents the beliefs they hold:

1. What happens to me is my own doing.
2. Sometimes I feel that I don't have enough control over the direction my life is taking.

This pair of statements relates to ideas of internal and external loci of control. Individuals with external locus of control—as represented by statement 2—believe that outside factors (not their own actions) determine the outcome of a given situation (Ingrum 2006). In turn, individuals with internal locus of control—as represented by statement 1—believe that their own actions (not outside factors) determine the outcome of a given situation.

The idea in using a locus of control variable as a motivational measure depends upon the presumption that individuals with internal locus of control—who believe that their actions affect their circumstances—are more likely to be highly motivated and to put forth greater effort in all endeavors, including employment. I created a dummy variable to reflect an individual's locus of control, setting statement two (representing external locus of control) equal to 0 and setting statement one (representing internal locus of control) equal to 1. This dummy variable acts as my control for motivation.

In addition to this motivational control and in accordance with Chevalier (2004), I utilize an inherent ability control. As mentioned above, there are two NLSY ability measures: AFQT aptitude tests and an IQ test. The fundamental limitation of using such variables is that both tests were administered to individuals between the ages of 14 and 21; the implication is that such individuals would have already undergone significant schooling by the time they took either test, thereby confounding the ability measure with educational attainment. Consequently, it becomes difficult, if not impossible, to identify the independent effect of inherent intelligence on earnings. This is especially relevant for AFQT, which tests specific verbal and quantitative skills likely to be learned in school. Intelligence Quotient tests, being a more general measure of ability, might more accurately reflect inherent intelligence, but, again, the limited sample population for the administered IQ tests poses a serious complication in its own right. As a result, I utilize AFQT scores for my ability control.

In my empirical model, I apply this ability control (AFQT) and the dummy motivational control (LOCUS) to an extended earnings function in a series of four models as outlined in Table 1. Model 1 acts as a base earnings function without controls added; dummy variables for different levels of educational attainment are utilized as independent variables. Model 2 assesses the independent effect of including my control for ability. Model 3 does the same with my control for motivation. Finally, Model 4 applies both controls together to the base earnings function.

The wage data utilized for the dependent variable derives from the NLSY measure of total

Table 1: Four Models

Model 1	WAGE2004 = β_1 + β_2HIGHSCHOOL + β_3SOME COLLEGE + β_4COLLEGEGRAD
Model 2	WAGE2004 = β_1 + β_2HIGHSCHOOL + β_3SOME COLLEGE + β_4COLLEGEGRAD + β_5AFQT
Model 3	WAGE2004 = β_1 + β_2HIGHSCHOOL + β_3SOME COLLEGE + β_4COLLEGEGRAD + β_5LOCUS
Model 4	WAGE2004 = β_1 + β_2HIGHSCHOOL + β_3SOME COLLEGE + β_4COLLEGEGRAD + β_5AFQT + β_6LOCUS

income from wages and salary. Income data was recorded each year for the period 1979-2004, and I utilize the 2004 wage variable (WAGE2004) as a representative measure. Concerning the independent variables for educational attainment, the NLSY provides a variable that records the highest grade completed by each individual as of the 2004 survey. In order to isolate the returns to different levels of educational attainment, I created a series of dummy variables: one for high school graduates (12 years of education), a second for individuals having undergone some amount of college (13-15 years of education), and a final variable for college graduates (16 or more years of education). These measures are represented in the earnings function by the independent variables HIGHSCHOOL, SOMECOLLEGE, and COLLEGEGRAD. My primary focus will be on returns to higher education and, more specifically, on returns to a degree in higher education; the coefficient on the COLLEGEGRAD variable will, therefore, be of greatest concern to this study. By observing how this coefficient changes with the inclusion of control variables for inherent ability and motivation, we should be able to identify the effects of education as a signal. If the signaling effect is large, we should expect a significant drop in the COLLEGEGRAD coefficient when the controls are added to the base earnings function.

IV. Results

In calculating the base earnings function outlined in Model 1, estimated returns to HIGHSCHOOL, SOMECOLLEGE, and COLLEGEGRAD were \$10,647, \$17,981, and \$44,935 respectively. In Model 2, when controlling for inherent ability with AFQT, the coefficient on COLLEGEGRAD fell to \$24,630—a decrease in returns of 45.2%. This would, at first, appear to be evidence of a large signaling effect. In contrast, the application of the motivational control in Model 3 resulted in a miniscule decrease of the COLLEGEGRAD coefficient, suggesting that the motivational signaling effect is near nonexistent. The results of the regressions are outlined in Table 2.

The 45.2% decrease in the COLLEGEGRAD coefficient observed in Model 2 is similar to the 27.4% decrease in returns found by Chevalier (2004) in his second round of ability-control tests. As you may remember, Chevalier attributed this decrease in returns to the confounding effects of education on ability scores for ability tests taken at later ages. However, signaling theory has its own explanation for this decrease in returns, which is that ability tests taken at later ages confound the effects of work-ethic/motivation on ability scores. These very same justifications can be used to explain the 45% decrease in returns observed in my study; controlling for ability using AFQT does not, therefore, allow us to conclude anything significant about the signaling effects of education.

In order to confirm the confounding effects of education on AFQT ability scores, I ran an additional regression with ability controls. Once again, I utilized AFQT as a control variable, but limited the testing population to those individuals who took the test between the ages of 14 and 17 (PRECOLLEGEAFQT). One would expect to find a smaller decrease in returns to higher education using this control (as opposed to AFQT), because the PRECOLLEGEAFQT scores are confounded with fewer years of education. This does occur with the coefficient on COLLEGEGRAD falling to $28,465, as opposed to $24,630 when controlling with AFQT. This result is promising if we assume that an individual's work ethic or level of motivation is established before entering higher education. If this assumption holds, then any additional decrease in the coefficient on COLLEGEGRAD—when controlling with AFQT as opposed to PRECOLLEGEAFQT—should reflect the returns to human capital acquired during higher education.

In addition to the problem of AFQT being confounded with educational attainment, AFQT might also—as signaling theorists argue—be confounded with motivation. If AFQT does partly reflect an individual's motivation, then a second complication arises; after all, I already have an independent variable (LOCUS) with which to control for motivation. If AFQT scores reflect a combination of ability and motivation, then adding this additional motivational variable will result in collinearity problems and will destabilize the coefficients on all independent variables. This complication could possibly explain the statistically insignificant result (t=1.772) that I found for the coefficient on LOCUS when adding it as a control variable in addition to AFQT. Even if the result had been statistically significant, the coefficient on COLLEGEGRAD actually increased by $74, which is insignificant in of itself. Removing AFQT from the regression, the coefficient on LOCUS becomes significant (t=4.665) but still lacks in magnitude with the coefficient on COLLEGEGRAD falling to $44,224—a decrease of only $712. Disregarding collinearity problems, this result suggests that motivation has little effect on an individual's returns to education, a result that runs contrary to signaling theory.

V. Conclusion

Ultimately, this study reveals a strong, positive and significant correlation between AFQT scores and earnings in the labor market. Additionally, my regression analysis fails to establish a significant correlation between the motivational measure, LOCUS, and labor market earnings. If AFQT scores were accurate measures of inherent intelligence and, additionally, if our locus of control variable accurately measured work ethic, then I could be confident in concluding that individuals utilize higher education as a signal of their inherent intelligence, but not of their work ethic, and that the signaling effect of education is substantial. But AFQT is not a good measure of inherent intelligence. Instead, it likely measures a combination of intelligence, motivation, and educational background. Because AFQT likely reflects motivational factors, controlling for an additional motivational measure—as I did in including the variable LOCUS—may have resulted in issues of multicollinearity, which, in turn, may have destabilized the coefficients on all independent variables in the regression. This might account for the insignificant effect of the

Table 2: Results

	HIGHSCHOOL	SOMECOLLEGE	COLLEGEGRAD	AFQT	LOCUS
Model 1	10,647 (6.8)[2]	17,981 (10.7)	44,935 (26.2)		
Model 2	3909 (2.4)	6175 (3.4)	24630 (11.8)	359 (17.8)	
Model 3	10,389 (6.6)	17,536 (10.4)	44,224 (25.7)		4,375 (4.7)
Model 4	3,914 (2.4)	6,201 (3.4)	24,704 (11.9)	353 (17.2)	1,701 (1.772)

[2] Numbers in parenthesis are t-statistics

variable LOCUS on returns to higher education, though such a conclusion is only conjecture.

The results of this study are inconclusive, but I believe that the theoretical foundation of this paper is sound. If I had been able to find an objective measure of inherent intelligence, I believe regression analysis would have revealed a more pronounced signaling effect for both inherent intelligence as well as motivational measures. Locating a dataset with suitable variables must be the first step taken by researchers who wish to pursue a regression analysis to identify the signaling effect of education. Chevalier (2004) located an excellent measure for inherent intelligence but failed to control for other important productivity-enhancing characteristics, such as the motivational measures from the NLSY explored in this study. Finding a single dataset containing both ability and motivational variables is necessary for the success of regression tests like those conducted by Chevalier and myself. If such data is unavailable, one would be better served in turning to alternative methods of testing signaling and human capital theory.

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