Individual Returns to Educational Investment

A Research Monograph Prepared for

The Education alliance
Business and Community for Public Schools

by the
Center for Business and Economic Research
Marshall University

Funding provided by the
Claude Worthington Benedum Foundation

November 2002

INDIVIDUAL RETURNS TO EDUCATIONAL INVESTMENT

Abstract: The purpose of this monograph is to review the existing research on education and wage and earnings outcomes. We do this by reviewing the most common models for calculating return to education and describing the most common variables employed. The important variables are: school quality, family background, years of education, educational level, and ability. This study evaluates and compares an investment in education with other common securities from 1965 to 2001. We find that, with the exception of the stock market, education provided the highest rate of return when adjusted for inflation. Further, we find that education returns (in the form of wages for our purposes) are the least risky of all assets. From a portfolio choice standpoint, this strongly recommends education as a highly desirable investment.

Viktoriya Rusalkina
Research Associate

Michael Hicks
Director of Research

Center for Business and Economic Research
Marshall University
1 John Marshall Drive
Huntington, West Virginia 25504

304.696.2313
hicksm @marshall.edu
rusalkina@marshall.edu
www.marshall.edu/cber

INDIVIDUAL RETURNS TO EDUCATIONAL INVESTMENT

EXECUTIVE SUMMARY

Background

An important first step in evaluating education policy is the measurement of private benefits to schooling. That is the central research question of this monograph. We do this by reviewing existing research on the financial rate of return to investment in education accruing to individuals.

This research encompasses a wide array of issues from the types of measurements used to individual variation in educational benefits due to demographic and school quality differences.

Clearly, there are many and varied benefits to education that are enjoyed by individuals. The joys of reading Shakespeare or Angelou are real, but will remain unmeasured in this analysis. Our exclusion of these benefits is not because they are unimportant, but because it is very costly to measure them. This analysis focuses on the benefits that can be directly estimated.

Key Findings from Existing Research

In reviewing over 50 peer reviewed studies we found that the methods of estimating education result in modest differences in the predictions to returns. However, several factors mattered greatly across studies. Among these are:

- School quality, both at the K-12 and in higher education affects the rate of return to education.
- Lower student teacher ratios positively affect rates of return to education in most groups studied
- More highly paid teachers were correlated with higher rates of return to education by several leading researchers.
- However there is little evidence that school expenditures are correlated with higher rates of return to education.
- Parent education – especially that of the child's mother – tended to correlate with higher rates of return to education for students. Also, the fathers' occupation effected rates of return to education, with professional occupations (more than just educational attainment) providing much benefit to children.

- We also found that research strongly supports the existence of a "sheepskin effect" whereby finishing a degree provides a key benefit above completion of similar numbers of years of schooling without the degree.

- Also, while natural ability seems to play a part in the rate of return to schooling, most researchers expressed real dissatisfaction with the measurements of ability currently employed in schools. This means that there is not widespread agreement on these results.

- Race and gender were not found to have a significant effect on the rate of return to education.

- Types of fields studied in higher education did affect rates of return.

- We also found that there is little agreement on whether the returns to education are linear (e.g. a constant increase with each successively higher degree). This is an important additional avenue of research, since if returns are increasing, we may see increasing income inequality, whereas if the marginal increase to returns decline with each additional year, we would expect decreasing income inequality.

Comparing Education as Investment

A central part of our study was to compare the rate of return on education to other commonly held investment securities. We find from existing studies that, in the United States, an additional year of education provides a rate of return of between 7 and 9 percent annual in wages.

We then compared this to actual returns to the stock market, a banker's acceptance, commercial paper, a Certificate of Deposit (CD), a stock, a Treasury Bill, and a Treasury Bond from 1965 through 2001. We found that, except for stocks (and only then for less than half the period surveyed*) education provided the best rate of return on investment*.

Importantly, throughout the period 1965 through 2001, *education enjoyed the lowest risk of any of the investment options we reviewed,*

This clearly suggests that education, if treated like other investment options, education would be a prime investment. See Figure 1 in the text.

POLICY RECOMMENDATIONS

The high relative individual returns to schooling found in this research make clear that investing in education is high payoff and low risk relative to most other investment options. Our findings mirror other research that arrives at similar conclusions. Indeed, there is no substantive research that counters these conclusions. This leads us to a number of policy options.

- Students in K-12 education should hear the benefits of education as an investment.

- We especially recommend providing a summarized set of these results to high school students and their parents.

- This is likely best achieved by broadly sharing this research with the education and business community.

- These findings are critical for users of workforce investment programs as well as those who design them.

- Similarly, economic development officials, at all levels, must understand the relevance of these findings to investment decisions that are aimed at the private sector.

- The business community in West Virginia should also share these findings with their workforce.

- We also recommend that firms consider bolstering the existing education and training subsidies provided to employees.

Viktoriya Rusalkina
Research Associate

Michael J. Hicks
Director of Research

Center for Business and Economic Research
Marshall University
1 John Marshall Drive
Huntington, West Virginia 25504
304.696.6251
hicksm@marshall.edu

INTRODUCTION

An important first step in evaluating education policy is the measurement of private benefits to schooling. Understanding the magnitude of benefits is important for analyzing choices about the quantity and type of education pursued by individuals. Also, an ultimate hope is that by understanding the benefits to education, we can better help policymakers understand what education does for individual citizens of our State. These questions and concerns provide motivation for this research.

At the outset we feel compelled to note the obvious – there are many and varied benefits to education. The joys of reading Shakespeare or Angelou are real, but will remain unmeasured in this analysis. Our exclusion of these benefits is not because they are unimportant, but because it is very costly to measure them. Throughout this paper, we will narrowly confine our discussion to education's benefits. This will ultimately lead us to understate the importance and benefits to schooling.

Since the beginning of the industrial revolution, literacy and knowledge have become increasingly valuable relative to basic manual skills. This increasing value has led to wage premiums for educated workers. Not surprisingly, an educated workforce is the dominant factor in explaining differences in regional growth and prosperity. As a result economists have extensively researched education's importance in determining individual differences in wages and regional differences in economic growth.

It is clear that better educated people typically are better paid, have access to more information, and enjoy greater economic success. Educational attainment serves as a signal of productivity in the labor market and suggests that a person has broader knowledge in a particular area. Educational attainment also implies that an individual is more productive than persons without a completed education. Education also implies that an individual has enough self-motivation and persistence to complete studies and to achieve goals.

Economic research strongly suggests that rates of return to education have been growing over the last decades. In perhaps the most important of hundreds of studies, Ashenfelter, Harmon, and Oosterbeek [2001] conducted a meta-analysis of 27 studies in 9 countries with data ranging from 1974 to 1995. They found that the average returns to education vary from 7 percent to 9 percent annually. They also found that rates of return to education seem to be the highest in the U.S. This is due to many factors, but most importantly perhaps due to rapid increases in returns over the last two decades. Their analysis indicates that investments in education provide considerable economic returns. These findings, and the many others we will review, suggest that understanding the benefits of education to individuals is an important area of exploration for both individuals and policymakers.

The purpose of this paper is to estimate the importance and value of education to the individual, and to test whether or not education provides a good return on investment. The paper is organized as follows. First, we review the most common models used to estimate returns to education and to evaluate various factors in determining differences in these returns. Next, we outline the most common measurement variables used in those models. Third, we compare the returns to a number of investment options over the past 40 years and discuss the results. Next, we

review the limitations to our analysis. Finally, policy implications are reviewed and overall findings of this paper are summarized.

TYPES OF STUDIES

There are several approaches used in researching education. Results of these studies depend on the question being asked, as well as the data and estimation method employed. In this paper we review and discuss the human capital model, production function model and reduced-form estimation model.

HUMAN CAPITAL MODEL

The human capital model treats education as an investment. In the human capital model, an individual invests time and forgone earnings in order to obtain higher future benefits. Several researchers have used the human capital model in their analysis. For example, Psacharopoulos [1995] uses the discounting method when calculating individual (private) rate of return. He finds the rate of discount by setting discounted benefits and discounted costs equal, thus yielding a rate of return to education. The costs include forgone earnings of the individual, education fees, and additional expenses incurred while studying. Benefits are primarily wages. This approach is useful since it may be employed to calculate returns to all levels of education – primary, secondary or tertiary. However, this approach requires numerous observations, either cross sectionally or over time, making it inapplicable in many circumstances.

A number of studies use Mincer's human capital earnings function (or HCEF). This model is also the most commonly employed method in labor economics. The HCEF is a simple regression model "with a linear schooling term and a low-order polynomial in potential experience" (Card, 1998:10). Mincer's HCEF finds the log of individual returns (Y) in a given period of time:

(1) $log(Y) = ? + ?_1 S + ?_2 W + ?_3 W^2 + ?_i$

where S accounts for years of completed education, W for the work experience of the individual after completing education, and $?$, the statistical residual (Card,1998). If there is no information about work experience, then "potential experience" is used as a proxy. "Potential experience" is the number of years of experience that a person could have worked if he/ she started school at the age of 6, continued to study, finished school in S years, and began working as soon as he/she graduated. In many cases, this basic formulation of the model is extended to include some characteristics other than education and tenure. Equation 2 illustrates this specification of the model where the variable X_i is a set of individual variables denoting other individual or labor market characteristics.

(2) $log(Y) = ? + ?_1 S + ?_2 W + ?_3 W^2 + ?_3 X_i + ?_I$

The methodology used in the human capital literature is a valuable theoretical and empirical basis for analyzing the role of education in the labor market. However, Mincer's earnings function has been criticized for not taking into consideration other important factors such as school quality

and family background that are not typically available in wage data. Many of these factors are typically considered in the education production function approach.

PRODUCTION FUNCTION APPROACH

The production function literature views various school characteristics, specifically teacher salaries, class size, student/teacher ratio, and expenditures per student, as inputs, and the educational attainments of individuals, specifically test scores, years of education, and graduation rates, as outputs. Such an approach concentrates on the educational process itself and the educational attainment of an individual. It also studies the relationships between various inputs and students' future wages (Wilson, 2001). The basic model takes the form:

(3) $Y = ? + ?_1 X_1 + \ldots + ?_n X_n + ?_i$

where Y is the output measure, the X_i variables are the different inputs, and u the residual.

Hanushek [1986] surveys several studies and uses the production function method to determine the relationship between school quality and educational attainment of the individual. He does not find enough evidence to support a strong relationship between school expenditures (input) and student performance (output). He also suggests that the quality of education should be a greater priority than the number of educated people. However, Kremer [1995] argues that Hanushek considers all studies as being equal and does not take into account the differences in the number of observations, procedures, and controls (Kremer, 1995). Supporting his assumptions with the studies done by Hedges and Greenwald [1996], he argues that there is indeed a strong relationship between school expenditures and student performance. He also finds that increasing the number of educated children should be a greater priority than the school quality. Notably, these studies looked primarily at the developing world, where school access was limited. What is clear from these (and other) divergent findings, is that even if a link between spending and quality exists, it is, at best, a weak relationship.

The education production function is an important method for determining the relationship (or absence of such) between inputs and outputs. By calculating the change in inputs, it is possible to determine the change in output. The major difference between human capital model and production function approach is that the latter does not consider "an individual as a decision maker choosing level of schooling" (Wilson, 2001: 521). Instead, it evaluates different factors that affect the individual's educational attainment.

REDUCED-FORM ESTIMATION MODEL

Another model used to calculate educational attainment is the reduced–form estimation model. Studies implementing reduced-form models typically evaluate the influence of family and neighborhood characteristics on returns to education. They set educational attainment as a dependent variable and a number of family and neighborhood characteristics as independent variables (Wilson, 2001). This method avoids restricting findings to theoretical relationships, permitting a less restrictive set of assumptions.

Typical family characteristics included in this analysis are: race, sex, religion, child's family position (birth order and number of siblings), mother's education, father's education, family income, family stress amongst others (Haveman et al, 1991). The examples of neighborhood characteristics are: average neighborhood family income, percentage of neighborhood that is non-minority, and neighborhood crime level. Reduced-form models often use simple regression and simultaneous equation models that reflect " endogenous nature of some relationships of particular interest" (Haveman et al, 1991:136).[1] These models typically take the form:

(4) $Y_1 = ? + ?_1X_1 + \ldots + ?_nX_n + ?_zY_n + ?_i$
$Y_2 = ? + ?_1X_1 + \ldots + ?_nX_n + ?_zY_n + ?_i$
$Y_m = ? + ?_1X_n + \ldots + ?_nX_n + ?_zY_n + ?_i$

where outputs appear on the left hand side of the equation and inputs on the right hand side. Notably, *Y*'s or outputs appear on both sides of the equation representing the fact that there may be endogenous or multi-directional causation between variables.

Numerous studies find strong evidence that parental education has a significant effect on the child's returns to education (Wilson, 2001). The recent research on family background and educational attainment is summarized in "The Determinants of Children's Attainments: A Review of Methods and Findings" (Haveman et al, 1991).

Generally, neighborhood characteristics are not as extensively discussed as family characteristics. One of the first major studies in this field was "Effects of Community and Family Background on Achievement" (Datcher, 1982). In her research, Datcher examines "the effects of socioeconomic background on education and earnings of black and white men ages 23-32". She finds that "neighborhood differences are at least as important as family characteristics in explaining gaps between black and white achievement" (Datcher, 1982: 32).

One shortcoming associated with studies of the relationships between school quality and neighborhood variables is that they can be potentially biased due to the fact that parents choose their place of residence and, therefore, "unobserved parental attributes that are correlated with the school or neighborhood choice may lead to a biased estimate of the effect of neighborhood and school" (Wilson, 2001: 522). To correct for this, Wilson uses the individual's utility function and adds numerous family controls to reduce the possible bias of neighborhood variables. In her model:

> "family, neighborhood, and school quality independently affect educational attainment both through changing an individual's expected income conditional on education and through directly affecting the utility an individual receives from schooling". (Wilson, 2001: 545).

[1] Endogeneity, in this context, occurs when the dependent variable (say wages) in turn affects the independent variable (say number of children). This is both a technical and a theoretical challenge that requires a simultaneous equation approach.

These findings support the human capital model and confirm the assumption that students "respond rationally to economic incentives in education choices." (Wilson, 2001: 545). The study also provides strong evidence that school characteristics are important factors in educational attainment. She argues that increasing school expenditures directly affects the increase in the individual's educational attainment as well as his/her future earnings (Wilson, 2001).

The three approaches outlined above permit researchers to answer many important questions regarding education. Among these questions are 'how does schooling affect earnings? How do variations in school characteristics affect the quality of education? And how does individual variation influence the outcome of education?' These are important questions that ultimately help us assess the overall returns to education. But, before we present our findings, it is helpful to discuss the research findings of specific variables employed in many of these studies.

IMPORTANT VARIABLES

As described in the previous section, different techniques may be used to help measure the individual returns to education. The following section discusses common variables used in this analysis.

SCHOOL QUALITY

One of the important variables in determining individual rates of return to education is school quality. Pritchett [2001] points out that mere years of schooling do not reflect learning and that "the impact of an additional unit of educational capital is higher when the quality of schooling is higher" (Pritchett, 2001: 379). Although numerous studies addressed the relationships between school quality, education, and earnings, the evidence they offer is mixed.

The most common measures of school quality are expenditures per student, student-teacher ratios, teacher salaries, and class size (note: these measures are the same as the most common inputs in the education production function model). Card and Krueger [1992] find that men educated in states with "lower student teacher ratios and higher paid teachers have higher rates of return to education" (Wilson, 2001: 520). Altonji and Dunn [1995] find no evidence that "school expenditures per student, while increasing the level of income at all education levels, does not have a positive effect on the rate of return to education" (Wilson, 2001: 521).

Hanushek [1995] concludes that reduction of class size does not necessarily lead to higher educational attainment, a major determinant of returns to education. He also stresses the importance of school quality and argues that "low-quality schools, although provid[ing] higher access to education, may actually be a self-defeating strategy" (Hanushek, 1995: 227). It is important to note that Hanushek's conclusions regarding the quality/quantity issue were targeted at developing countries. For this reason, his findings may not be generalizable across West Virginia as a whole. However, there are counties in the State were educational achievement is similar to many developing countries.

Marlow [1999] examines the relationships between school structure, spending, and performance in California. Similar to Hanushek's conclusions, he finds that higher education spending does not raise student achievement. In fact, he argues that when higher education spending is defined as a percentage of personal income, it shows a negative effect on student attainment in five out of nine cases. (Marlow,1999). Likewise, when expenditures are defined as spending per student, it also negatively affects student attainment in five out of nine cases. Eide, Showalter, and Sims [2002] found that the student who attended a school with high pupil/teacher ratio had earnings of 1.5 percent lower than the student who attended a school with the low pupil/teacher ratio.

Clearly, research findings are often non-conclusive or render conflicting results. Differences between studies may be attributable to different estimation methods and techniques used.[2] However, the majority of studies suggest that school quality is an important determinant of individual rates of return and increasing quality of education should be a high priority.

FAMILY BACKGROUND

Many studies include family background into the models estimating returns to education. To what degree does parental education, income level, and occupation really matter? A number of research studies demonstrate that children who grow up in a low-income family typically have lower educational achievements and, subsequently, lower returns to education than children who grow up in a wealthy family (Haveman et al., 1991). The authors use data on 1,300 children and adults along with a set of family characteristics. They find a strong relationship between a father's education and occupation and his child's educational attainment and educational returns. However, it is important to note that the father's occupation seems to be more significant than his education. They also find that the mother's education usually has a positive effect on educational returns of a child. Their findings are consistent with the findings of Card [1998], who associates mother's higher educational level with a child's higher returns to education.

Wilson [2002] finds that "higher parental education is negatively related to income for late teens and early 20s but positively related at older ages" (Wilson, 2001: 535). Her conclusions are supported by the evidence that children of higher-educated parents typically attend college after graduating from high school, and while their initial earnings are lower during years spent studying, their returns to education significantly increase after they receive a college degree. Wilson also concludes that growing up in a low-income family and having a working mother are associated with lower (but not significantly lower) returns to education in the late teens and early 20s, but those factors do not affect income later in life. In addition, she determines that "having a higher-educated mother or one that works, increases the likelihood of graduating"
(Wilson, 2001: 537).

[2] It is also possible, given the number of studies performed in this area, that type 2 statistical error is occurring. For example, variables that are statistically significant to the 0.05 level are generally described as having a high degree of statistical significance. This characterization results from the fact that this outcome could be attributed to chance in only 1 out of every 20 occurrences. However, if 20 studies are performed, the expected probability of one of the studies failing to reject a false null hypothesis is 1. This means that when conducting many studies, it is nearly certain that one will be different from the majority given the same hypothesis, but using different data.

Broad research in a number of disciplines supports the obvious suggestion that family background has an important affect on many aspects of our lives, including education. Generally, coming from a wealthier and better-educated family, having more opportunities, and seeing educated parents as an example typically encourages children to attend school longer, to receive a better education, and to enjoy higher overall returns to education.

YEARS OF EDUCATION

Does studying longer increase individual returns to education? The vast research in this field again yields slightly varying results. However, the bulk of evidence suggests that additional years of schooling increase the return to education.

According to Altonji [1998], the wage level rises by 8 percent in response to each additional year of academic postsecondary education. In their study on estimating returns to education for a sample of twins, Ashenfelter and Krueger [1994] find that each year of school increases wage rate by 12 –16 percent. Even when they adjust for a measurement error, their estimates are not less than 9 percent per year of school completed (Ashenfelter and Krueger,1994:1165). Card and Krueger [1992] find that being educated in a higher-quality school positively affects the return to additional years of schooling.

Angrist and Krueger [1991] study how the different seasons of birth and compulsory school attendance influence returns to education. Since children who are born in the beginning of the year typically start school at an older age than their classmates who were born later in the year, they may stay in school a shorter period of time. [3] Angrist and Krueger find strong evidence that "students who are compelled to attend school longer by compulsory schooling laws earn higher wages as a result of their extra schooling" (Angrist, Krueger, 1991:1010).

Boissiere and Knight [1985] describe the return to years of education as moderate. In their study, they use data from East Africa. However, it is questionable whether the conclusions of the study can be generalized, since the countries in that part of the world have much lower incomes and a shorter supply of education related cognitive skills than most developed countries.

EDUCATIONAL LEVEL

Another important variable often discussed in the literature is educational level. Years of education are important, but the fact that an individual spent twelve years in school does not necessarily mean that he or she received a high school diploma. For example, that person could have repeated one or more years. That is why it is important to study not only how years of education affect future earnings, but also how the educational level that an individual ultimately achieves affects his/her wages.

According to results from the 2002 Census, "someone with a bachelor's degree earns nearly $1 million more over his lifetime than a high school graduate". Clearly, the difference is quite large. Cosca [2000] confirms the finding of many economists that, in general, employees with a

[3] Compulsory schooling laws usually require children to stay at school until the age of sixteen or seventeen.

bachelor's, master's, doctoral, or professional degree have higher average incomes and lower unemployment rates than do employees with less education. Her study also points out that, although earnings typically vary by occupation,[4] it can be concluded that investing in a college degree pays off.

Hecker's [1992] study was done in the early 1990's and has similar results to those of Cosca. He proves that earnings rise with education, specifically with educational level. He also stresses the importance of subject of study and, consequently, the importance of occupation. Once again, he demonstrates that among college-educated, individuals with advanced, professional degrees and degrees in physical science, engineering, or business had the highest earnings.

Jaeger and Page [1996] estimate the returns to schooling and the "sheepskin" effect. The sheepskin effect reflects the difference in earnings due to the possession of a degree. The reason is simply that a diploma serves as a signal of productivity in the labor market, thus increasing the individual's potential earnings. Jaeger and Page demonstrate strong evidence that diploma effects exist for all post-secondary degrees. The labor market values bachelors and post-graduate degrees more than the equivalent years of schooling.

In their analysis of the payoffs of a two and four-year college education, Kane and Rouse [1995] demonstrate that the individual who attended a two-year college earns about 10 percent more than those without any college education. Surprisingly, they find similar wage differentials for a four-year college credits: 4-6 percent for every two semesters completed.

Clearly, in most cases, the returns to education increase with the educational level, not just with the additional years of schooling. It also seems likely that this pattern will continue.

ABILITY

Will individuals with higher ability receive higher returns to education? Or is it just the opposite: if an individual has more natural ability, will he/she benefit from education as much as an individual with lower ability?

Numerous studies have attempted to determine the relationship between ability and returns to education. In this research, it is typical to analyze the returns of education of identical twins, assuming that they represent a sample of two individuals with the most similar genetic characteristics and family background. Even after numerous studies, ability still remains a controversial issue. It is especially difficult to account for what economists call "unobserved ability." Many critics argue that typical instruments of measuring ability, such as IQ tests, SAT scores, etc., are not completely accurate.

Some studies, such as one done by Arias and Hallock (2001), argue that typically high-ability individuals have higher returns to schooling. They also tend to obtain more and a higher level of education because their marginal costs are less than those of lower-ability individuals

[4] Physicians, lawyers, and high-level executives being paid the highest.

and their marginal benefits to each additional year of education are higher than those of lower-ability individuals (Arias and Hallock, 2001).

However, other economists find just the opposite. They provide strong evidence to demonstrate that individuals with higher ability tend to receive lower marginal returns from education after considering measurement error and endogeneity (Ashenfelter and Rouse, 1998).

Some studies show no statistically significant relationship between ability and earnings. Such analyses typically concentrate on data from developing countries, where income levels are below average. As a result, their findings cannot often be generalized. For instance, Boissiere and Knight (1985) study returns to education in East Africa. They demonstrate that ability does not influence earnings in those countries. Glewwe (2002) finds that ability does not directly affect productivity or earnings.

In addition, Glewwe, in his study on education in developing countries, points out a possible problem with ability measures such as test scores. He argues that future research should examine not only mathematical and reading skills, but also scientific, abstract thinking, and health knowledge skills. However, this fact could raise another potential problem when applying data from developing countries to study the educational systems in the United States.

In many cases, tests measuring ability in developing countries determine basic literacy skills, while similar tests in the United States measure much more than just reading and writing. It is important to mention that in some parts of West Virginia, literacy levels are extremely low and that data from developing countries could be used in researching that particular region.

OTHER VARIABLES: RACE AND GENDER

Economic literature has often addressed the issue of the discrimination factor in returns to education on the basis of sex and race. Several studies have pointed out that such differences exist. However, our research finds that such differences in most of the studies are not statistically significant or are based on valid explanations of worker behavior (such as tenure lost due to childbirth).[5]

Jaeger and Page [1996] use a data set from a sample of 1991 and 1992 Current Population Surveys (CPS) consisting of 18,699 individuals. They specifically study the ‘sheepskin effects’ of high school and college degrees between different races and sexes. They

---

[5] To be clear, there is research that points to gender and ethnic inequality in wages, but this tends to be more often found in individual firms or industries (see Agesa, J. "The Impact of Deregulation on Employment Discrimination in the Trucking Industry," *Atlantic Economic Journal*, Vol. 26, No.3, September, 1998, pp. 288-303.

find “little evidence that the sheepskin effects of high school and college graduation differ across race and sex groups” (Jaeger and Page, 1996: 739).

Any study that simply illustrates differences in individual rates of return between races and sexes may not take into account important factors such as type and quality of education obtained. Studies that show women receiving lower returns to education than men with the same level of education often ignore important facts. For example, women in the data set may have chosen to pursue degrees that generally pay lower wages such as sociology, psychology, or liberal arts.

It is also common for such studies to ignore the fact that men included in the sample had degrees in better-paid occupations such as business, law, or medicine. After accounting for these factors, it becomes evident that the difference in returns to education is statistically insignificant. Quality of education is another important factor that is commonly ignored. The fact that the individuals have similar “educational attainment” does not actually mean they have the same education or the same job skills (Bradbury, 2002).

It is rather difficult to answer the question of whether wage differences across races and genders are due to labor market discrimination or to differences in career choices and quality of education (Weinberger, 1998). However, most of the studies, argue that the factors mentioned above, such as career choices or school quality, are ignored and, consequently, the estimated differences in returns to education between different races and sexes can be biased.

TYPES OF SCHOOLING AND INCREASING RETURNS

The research described in the earlier sections encompasses a wide range of school types. It is important to understand how research into the returns to education differentiates between primary, secondary and tertiary education. Clearly, while a number of issues regarding the sheepskin effect, quality and types of major (at the tertiary level) matter, a central issue is whether education generates increasing returns to individuals.

Linear returns to the individual suggest that extra years of schooling increase wages, but at a constant rate. Increasing (decreasing) returns suggests that wages increase (decrease) at an increasing (decreasing) rate. This matters because income inequality in current (and potentially later) generations may be affected by increasing returns.

Increasing returns potentially indicate a widening income gap, while decreasing returns would imply a declining income gap as education levels increase. This is an important issue in our State, since the income gap between West Virginians and the rest of the nation has risen steadily over the past decade. There may also be second order effects where parental education and wages affect their children.

COMPARISON OF INVESTMENTS: EDUCATION AND SECURITIES

In this section, we illustrate the benefits of investing in education relative to other investment instruments. We make the comparison between $1 invested over the period 1965-2001 with returns compounded annually. We compare estimated educational rates of return with actual returns to the stock market, a banker's acceptance, a commercial paper, a Certificate of Deposit (CD), a stock, a Treasury Bill, and a Treasury Bond.[6]

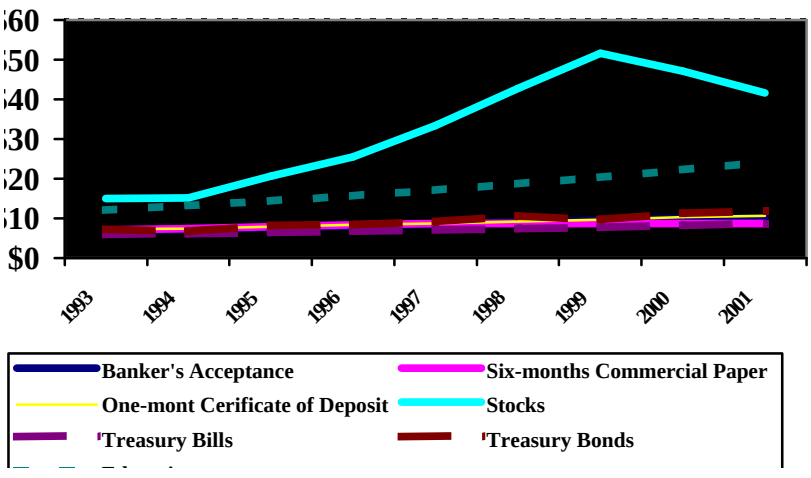
After making these assumptions, we find the average annual rates of return using historical data from the Federal Reserve Bank and New York University website. Next, we calculate how much return $1 compounded annually will give us in both scenarios by the end of 2001. Finally, we plot our data into the graph and analyze our findings. (See Appendix B). Results are illustrated in Figure 1.

This graph is helped by some brief interpretation. What we illustrate is the dollar value of investment in several different instruments. Clearly, one cannot simply invest $1 in education. Investment in education (and in many other instruments) is 'lumpy' and oftentimes cannot be made in small amounts. By using the representative $1 investment we are able to readily compare the many different investment instruments to one another.

Over the time period examined, the only investment that yielded higher returns than education was stocks. However, until 1989, returns to investment in education were higher than returns to investment in stocks. It was only after 1986, during an historic stock "boom" period that stock returns outpaced education. However, such growth is not stable and in 1999 the growth rate started to decrease dramatically. This is in great contrast to returns to investment in education that grew at a relatively stable rate of 9 percent. Also, our returns on stock do not include failed stock issuances over this period. Though this was a modest proportion of total firms, it does lead us to overestimate returns on stocks.

In addition, portfolio theory treats both risk and returns equally when analyzing investment decisions. This clearly matters for individual investors, and is an integral part of any investment decision.

Figure 1, The Real Return to $1 invested in 1965



The risk associated with the investment in securities is much higher than the risk associated with the investment in education. In order to measure this, we evaluated the risk associated with each of the instruments displayed in Figure 1. To do this we measured the standard deviation for each of the instruments using average weekly earnings in the private sector as a proxy

for measuring the variation of the rate of return for education displayed in Figure 1. We placed all the variables in comparable units by calculating the standard deviation divided by the return over the period from 1965 through 2000. This was necessary since no study measured the risks to educational return. This process is derived from portfolio choice theory and is commonly used to evaluate investment options. The results were startling. See Figure 2.

Figure 2, Risk and Return

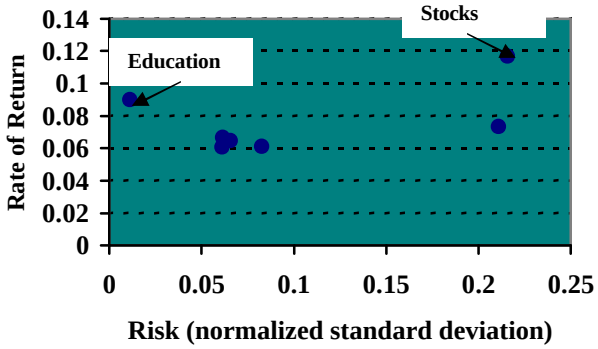


Figure 2 clearly illustrates our finding that when analyzed with modern portfolio theory, education provides an attractive investment option. The low risk and high return with respect to our other investment options would clearly recommend education as a potentially important investment.

This analysis is not perfect. All of these variables are annual estimates (the shortest common data interval). Also, the use of standard deviation as a risk proxy, though common, is not perfect. Other risks matter in the context of comparing these investments. For example, one purpose for investing may be to provide resources to family members after the investors' death.[7] Clearly, earnings, which drop to zero after death, are subject to different types of risk than are the other assets. Still, it is clear that education provides rates of return that attractively mix low risk with high return. It is unlikely that future research will substantially counter this finding.

In addition, a stock portfolio has to be managed. This is more costly and time consuming than education (following the initial investment). It can also be argued that an individual has to have an education in the first place to mange his/her portfolio successfully. Also, as we mentioned at the beginning of this study, investment in education, unlike investment in stocks, provides non-monetary benefits such as personal growth, better information access, benefits related to consumption/savings, occupational and health benefits. So, our findings that education provides a low risk, high return investment understates the true benefits of education.

[7] Note, that we are only counting money wages, not fringe benefits that may include life insurance or annuities

STUDY LIMITATIONS

It is important to mention that this analysis has several limitations. The first of these is the ability measurement. As mentioned earlier, ability continues to be a controversial variable in the literature addressing value of education to the individual. The most common types of measurements are IQ tests, SAT, and ACT scores. However, many factors affect those test scores. For instance, inappropriate testing conditions, distress, or illness of the respondent can provide inaccurate test results. Glewwe (2002) suggests that ideally the respondents " should be tested twice, on different days and under different conditions." (Glewwe, 2002: 472).

Second, school quality differentials can also be inaccurate. How can we distinguish between the "high-quality school" and the "poor-quality school?" The data can have many errors due to inaccurate information provided by the schools. This is a problem that extends far beyond West Virginia's borders. For instance, teachers may provide similar test questions on the day before standardized tests, consequently "improving" students' test results.

Schools may also have a policy that simply does not allow students to fail in order to maintain the image of "the best" school with "the best" students. Obviously, such schools will have low dropout rate and the majority of students will have excellent grades. But does such a school really provide higher quality?

Finally, perhaps the greatest limitation of this study is that it does not address the non-monetary benefits of education. As we mentioned, education provides benefits in such areas as personal growth, occupational choice, longer lifespan, better health, and benefits related to consumption and savings (Vila, 2000). Higher wages, higher income and other purely economic benefits are an important part of the individual benefits to education. But, they are not the only benefits and may not even represent the majority of education's benefits.

POLICY IMPLICATIONS

This research deals with individual returns to education. This choice of topics suggests that many of the policy implications derived from the study's findings should be targeted to the private sector. A later monograph is designed to outline public sector interest in education.

The high relative individual returns suggested by this research make clear that investing in education is high payoff and low risk relative to most other investment options. Our findings mirror other research that arrives at similar conclusions. Indeed, there is no substantive research that counters these conclusions.

Given these findings it seems clear that incorporating education as a useful investment option to students at all levels is warranted. We especially recommend providing a summarized set of these results to high school students and their parents. This is likely best achieved by broadly sharing this research with the education and business community.

These findings are critical for users of workforce investment programs as well as those who design them. Similarly, economic development officials, at all levels, must understand the relevance of these findings to investment decisions that are aimed at the private sector.

The business community in West Virginia should also share these findings with their workforce. We also recommend that firms consider bolstering the existing education and training subsidies provided to employees.

Researchers too, may find much in this paper to direct additional resources. The *Center* will soon complete additional research into the regional impact of education on growth and prosperity. We ask other scholars to address the many issues remaining in this area. Specifically, we would like to see, from micro data sets, evidence regarding the non-linearity of returns to education, as well as second generation effects to current investment. We would also like to see better quality instruments developed and tested to evaluate both programs and individuals.

SUMMARY

The purpose of this paper was to review the existing research on education and wage outcomes. It is clear that this relationship is important and that its importance continues to increase due to technological changes, changes in international trade, changes in labor market composition, and other factors (Haider, 2001). The most common models for calculating return to education were described and variables typically used in three different approaches were discussed. The most important variables are: school quality, family background, years of education, educational level, and ability.

After reviewing a number of studies, it is clear that that school quality is an important factor in determining individual rates of return. The majority of studies show that school expenditures per student do not affect rates of return to education. On the other hand, lower student/teacher ratios and higher-paid teachers seem to play an important role in determining individual rates of return to schooling. Family background also influences educational attainment and return to education. Children coming from low-income families typically have lower returns to education. Mother's education positively affects the future educational returns of a child. A father's education also influences the returns to education of his child and, in many cases, the father's occupation seems to play an even more important role than his education.

According to numerous studies, more years of education result in higher returns to schooling. Specifically, higher-quality schools positively affect the returns to additional years of education. A higher educational level typically increases individual earnings. Although wages may very by occupation, investing in a college degree pays off in general.

The relationship between individual ability and returns to education is difficult to determine. Many studies indicate that individuals with higher-ability have higher returns to education. On the other hand, other studies show that individuals with higher ability tend to receive lower marginal returns to schooling. Several critics suggest that improvements in determining individual ability are necessary for future research.

Race and sex do not tend to be important variables in determining returns to education. Although some studies point out race and gender related differences in earnings for persons with similar educational levels, there is not broad agreement. Problems with education quality measurement and omitted variable bias tend to weaken the overall impact of these findings. Even if gender and race variations in rates of return to education are found, they are still likely to be high relative to other investment options.

In this paper, we compared investments in education and other types of securities. We analyzed the returns of $1 invested in education as opposed to a $1 investment in a CD, a banker's acceptance, a Treasury bill, a Treasury bond, and a stock. Only investment in stocks indicated higher returns than investment in education. However, considering the high risk and volatility associated with stock market, the education necessary to manage the portfolio successfully, risk-averseness of the majority of people, and non-monetary benefits of education, we believe that investment in education is a preferred investment.

BIBLIOGRAPHY

Altonji, Joseph G. 1998. "Effects of Personal and School Characteristics on Estimates of the Return to Education," *Economic Perspectives* 22, pp.65-80.

Angrist, Joshua D. and Alan B. Krueger. 1991. "Does Compulsory School Attendance Affect Schooling and Earnings?" *The Quarterly Journal of Economics* 106, pp. 979-1014.

Arabsheibani, Reza G. and Lamine Manfor. 2001. "Non-Linearities in Returns to Education in Libya," *Education Economics* 9, pp.139-144.

Arias, Omar; Kevin F. Hallock and Walter Sosa-Escudero. 2001. "Individual Heterogeneity in the Returns to Schooling: Instrumental Variables Quantile Regression Using Twins Data," *Empirical Economics* 26, pp.7-40.

Ashenfelter, Orley and Alan Krueger. 1994. " Estimates of the Economic Return to Schooling from a New Sample of Twins," *American Economic Review* 84, pp.1157-1174.

Ashenfelter, Orley; Colm Harmon and Hessel Oosterbeek. 1999. "A Review of Estimated of the Schooling/Earnings Relationship, with Tests for Publication Bias," Industrial Relations Section working paper, Princeton: Princeton University Press, pp.425-449.

Black, Sandra E. 1998. "Measuring the Value of Better Schools," *Economic Policy Review* 4, pp. 87-94.

Boissiere, M; J.B. Knight and R.H. Sabot. 1985. "Earnings, Schooling, and Cognitive Skills," *The American Economic Review* 75, pp.1016-1030.

Bradbury, Katharine L. 2002. "Education and Wages in the 1980s and 1990s: Are All Groups Moving Up Together?" *New England Economic Review*, pp.19-46.

Card, David. 1998. "The Casual Effect of Education on Earnings," The Center for Labor Economics working paper 2.

Card, David and Alan B. Krueger. 1992. "Does School Quality Matter? Returns to Education and the Characteristics of Public Schools in the United States." *The Journal of Political Economy* 100, pp.1-40.

Casse, Daniel and Bruno V. Manno. 1998. "The Cost and Price of College and the Value of Higher Education," *Academic Questions* 11, pp. 38-55.

Census: More Degrees Equal Bigger Bucks. CNN.com. 07/18/02. fyi.cnn.com/2002/fyi/teachers.ednews/07/18/degree.dollars.ap/index.html Access Date: 07/18/02.

Chu, Hong-Yih. 2000. "The Impacts of Educational Expansion and Schooling Inequality on Income Distribution," *Quarterly Journal of Business & Economics* 39, pp. 39-50.

Consumer Price Index. Federal Reserve Bank of Minneapolis. http://minneapolisfed.org/research/data/us/calc/hist1913.cfm Access Date: 09/14/02.

Cosca, Theresa. 1998. "Earnings of College Graduates in 1996," *Occupational Outlook Quarterly* 42, pp. 20-29.

Datcher, Linda. 1982. "Effects of Community and Family Background on Achievement," The *Review of Economics and Statistics* 64, pp.32-41.

Dinopoulos, Elias and Paul Segerstrom. 1999. "A Schumpeterian Model of Protection and Relative Wages," *The American Economic Review* 89, pp. 450-472.

Dothan, Uri and Joseph Williams. 1981. "Education as an Option," *The Journal of Business* 54, pp.117-139.

Eide, Eric R; Mark H. Showalter and David P. Sims. 2002. "The Effects of Secondary School Quality on the Distribution of Earnings," *Contemporary Economic Policy* 20, pp. 160-170.

Glewwe, Paul. 2002. "Schools and Skills in Developing Countries: Education Policies and Socioeconomic Outcomes," *Journal of Economic Literature* XL, pp. 436-482.

Grosskopf, Shawna; Kathy Hayes, Lori L. Taylor and William L. Weber. 1998. "Allocative Inefficiency and School Competition," *Proceedings of the 91 Annual Conference on Taxation, National Tax Association*, pp.282-290.

Haider, Steven J. 2001. "Earnings Instability and Earnings Inequality of Males in the United States: 1967-1991," *Journal of Labor Economics* 19, pp.799-837.

Hanushek, Eric A. 1995. "Interpreting Recent Research on Schooling in Developing Countries," *The World Bank Research Observer* 10, pp. 227.

Harmon, Colm and Ian Walker. 1995. "Estimates of the Economic Return to Schooling for the United Kingdom," *American Economic Review* 85, pp. 1278-1287.

Haveman, Robert; Barbara Wolfe and James Spaulding. 1991. "Childhood Events and Circumstances Influencing High School Completion," *Demography* 28, pp. 133-157.

Haveman, Robert and Barbara Wolfe. 1995. "The Determinants of Children's Attainments: A Review of Methods and Findings," *Journal of Economic Literature* 33, pp. 1829-1878.

Hecker, Daniel E. 1992. "College Graduates: Do We Have Too Many or Too Few? College Earnings and Why They Vary," *Occupational Outlook Quarterly* 36, pp. 13.

Heckman, James. 1998. "What Should Be Our Human Capital Investment Policy?" *Fiscal Studies* 19, pp.103-119.

Hedges, Larry V. and Rob Greenwald. 1996. Have Times Changed? The Relation between School Resources and Student Performance. Brookings Institution Press.

Hoxby, Caroline M. and Bridget Terry Long. 1999. "Explaining Rising Income and Wage Inequality Among the College-Educated," Harvard University, NBER working paper.

Imazeki, Jennifer and Andrew Reschovsky. 1998. "Measuring the Costs of Providing an Adequate Public Education in Texas," *Proceedings of the 91Annual Conference on Taxation, National Tax Association*, pp.275-281.

Jaeger, David A. and Marianne E. Page. 1996. "Degree Matter: New Evidence on Sheepskin Effects in the Returns to Education," *The Review of Economics and Statistics* 78, pp.733-740.

Jolliffe, Dean. 2002. "Whose Education Matters in the Determination of *Household Income? Evidence from a Developing Country," Economic* Research Service, U.S. Department of Agriculture, working paper.

Juhn, Chinhui; Kevin M. Murphy and Brooks Pierce. 1993. "Wage Inequality and the Rise in Returns to Skill," *The Journal of Political Economy* 101, pp.410-442.

Kane, Thomas J. and Cecilia Elena Rouse. 1995. "Labor-Market Returns to Two- and Four-Year College," *American Economic Review* 85, pp.600-615.

Kremer, Michael R. 1995. "Research on Schooling: What We Know and What We Don't – A Comment on Hanushek," *The World Bank Research Observer* 10, pp. 247.

Lassibille, Gerard and Lucia Navarro Gomez. 1998. "The Evolution of Returns to Education in Spain 1980-1991," *Education Economics* 6, pp. 3-10.

Mallier, Tony and Timothy Rogers. 1995. “Measuring Value Added in Higher Education: A Proposal,” *Education Economics* 3, pp. 119-133.

Marlow, Michael L. 2000. “Spending, School Structure, and Public Education Quality. Evidence from California,” *Economics of Education Review* 19, pp. 89-106.

Mariani, Matthew. 1999. “High-Earning Workers Who Don’t Have a Bachelor’ Degree,” *Occupational outlook Quarterly* 43, pp.8-15.

McHaffie, Patrick H. 1998. “Contingency in the Local Provision of Public Education,” *Growth and Change* 29, pp. 196-215.

Miller, Paul and Charles Mulvey. 1995. “What Do Twins Studies Reveal About the Economic Returns to Education? A Comparison of Australian and U.S. Findings,” *American Economic Review* 85, pp. 586-600.

Moll, Peter G. 1998. “Primary Schooling, Cognitive Skills and Wages in South Africa,” *Economica* 65, pp.263-284.

Newell, Andrew and Barry Reilly. 1999. “Rates of Return to Educational Qualifications in the Transitional Economies,” *Education Economics* 7, pp. 67-85.

Odden, Allan. 1990. “ School Funding Changes in the 1980s,” *Educational Policy* 4, pp. 33-48.

Pritchett, Lant. 2001. “Where Has All the Education Gone?” *World Bank Economic Review* 15, pp.367-391.

Pryor, Frederic L. and David Schaffer. 1997. “Wages and the University Educated: A Paradox Resolved,” *Monthly Labor Review* 120, pp.3-15.

Psacharopoulos, George. 1994. “Returns to Investment in Education: A Global Update,” *World Development* 22, pp. 1325-1344.

Psacharopoulos, George and Eduardo Velez. 1996.” Returns to Education During Economic Boom and Recession: Mexico 1984, 1989, and 1992,” *Education Economics* 4, pp. 219-231.

Psacharopoulos, George. 1995. “The Profitability of Investment in Education.” Working Paper.

Rosenzweig, Mark R. 1995. “Why Are There Returns to Schooling?” *The American Economic Review* 85, pp.153-158.

Rubenstien, Ross, Amy Ellen Schwartz and Leanna Stiefel.2000. “Conceptual and Empircal Issues in the Measurement of School Efficiency” Proceedings of the National Tax Association, v 91. pp. 267-274.

Rupert, Peter and Mark E. Schweitzer. 1996. “Earnings. Education, and Experience,” *Economic Review* 32, pp. 2-13.

Selected Interest Rates. Federal Reserve Statistical Release http://www.federalreserve.gov/releases/h15/data.htm. Access Date: 09/12/02.

The Data Page. University of New York. http://pages.stern.nyu.edu/~adamodar/New_Home_Page/data.html Access Date: 09/10/02.

Toh, Mun Heng and Chai Shing Wong. 1999. "Rates of Return to Education in Singapore," *Education Economics* 7, pp.235-253.

Vila, Luis E. 2000. "The Non-Monetary Benefits of Education," *European Journal of Education* 35, pp. 21-33.

Weinberger, Catherine J. 1998. "Race and Gender Wage Gaps in the Market for Recent College Graduates," *Industrial Relations* 37, pp. 67-84.

Wilson, Kathryn. 2001. "The Determinants of Educational Attainment: Modeling and Estimating the Human Capital Model and Education Production Functions," *Southern Economic Journal* 67, pp. 518-551.

Wolter, Stefan C. 2000. "Wage Expectations: A Comparison of Swiss and US Students," *Kyklos* 53, pp.51-70.

A Review of the Literature

Appendix A

Value of Education to the Individual

Name	Focus/Relevance to Report	Findings
Altonji, Joseph G. (1998)	The effects of personal and school characteristics on estimates of the return to college education. Economic return to attending college; factors for the earnings gap between college and high school graduates.	The wage rises by about 8 percent in response to an extra year of academic postsecondary education. The financial return to spending a year in postsecondary vocational education is only about 1.5 percent.
Angrist, Krueger (1991)	Correlation between the season of birth and educational attainment; return to schooling; earnings equation.	Difference in education related to season of birth occurs because some individuals, by accident of date of brith, are forced to attend school longer than others due to compulsory schooling. Men born in the first quarter of the year (who have lower education) earn slightly less per week than men born in surrounding months.
Arabsheinbani, Manfor (2001)	Returns to diploma years in Libya.	Returns to years of education are non-linear but do not strongly support sheepskin effect. The largest marginal return is at 8 years of education (not a diploma year).
Arias, Hallock (2001)	Individual heterogeneity in the returns to schooling; twins data, instrumental variables quantile regression	The estimated returns to education accounting for the endogeneity of schooling are positive and significant, consistent with the human capital model. Two sources of heterogeneity in the returns to education: differential heterogeneity effect by which more able individuals become more educated; there is no unique causal effect of schooling, and for any individual the effect may be above or below the OLS estimate depending on his/her unobservable abilities in the generation of earnings.
Ashenfelter, Krueger (1994)	Economic returns of education. Comparison of the wages rates of identical twins with different schooling levels; collection of multiple measurements of schooling levels.	Each year of school completed increases a worker's wage rate by 12-16 percent. No evidence that unobserved ability is positively related to the schooling level completed was found. Some weak evidence that unobserved ability may be negatively related to schooling level was discovered. There was a significant evidence of measurement error in schooling levels.
Ashenfelter, Harmon (2001)	Analytical review of previous estimates of the rate of return to schooling.	Returns to education are higher in the United States compared to other countries, and they continue to increase. Differences due to estimation method are considerably smaller than is sometimes reported.

Black (1998)	Two methods of measuring value of better schools. One method: determining how the quality of the individuals' education affects them later in their lives. Another method: calculating parental valuation of better schools today.	There is no perfect approach to measure value of better schools. The best method would be a combination of both techniques used in the paper.
Boissiere, Knight (1985)	Influence of cognitive achievement, native ability, and years of education on earnings. Studies of Kenya and Tanzania.	Returns to reasoning ability in the labor market are small, returns to years of education are moderate, and returns to literacy and numeracy are large. Effects of length of education and reasoning ability on earnings are indirect.
Bradbury (2002)	Median earnings by sex, race, and educational attainment during 1980s and 1990s are described, and an attempt is made to seek out the sources of wage differences at each education level.	Educational attainment is a key determinant of wages. The payoff to obtaining additional education rose over the last decades.
Card, Krueger (1992)	The effects of school quality measured by the pupil/teacher ratio, average term length, and relative teacher pay. Rate of return to education for men born in 1920-1949.	Men educated in higher-quality schools have a higher return to additional years of schooling. Rates of return are higher for individuals from states with better-educated teachers and with a higher fraction of female teachers. No evidence that parental income or education affects state-level rates of return.
Card (1998)	The return to schooling. Progress on some econometric problems related to studying the return to schooling.	The instrumental variable estimates of the return to schooling exceed OLS estimates, often by 20 percent or more. One interpretation of this finding is that marginal returns to education among the low-education subgroups typically affected by supply-side innovations tend to be relatively high, reflecting their marginal costs of schooling, rather than low ability that limits their return to education.
Casse, Manno (1998)	The cost and price of college and the value of higher education.	Community graduates earn 20 percent more than high school graduates, those with bachelor's degrees earn 40 percent more, and those with medical or law degrees earn over 60 percent more. Correlation between reading proficiency and educational level: over 75 percent of those with a two-year or four-year college degree reach at least level three proficiency (five is the highest), only 48 percent of those with high school diploma reached that level. However, only 4 percent of two-year college graduates and 10 percent of four-year graduates reached the top of the proficiency level.
Chu (2000)	Analysis of the schooling impact on income concentration.	Increases in education level as well as schooling dispersion are likely to improve the income distribution.

Cosca (1996)	Correlation between higher education and higher earnings. The median earnings for 1996 college graduates, the kinds of jobs they held, and the proportion of college graduates who earned less than the median for high schooled graduates are analyzed.	Workers with a bachelor's, master's doctoral, or professional degree have higher median incomes and lower unemployment rates than do workers with less education. Median earnings usually increase with age. About 14 percent of the college graduates aged 30 and over earned less than the median for high school graduates. Earnings often vary by occupation without regard to the education of the worker. For workers in almost all of the occupations listed, investing in a college degree paid off.
Datcher, (1982)	How family background and neighborhood characteristics affect achievement.	She finds that family income has no impact on education of a child, but it tends to raise a child's hourly and annual earnings.
Dinopoulos, Segerstrom (1999)	Role of international trade in reducing the relative wage of unskilled and less skilled workers.	A reduction in global tariffs that increases the profitability of R&D causes long-run changes in relative wages. Unskilled-labor biased technological change is not a required condition for a reduction of the relative wage of unskilled workers.
Dothan, Williams (1981)	Value of education as an option. A general valuation equation for education as an option is derived under uncertainty and solved in several special cases. The equation uniquely determines for the individual the value of education as a function of several variables, such as the student's current evaluation of all subsequent employment opportunities and the current time to graduation.	Given more risky alternatives for subsequent employment, students generally view continued education as more valuable and prefer to stay in school longer. Educational programs with broader training and more diverse opportunities for subsequent employment are more valuable to individuals. Students training for occupations with highly peaked age-earnings profiles, regard education as more valuable. Other things being equal, programs charging lower tuition are more valuable to individuals, thereby delaying departure from school. Students with more educated, affluent parents generally leave school later.
Eide, Showalter, Sims (2002)	The effects of secondary school quality on average earnings.	The student who attended a school with high pupil/teacher group had earnings of 1.5%lower than the student who attended a school with the low pupil/teacher ratio. Higher enrollments increase "the upper tail of the earnings distribution" without similar increase in the bottom of the distribution.
Glewwe (2002)	Educational Policies and socioeconomic outcomes in developing	Most of the literature on the impact of educational

	countries; review of the literature on relationship between school and teacher characteristics; relationship between schooling and labor productivity; relationships between cognitive skills and socioeconomic outcomes other than labor productivity.	policies on learning is methodological. There are many econometric problems; more confidence can be placed in randomized studies and natural experiments. Cognitive skills directly affect wages; " ability" does not affect the productivity. There is very little evidence on relationships between cognitive skills and socioeconomic outcomes. Mother's innate ability does not affect her children's health. Mother's health knowledge is the key contribution of education to child health.
Grosskopf, Hayes, Taylor, and Weber*	Allocative inefficiency and school competition; the distance function.	The school district inefficiency reflects competitive pressures; allocative inefficiency rises with market concentration, and the relationship is non-linear. Increased competition could enhance the efficiency of school districts in concentrated markets. The school districts in highly concentrated markets are substantially more allocatively inefficient then school districts in competitive markets.
Haider (2001)	Earnings instability and earnings inequality of males in the US; distribution of wages and hours; returns to education.	Lifetime earnings inequality increased by 70% during 1967-1991 period. Education is an indicator of skill; therefore, the increasing returns to skill are important components of the increase in lifetime earnings inequality.
Hanushek x(1995)	Overview of the literature on schooling in developing countries. Quality of education; school efficiency.	The evidence does not support reduction of class size. No evidence supports the notion that higher wages yield better teachers. Low-quality schools, although provide higher access to education, may actually be "a self-defeating strategy."
Harmon, Walker (1995)	Return to schooling with regard to the United Kingdom is estimated using ordinary least-squares.	The results of the study are consistent with the findings of Ashenfelter and Krueger (1994). The outcomes provide greater accuracy to substantiate U.S. evidence of much larger rates of return to education than ordinary least-squares suggests.
Haveman, Wolfe (1995)	Review of methods and findings on relationship between education and family background.	Children who grow up in a poor or low-income family have lower educational attainment. Growing up in a family with a single parent negatively affects educational attainment of a child.
Haveman, Wolfe, Spaulding (1991)	Family background and school completion.	Mother's work and parental education are important factors positively affecting educational attainment of a child. Growing up in a low-income family with more

		children negatively affects educational attainment of a child.
Hecker (1992)	Earnings and different educational levels.	Individuals with a college degree have higher returns to education. Earnings are higher for individuals with advanced, professional degrees, and degrees in physical science, engineering, and science.
Heckman (1998)*	The amount of the human capital investment necessary to offset the increase in the wage inequality in the US economy since 1979; ineffectiveness of government training policies; effectiveness of private sector training.	It would take $ 426 billion in 1989 dollars to restore real earnings of male high-school graduates to their 1979 levels. It will require $1.66 trillion in 1989 dollars to restore 1979 earnings ratios between lower education groups and college graduates without reducing the 1989 earnings of college graduates. Marginal rates of return are higher for persons who have fewer years of schooling.
Hoxby, Long (1999)	Three possible sources of growing income and wage inequality among the college-educated Americans. The first source is the increasing demographic diversity of college students ("extensive margin"); the second is the increasing return to aptitude; and the third is the increasing correlation between the average aptitude of a college's student body and its expenditure on education inputs ("intensive margin").	There is a return to aptitude and it has increased greatly from 1972 to 1995. Attending a college that has a higher standard deviation of SAT verbal scores is associated with higher individual incomes if that college has low aptitude rank; attending a college that has a smaller standard deviation of SAT verbal scores is associated with higher individual incomes if that college has high aptitude rank. The return to backgrounds shrinks over time, but the variance in background characteristics among the baccalaureate-holding group grows. People with higher aptitude earn significantly more income.
Imazeki, Reschovsky *	Link between school finance and the achievement of student performance goals; minimum amount of money each district should spend to provide a student with adequate education; state government reforms and school financing systems; public education in Texas.	Cost considerations should be integrated into school financing formulas. There is an important link between cost indices. Providing school districts with enough resources does not guarantee that students will receive and adequate education. States have to develop other financial incentives and/or penalties to make sure that local districts meet their goals of educational adequacy.
Jaeger, Page (1996)	Earlier estimates on the returns to schooling and sheepskin effect are improved.	Substantial diploma effects exist for all post-secondary degrees. Bachelor's and post-graduate degrees are valued by the labor market at least as much as years of education. Returns to individual years of schooling are insignificant relative to the sheepskin effects of these degrees. There are only few significant differences in

		sheepskin effects between race and sex groups.
Jolliffe (2002)	Three existing models of how household education affects household income are discussed.	The minimum value of schooling is the only school variable that has a statistically significant effect on household income. Education affects the components of income through a productivity effect. Education seems to improve total income through an allocative effect.
Juhn, Murphy (1993)	Increase in wage inequality for males over the past 30 years; returns to skill.	Skill premia increased greatly since 1963. The demand for skill has risen as well. From 1968 through 1989 the variance of log earnings increased by about 80 percent.
Kane, Rouse (1995)	Payoffs to a two- and four-year college education.	The average person who attended a two-year college earned about 10 percent more than those without any college education. The study found similar returns to two-year and four-year college credits; forgone earnings were presumably the same.
Kremer (1995)	Comment on Hanushek's article "Interpreting Recent Research on Schooling in Developing Countries."	Argues that expenditure affects school quality and that there is no evidence to conclude that school quality is more important than greater access to schools. Agrees with Hanushek that class size is not significant.
Lassibille, Gomez (1998)	Evolution of returns to education in Spain: 1980-1991	Returns to both secondary and faculty degrees have declined between 1980 and 1991. r The rate of return to primary education somewhat increased, and returns to university education increased considerably.
Mallier, Rodgers (1995)	A measure of value-added in higher education based on the earning differentials between graduates and non-graduates in Great Britain. The Social Internal Rate of Return (SIRR).	Female graduates with the same qualifications as male graduates received considerably lower salaries. There are significant differences in the number of first class degrees awarded between different disciplines, and this was reflected in the different salary levels received by graduates.
Marlow (1999)	School structure, spending, and performance relationships in California.	Higher education spending does not raise student achievement. Education spending is the highest in the countries exhibiting highest monopoly power.
Mariani (1999)	Correlation between education and earnings, benefits, projected growth and openings, job security, advancement potential, and nature of work.	There are many occupations in which highly paid employees do not have a bachelor's degree. In 1998, 15% of the full-time wage and salary workers age 25 and older without a bachelor's degree earned more than $821 a week, which is more than the median for college graduates.
McHaffie (1998)*	Relationships between education spending and measures of	Local wealth affects the funding of public education. The

	wealth, absentee and ownership, and educational attainment in central and southern Appalachia.	variation of the elasticity coefficients across the region and within the states has proved that two locally contingent factors transform the translation of property wealth into a specific level of education spending.
Miller, Mulvey (1995)	The implications of the studies on twins and their returns to education. Means and standard deviations of selected variables including report of co-twin's education and sample size. Estimates of twins models of log annual earnings.	The correlation between education and income is about the same and is similar for the different types if twins. The correlation between level of education and income is considerably higher than that reported in earlier studies.
Moll (1996)	Primary schooling, cognitive skills, and wages in South Africa	Good theoretical basis and literature review. Cognitive achievement has a significant effect on wages. The computational element is more important than the comprehension element.
Newell, Reilly (1999)	Estimates of the private rate of return to higher educational qualifications. Changes in returns to higher education on wage inequality. Transitional economies.	No sufficient evidence that age is an important factor in wage differences. No sufficient evidence that men are better paid than women are. Although the returns to higher education are important factors in determining wage inequality, there are many things still unexplained.
Odden (1990)*	Public school funding in 1960-1990; education funding in 60s and 80s; relationships between GDP, personal income and education funding in the 1980s.	Revenues for public schools have been growing dramatically during 1980s. Education funding, while growing substantially, was consuming a smaller percentage of GDP and personal income in 1988 than in 1980.Per pupil school funding rose on 31 (or 27) percent during 1980-1988. Average teacher salaries have gown in real terms, even though salary growth lags behind both total real funding and real funding per pupil growth.
Pritchett (2001)	Impact of education on total production and economic growth across different countries; return to education; the Augmented Solow model.	In some countries, education has created cognitive skills and they were in demand, but for the wrong purpose. The rate of growth of demand for educated labor has varied widely across countries, so countries with the same initial individual returns and equal subsequent expansions in the supply of educated labor could have seen the marginal returns to education fall, stay constant, or rise. In some countries, education has been greatly effective in transmitting knowledge and skills, but in others it did not have much value and did not create any skills.
Pryor, Schaffer (1997)	A paradox of wages and the university educated. Data on employment levels and wages for workers with different levels of	Increasingly, university-educated workers are taking jobs in which the average educational level is much lower. The

	education in different types of education.	real wages of university-educated workers occupying jobs requiring such education have increased significantly in the last quarter of the century. The real wages of the university educated in jobs in which the average level of education is 14.5 years or less have remained roughly constant. The real wages of those without a university education have generally declined. The ratio of wages between those with a university degree and those with just a high school degree has increased, by 34 percentage points.
Psacharopoulos (1995)	Rate of return to investment in education for individual, and for society; various techniques are discussed.	Since the costs are higher in a social rate of return calculation compared to private rate of return, social returns are lower than private returns.
Psacharopoulos (1993)	Returns to investment in education: a global update.	Private returns to education are much higher than social returns due to public subsidization of education. The returns to female education are higher than those to male education, but at individual levels of education the pattern is more mixed. The returns for those who work in the private sector are higher then in the public sector.
Psacharopoulos (1996)	Returns to education in Mexico (1984, 1989, and 1992) returns to education during economic boom and recession. Mincerian human capital earnings function. Private and social returns.	The overall yearly rate of return is 15%. Investment in female education gives greater rate of return than investment in male education. Private returns to university education have fallen and risen with the economic growth. Social returns to secondary education are the highest.
Rosenzweig (1995)	Circumstances under which schooling improves productivity based on the notion that schooling enhances information acquisition.	Returns to schooling are high when the returns to learning are also high.
Rubenstein, Schwartz, Stiefel	Different methods of measuring individual school efficiency; their advantages and disadvantages	APMs are easiest to understand, but possible specification bias should be considered. Production functions do not have specification bias problem, but they have problems of endogeneity between resource variables and outputs. Cost functions include multiple outputs, and can be used as a way to avoid endogenous relationships; but they are impractical in most cases. DEA offers measures of efficiency and of degrees of inefficiency. However, it does not avoid the problems of the production function measures and can provide some extreme results.

Rupert, Schweitzer (1996)	Standard Mincer empirical earnings function. Return on education measured by the increase in income resulting from that education. Basic facts related to earnings, education, and experience.	The return to a college education has been rising over time. Part of the return, however, is due to the increasing number of individuals pursuing post-graduate education. Overestimate of the return to college is 12 percent.
Toh, Wong (1999)	Rtes of return to education in Singapore; cost-benefit approach.	Rates of return to education increase with the level of education. Although higher than the rates of return to secondary education, the rates of return to higher education were declining during the 15 years study period.
Vila (2000)	The non-monetary benefits (NMB) of education; criteria economists use to classify the NMB of education; dimensions of NMB. Private benefits: health benefits, fertility benefits, benefits for children, occupational benefits. Benefits related to consumption/savings.	Studies proved that education positively affects individual's health. The expected costs of having a child increase with the educational level of the parents; the effects on expected benefits for parents are unclear. Parental education is related to " child quality" (children's educational development and health). Higher levels of education are related to shorter, more efficient job-search and to better-matched expectations regarding occupational choices. More education directly increases demand for specific manufactured goods and complementary services related to the acquisition of knowledge. Education influences personal preferences that guide choice of expenditure, leading to more efficient household management.
Weinberger (1998)	Race, gender and returns to education	White women, black men, black women, Asian women, and Asian men have 10-15 percent wage disadvantage relative to white men with the same type and level of education.
Wilson (2001)	Utility-maximizing model based on the human capital literature. Also allows for family background, neighborhood and school characteristics described in the education production function literature. Economic returns to schooling and utility obtained from education. Good literature review.	Individuals are rational decision makers, and they make rational economic choices in their education. For example, the greater the returns to graduating from high school, the greater the possibility that the individual will graduate. However, the economic incentives are not the only important aspects. Family, neighborhood, and school characteristics affect the utility associated with being educated. School factors are significant determinants of educational attainment. Increasing

		school spending raises the educational attainment of a student as well as expected future income regardless of whether the individual graduates or not.
Wolter (2000)	Effect of wage expectations on educational decisions; calculation on the rates of return on education; wage expectations of students in Switzerland and the United States.	The rates of return on education that can be calculated with cross-sectional data come reasonably close to the implicit rates of return assumed by students when faced with an educational choice.