Integrating Human Capital Concepts in Productivity and Growth Topics

Roderic Hewlett

Abstract

Knowledge management and intellectual capital have become the mantra of cutting edge business topics; however, the building block of human capital has never been fully integrated into a knowledge based approach to productivity – specifically, how to develop human capital or analyze it. During the course of this paper, a careful framework detailing the relationship between formal education, informal education, acculturation, earnings and economic growth has been developed. A review of economic, education, and educational psychology literature develops the linkages between education and productivity, productivity and earnings growth, and ultimately education and economic growth. The central argument embraces applying human capital concepts in integrated business applications in a fashion that captures how human capital is developed, harnessed, and translated into productivity. Epistemologically, the paper argues that economists must develop firm microeconomic underpinnings to human capital theory beyond wage-earnings arguments to fully develop the economic growth – education relationship.

Keywords: Knowledge Management, Intellectual Capital, Human Capital, Economic Growth, Productivity, Earnings Growth.

The quest for the engine that drives economic growth is both a dynamic and elusive search. Since Aristotle, philosophers and researchers have attempted to define the variables that increase social welfare. For the last two hundred years, the trade-off between labor and capital has garnered much of the research focus. Labor, in many cases, has been treated as a mere factor input into growth and productivity. Even worse, some research treats labor as if it is homogeneous. The role humans play in economic growth has almost always been taken for granted. Yet, a thoughtful analysis of the human role in economic growth reveals that humans have created all of the other forms of productive factors of production such as institutions, capital, financial capital, and harnessed nature to yield production from raw resources.

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Until the latter half of the twentieth century, the role of how humans developed and acquired the abilities to develop institutions and markets was not even directly addressed. Missing in the theories of growth was the role of human knowledge as a means to explain economic growth and evaluate productivity. However, in the 1950s, researchers began to appreciate the role knowledge and research, or human capital, played in economic growth.

Research during the last fifty years of the 20th century has made the connection between human capital, earnings, productivity, and growth. However, to fully understand human capital, the relationship between the human learning process, learning variables (later referred to as micro variables), and how humans employ learning must be connected to economic growth and productivity. No single endeavor of study commands the breadth of understanding of humans to make all of these connections. Accordingly, a heterodox approach must be employed to assist in defining these relationships to make the next successful step in the

understanding of human capital and economic growth.

The research highlighted in the following pages traces some of the important connections between humans, learning, productivity, and economic growth. Research beyond any one field of endeavor is introduced and connected to provide a fuller framework for understanding the roles of humans in economic growth.

SECTION 1

UNDERSTANDING HUMAN CAPITAL

How Humans Accumulate Knowledge and Use Knowledge

At first it may appear obvious how humans accumulate and use knowledge; however, the deeper one looks at the subject the less obvious the process appears. Theodore Schultz suggests a classification scheme for investments in human capital as follows:

- Schooling and higher education.
- On-the-job training.
- Migration.
- Health.
- Economic information.

Much of the economic work in this field focuses on formal schooling and higher education. Theories have even been developed to consider the allocation of time in human capital investment decisions. Yet, the precise mechanisms of what knowledge is, how it is attained, and how it is manifested in spurring economic growth remains largely undefined. Schultz's classification is much more a definition of venues of where human capital can be formulated and what can affect its full implementation rather than a systematic classification of the variables for developing human capital.

The nature of knowledge is borderless, intertemporal, and subject to many external factors such as genetics, culture, quality of education, and the quality of life experiences. No wonder economists tend to stay away from the mechanics of knowledge and attempt to measure human capital based on level of attained education. This indirect approach to assessing human capital is akin to "where there's smoke there's fire." Regretfully, this approach may lead to faulty conclusions and does not provide descriptive micro data that can be used to evaluate forms of human capital accumulation.

Critiques of Human Capital Theory

Economists tend to equate observed earnings with human capital based on years of attained formal education. While it is clear that in a modern society formal education is highly correlated to higher earnings, some researchers claim that factors, other than formal education, may contribute to earnings.

Human capital, and measuring the investment in human capital, has been researched extensively in economic and education literature for the last forty years or so. The theoretical underpinnings of human capital relate investment in education to economic growth (Bowman, 1964; Denison 1962; Psacharopoulos, 1981; Schultz 1961) and economic development (Bowman, 1980; Carnoy, 1977). Additional research has been done on educational investment as it relates to efficiency in consumption and labor productivity (Dean, 1984; Welch, 1970), household productivity (Haveman and Wolfe, 1984), and health (Grossman, 1976). Also there have been empirical studies of education and the distribution of income (Chiswick and Mincer, 1972; Mincer 1974).

This broad array of research into the relationship between education and economic growth, efficiency, and equity is typically demonstrated by developing a financial rates-of-return on education. This research calls for an inquiry into the appropriate mix of physical and human capital to fuel future economic growth. The mix of capital is an important concern to educators, policy makers, and industry. The essential ingredients into rates-of-return studies center around a few important

topics:

- The relationship between education, earnings, and economic growth.
- Studies of the rates-of-return on higher education.

Some economists claim that higher education serves as a filtering, or screening, device (Arrow, 1973) for the job market. This concept is also known as the "certification" hypothesis and "signaling" theory. According to this theory, formal schooling does not have a productive role *per-se*. The role of education becomes a mere signaling device for filling higher paying jobs that enables potential employers to select individuals according to their ability. A substantial component of a worker's ability that is initially unobservable to the employer must be signaled by education. Kenneth Arrow concludes that since this selection, or signaling, could have taken place by less expensive tests, rather than a four-year degree, societal resources are wasted. Economists tend to consider human capital and signaling theories to be the most prominent in attempting to explain labor market returns to education; however, it is extremely difficult to empirically distinguish between these competing theories (Willis, 1986). Other related theories, which tend to be related to signaling, have been proffered to explain returns to labor.

Richard Layard and George Psacharopoulos (1974) attack this reasoning by observing that there are increased earnings associated with individuals who have "some higher education" but do not have a bachelor's degree. Barry Chiswick (1973) reinforces this human capital approach by suggesting that a self-selection bias exists. He reasons that individuals who dropout before attaining a desired level of education do so because they realize they do not have the ability to effectively employ the additional human capital. Hence, there is little or no "diploma effect" associated with signaling theory; individuals merely recognize their limitations and "drop-out." This theory introduces the role that education plays in informing not only the employer but also the prospective employees about ability. While there may be other reasons for individuals not to complete an additional level of education, this argument is effective in explaining the dual role education may play in the "signaling theory."

Psacharopoulos (1973, 1981) points out that labor markets tend to be competitive and earnings tend to reflect the marginal product of labor. Hence, if degrees were merely signaling devices, then the related higher earnings associated with the degree would quickly dissipate and return to a generalized wage pattern. Psacharopoulos (1975) adds that earnings associated with higher attained education levels tend to be quite persistent demonstrating that the investment in education continues to extract high returns during career spans.

In a study based on Kenya (Boissiere, Knight and Sabot, 1985), the researchers find that screening theory explains why levels of education may bear some relationship to starting wage; however, if education is only a signal that produces an economic rent, one would then expect wages to decline with length of experience to match the employee's marginal product of labor. Yet, this is not the case. The level of education is found to be a better predictor of current wage than starting wage. These market effects are due to skills developed in a highly competitive education environment. Boissiere *et al* argue that literacy and numeracy have the most pronounced effects and that length of education has less effect. This result provides compelling support for the concept of human capital employed in the United States and other developed countries. Education, or learning, that produces skills which complement advanced technology employed by society tends to garner higher returns. In technologically advanced societies, the attainment of advanced learning is integral to the acquisition of these required skills.

The term "ability" takes on many different definitions in the debate on what affects earnings. Some suggest ability is genetic (Griliches and Mason, 1972) and that education hones this native ability and serves as a signal. Others insist that ability has more to do with education than some

form of genetic endowment, family background, or other measures of ability (Psacharopoulos, 1982). An operational definition of "ability" is elusive. Psacharopoulos maintains that formal education is so intertwined with ability that it is difficult to separate them into individual concepts. Formal education develops literacy, numeracy, critical thinking capabilities, and develops work habits that serve as the foundation for all other forms of human development. Accordingly, earnings growth and advancement are directly related to the level of formal education attained. In an attempt to isolate education and other factors and their relationship to productivity and earnings, researchers studied self-employed and agricultural workers. The study uncovered a very strong relationship between productivity and formal education (Jamison and Lau, 1982). The research on ability, learning, and formal education suggests a connection between these factors and productivity. Additional research also suggests that other forms of education and training add to productivity.

Jacob Mincer (1962) claims that on-the-job training (OJT) accounts for approximately one-half of the returns to certain levels of education. However, using Psacharopoulos's definition of ability, it is apparent that Mincer does not fully consider the impact that formal educational attainment exerts on employees' abilities to successfully undertake OJT. Gary Becker (1964) hints at this symbiotic relationship when he makes his distinction between general and specific training. He notes that second-round interaction between formal education and the trainability of the employee, brings to the surface the "unrecorded benefits" (associated with formal education) later reaped by the firm that invests in specific employee training. Becker concludes that ability explains a very small part of the earning differentials and college education explains the larger part.

Education, and its ancillary or non-market effects on earnings, is rarely considered or calculated as a return on education. Several studies report significant partial effects of literacy on life expectancy after standardizing for the level of income and positive deviations from normal life expectancy associated with higher rates of per capita GNP growth (Cochrane, 1980; Hicks, 1980).

Dale Jorgenson and Barbara Fraumeni (1993) redefine social accounting to include non-market benefits of education and human capital investment. They measure the economic value of labor market activities then estimate the value of non-market labor activities. When these new measures of economic activity are calculated, the returns to education skyrocket. Many of the benefits suggested by Jorgenson and Fraumeni include increased value of leisure time; enhanced parenting; advances in health and environmental medicine (decreased morbidity and mortality); increased consumption, and labor saving devices that reduce household type work.

Gordon (1972) proposes a labor market segmentation or duality hypothesis. This hypothesis suggests that two distinct labor markets exist: one for high skill employees and one for low skill employees. Market conditions, rather than education, account for earnings. However, when a distinction is made between non-clearing and competitive labor markets, Glen Cain (1976) finds that wage differentials in the public sector understate the true productive advantage of the more educated as the latter is measured by earning differentials in the competitive private sector (Psacharopoulos, 1982).

Hybrid theories that combine historical blockages of individuals to institutions of higher learning with signaling theory suggest that social class may account for the earning differentials. However, in a review of several studies and in empirical work, Psacharopoulos and Tinbergen (1978) conclude that social class is not the main determinant of earnings net of education.

Psacharopoulos (1975) evaluates the extent to which market distortions, rather than education, account for wage differentials. An example is the limited supply of medical doctors and a high level of demand for medical services. Psacharopoulos reviews a wide range of studies and finds the results inconclusive. However, several factors relating to

this professional type of labor must be considered:

- The high costs of training associated with professional education.
- Longer hours worked by those with higher incomes.
- The lifetime aspect rather than a cross-sectional comparison at a given age (forgone wages and high investment costs).

Psacharopoulos concludes that if a profession requires extensive education that is essential to quality and productivity, no market distortion exists; however, if excessive training for the sake of market entry barriers exists, then distortions exist.

Research, though imperfect, has demonstrated a strong connection between ability, education and earnings growth. The human capital model remains a valid model; however, the inner workings of connecting "education" to productivity remain somewhat mysterious. The following section reviews a portion of the vast body of research that connects education to earnings and economic growth. The subsequent sections connect returns to education, albeit a preliminary connection, and finally the connection is made between learning, education, human capital, productivity and economic growth.

SECTION 2

RELATIONSHIP BETWEEN EDUCATION, EARNINGS, AND ECONOMIC GROWTH

Education And Growth

Psacharopoulos (1973) argues that as early as Adam Smith, and certainly Marshall, scholars were writing about the economic consequences of education. Modern economists such as Mincer (1958), Schultz (1961), Denison (1962), Becker (1964), and scores of other economists and educators have made significant contributions to the interpretation concerning the relationship between education and human development. Most researchers concentrate on how this form of human development, known as human capital, contributes to economic growth, increased earnings, and other measures of improved welfare. Recently, the quality of the labor force, as measured by comparative tests of mathematics and scientific skills, has been linked with consistent, stable, and strong relationship with economic growth (Hanushek and Kimko, 2000). Recent attempts to relate quality, not just quantity, of human labor have interesting implications – what learning variables in education account for quality?

Psacharopoulos (1973) notes that in the 1950s empirical investigations of the United States economy shows total output growing faster than "physical" inputs. This excess of output over input is known as the "residual." The residual is attributed to technical changes or shifts in the aggregate production function. Study of this residual phenomenon leads to an increased attention, by economists, to the labor input in the economy and the study of human capital. Since the 1950s, the study of human capital has developed many variants. The variants that are of particular interest trace the link in economic growth as a function of formal education. This growth is manifest as increased productivity and enhanced earnings.

Formal education forms the building blocks of human capital in the United States. Formal education is an investment, much like the accumulation of physical capital. Viewed as an investment, the process of adding to the stock of knowledge and the process of transmitting this knowledge can be quantified much like the process of adding to the stock of physical capital of the United States. According to Psacharopoulos (1973) the efficiency of this human capital investment can be assessed by:

- Comparing the profitability of human capital investment with the profitability of alternate investments.
- Determining the structure of rates-of-return associated with levels of education.
- Assessing the efficient degree, or level, of public subsidization of human capital investment.

- Determining the earnings ratios of people with different levels of education within a given location.
- Considering the economic consequences associated with higher education graduates who migrate from a political or geographic region to work.

Based on a multi-country study, Psacharopoulos (1973, 1981, 1982) concludes:

- A strong statistical relationship exists that suggests education has both a private and a social payoff.
- Returns to investment in human capital are well above returns to physical capital in less-developed countries and are of equal magnitude in advanced countries.
- Per-capita income differences can be better explained by differences in the endowment of human rather than physical capital.
- There is a high degree of substitution in production between different types of educated labor.
- Typically, higher educated labor is successfully substituted for less educated labor; however, this normally does not work in reverse.

Education and Productivity

Denison (1967) concludes that educational background is a key determinant in the quality of labor. He states, "It conditions both the types of work an individual is able to do and his efficiency in doing them." Education contributes to productivity on two fronts. Education improves the quality and capability of the workforce, allowing more productive use of the existing stock of knowledge. Increased education tends to increase the rates of intellectual development, which add to the existing stock of knowledge (Denison, 1962).

Education and Earnings Growth

Schultz (1961) suggests that the rise in the investment in education accounts for a substantial portion of the rise in earnings. The impact of these increased earnings and productivity enhancements leads to an increase in national income. This relationship can be thought of as a production function.

A large proportion of the early research into human capital revolves around the amount of earnings growth, or earning differentials, between education levels associated with formal education. This adjustment factor, in the literature associated with the proportion of earning differentials attributed to education alone, is known as the alpha coefficient. Research pertaining to the alpha coefficient clearly identifies two major characteristics:

- Formal education is the most significant component of earning differentials.
- Other factors, to be discussed in the next section, may account for some portion of earning differentials.

Denison (1985) uses a methodology in which the alpha coefficient for completed education is estimated at about 0.88. An alpha coefficient of 1.0 suggests that all earning differentials are attributable to completed formal education. Denison's work is an attempt to define an adjustment for growth accounting. Becker (1964) reviews five major studies and finds that the alpha coefficient is 0.80. Becker lays the groundwork for an attempt to estimate the rates-of-return associated with education.

A study by Morgan, David, Cohen, and Brazier (1962) uses 1959 earnings data on 3,000 households and employs the following explanatory variables:

- Education and age.
- Occupation.
- Attitude towards hard work.
- Race.
- Ability to communicate.
- Physical condition.
- Rank and progress in school.

The study finds that education and age are the

most significant variables; age and education are undifferentiated in this study. The alpha coefficients associated with a bachelor's and master's degree are 0.88 and 1.00 respectfully.

Hunt (1963) uses a 1947 survey by *Time* magazine on the income of college graduates to create an earnings function. The total number of observations is 2,635. Hunt uses the following explanatory variables:

- Ability (test score in college).
- Years of graduate study.
- Parents, college attendance.
- Occupation.
- Region.
- Earnings.

Hunt does not identify an alpha coefficient; however, he determines that after adjusting for other factors, the rate-of-return to college education is reduced by 50 percent. Critics highlight several flaws in this study:

- A high degree of multi-collinearity exists because the study uses both occupation and earnings as explanatory variables.
- The study refers to graduates only.

- The study employs a limited sample size.
- The sample technique is based on a survey by *Time* magazine developed for a news article, not a research project, and may contain sampling flaws.

Carroll and Ihnen (1967) in their study took a sample of eighty-seven high school and two-year post secondary school graduates to study the relationship between education, ability (grades in high school), and other factors found in similar studies. They calculated an alpha coefficient of 0.73; however, a major limitation of their study is the use of a very limited sample size, which deals only with technical education.

Psacharopoulos (1975) summarizes the alpha coefficient studies, the results of which are highlighted in the following table.

Hause's studies concentrate on education and earnings associated with ability alone and use no other contributing factors. Psacharopoulos (1975), reviewing Hause's findings, reveals that when using only ability as a factor associated with formal education, the alpha coefficient is 0.97 for higher education and 0.89 for graduate study. When "other factors" are considered the alpha coefficient for higher education reduces to 0.79 and 0.82 for

Alpha Coefficient Studies

Study	Education Level	Alpha Coefficient
Ashenfelter and Mooney, 1968	graduate study	0.90
Weisbrod and Karpoff, 1968	higher education	0.75
Rogers, 1969	higher education	0.73
Griliches, 1970	years of schooling	0.96
Hause, 1971	higher education	0.94
Griliches and Mason, 1972	years of schooling after military education	0.88
Hause, 1972	higher education bachelor's degree graduate study	0.97 0.87 0.89
Taubman and Wales, 1973	higher education	0.65

graduate study.

Compensation, other than earnings, may be an important element to consider in the earnings and education relationship. If individuals with higher levels of education consistently enjoy more fringe benefits (higher compensation levels) than individuals with lower levels of education, then returns developed using only earnings differentials understate the returns to education. Fringe benefits grew from 1.4 percent of total compensation in 1929 to about 10 percent in the 1970s (Psacharopoulos, 1975). Psacharopoulos concludes that total compensation should be considered in calculating returns. His analysis demonstrates that in the United Kingdom and United States occupations that tend to be dominated by individuals with higher levels of education also have higher levels of fringe benefits.

Age-Earning Profiles and Rates-of-Return Methods

Many early studies concentrate on developing the earning profiles over one, or a few, individuals during the span of their lifetime. Some of the subsequent studies use limited cross-sectional and longitudinal data (Psacharopoulos, 1975). However, a limiting factor with any study that uses current or historical data is the inability of these profiles to reflect future age-earning profiles.

Psacharopoulos (1975) argues that age-earnings profiles developed with longitudinal data are contaminated by the experience dimension and therefore are limited for formal educational policy but not for developing rates-of-return analysis.[1]

A simple model for determining an age-earning profile is put forth by Mincer (1958). The model considers the average length of working life in occupational groups.[2] In Mincer's simplified model he uses zero expenses for educational services and concentrates on earnings associated with attained education levels (years of training). Additionally, he discounts earnings to arrive at a present value of life-earnings at the start of training. His reasoning is based on the premise that economic decisions are based on rational

choice. In making the decision to pursue further education, a rational individual weighs the benefits against the costs and determines if it is prudent to pursue further education. Hence, Mincer discounts earnings to present value (PV). Mincer's early work still permeates age-earnings profile research today. His model creates a ratio of annual earnings by individuals with different attained education levels. The difference between attained education, d, is the basis for the model:

$$k_{d,0} = \frac{e^{rt} - 1}{e^{r(t-d)} - 1}$$

where:

- e is the base of natural logarithms.
- r is the discount rate.
- t is time in number of years.
- k represents the ratio, considered a multiplicative factor, of earning differentials between attained education levels.

Subsequently, Mincer adds the PV of schooling costs and foregone earnings to the simple model.

Mincer's model is now a widely accepted standard. Age-earning profiles demonstrate that more education equates to more earnings.[3] When graphed with *income* on the vertical axis and *age* on the horizontal axis, a graphical age-earning profile is established. Universally, the graphs show earnings increase rapidly during the first ten to twenty years, then peak in the 45-55 age bracket, and then decline to age 65. Characteristically, those profiles of higher attained education reflect higher income levels than the profiles of lower levels of attained education. These profiles are merely graphical representations of earning differentials. Mincer suggests that formal education levels, OJT, and experience affect the profile slopes. The declining slopes at the end of the profile reflect depreciation of human capital or a deterioration in productive skills, particularly in jobs that require physical or motor skills. Of significant importance, Mincer (1958) notes that using cross-sectional data eliminates much of the

distortion of age-earning profiles due to seasonal or cyclic forces.

Mincer separates education into two classifications: formal or time preparing for the job; and informal or education (OJT and employer provided training) plus experience.[4] Mincer's early work with age-earning profiles uncovers patterns that not only exist today but have also become more pronounced. Industrial positions that require higher levels of attained education, make use of advanced technology, and require innovation as a tenet of these positions tend to make up a significant proportion of the top earning jobs. Examples of the industries that comprise higher earning jobs include professional and business services, entertainment and recreation, and finance and insurance. Industries requiring lower levels of attained education reflect a lower proportion of top earning jobs such as mining, construction, and manufacturing.[5]

Becker (1964) concludes that increased investment in education is induced by technological progress based on a high rate-of-return as measured by the costs of education and the wage differences associated with higher attained education. Becker also notes that almost all studies show that age-earning profiles tend to be steeper among more educated persons; therefore, an investment in human capital makes the profiles more concave. Hence, education tends to steepen the age-earning profiles. Becker's techniques are similar to Mincer's; however, Becker's age-earning profiles do not decline for the age groups at the end of their working lives. The slopes of the profiles moderate, or flatten, but do not decrease.[6] The slopes in Becker's age-earning profiles are of particular interest; the slopes for cohorts with higher levels of attained education are steeper and earnings growth for lower education levels occur at an earlier age. A significant difference between Mincer's and Becker's profiles is the netting out of the investment costs prior to the calculation of the age-earnings profiles. All earnings are after-tax. While Becker agrees that OJT, migration, and adult education can contribute to the steepness of the age-earning profiles, he notes that these factors

tend to be positively related to education. Becker suggests that a simple theory of investment in human capital explains the difference in concavity as well as in steepness in the age-earning profiles.

Psacharopoulos (1981) distinguishes between three main methods to calculate age-earning profiles, and hence rates-of-return, associated with investment in higher education. The three methods include

- The Elaborate Method,
- The Earnings Function Method, and
- The Short Cut Method.

The Elaborate Method equates a stream of benefits to a stream of costs at a given point. This method is generally equivalent to developing an internal rate-of-return (IRR) for costs associated with education and the associated benefits. The benefits are generally differential earnings developed by the age-earning profile. This method is particularly useful in calculating a private rate-of-return for the individual or a social rate-of-return. The social rate-of-return uses the cost of subsidizing education measured against a stream of benefits to society, which are typically derived from the age-earning profile.[7] The age-earning profile, the basis for the benefits, tends to exhibit a characteristic saw-tooth pattern, which creates a highly sensitive rate-of-return calculation.

To smooth-out this calculation, three steps are typically followed:

- A regression is fitted within subgroups of workers with the same educational level for the purpose of summarizing the data.

$$Y_i = a + b_1 AGE_i + b_2 AGE_i^2$$

- An idealized age-earning profile is developed by predicting the value of Y for given ages and educational levels, using the estimated function (above).
- Determine the IRR

The Earnings Function Method is generally used for calculating private rates-of-return and typically takes the form:

$$\ln Y_i = a + b_1 S_i + b_2 EX_i + b_3 EX_i^2$$

where

- S = years of schooling for the individual.
- EX = years of labor market experience.

The Short Cut Method is an abbreviated method to use with data that is already tabulated by earning and education level. It is useful in developing a quick calculation of private rates-of-return.

The methodology debate concerning age-earning profiles and rates-of-return studies tends to focus on three distinct issues (Blaug, 1976):

- Does a bias exist in reduced form earnings functions (identification problems)?
- Which variables are the most appropriate for estimating rates-of-return (proxy variables)?
- Does the School Model of human capital put forth by Schultz, Becker, and Mincer apply?

The methodology debate is an attempt to clarify education policy implications. Definitions of the proxy variables, such as ability, social affiliation, or OJT, are elusive. The variables interact to enhance earnings, but attained education remains the catalyst (Griliches and Mason, 1972; Psacharopoulos, 1973, 1981). Mincer (1974) discusses the difficulty of attempting to isolate years of experience from the quality of experience (development of human capital). In an overwhelming proportion of research attained education is the major factor that relates wage growth and facilitates human capital development.

Supply and demand market conditions for educated labor also accounts for the rates-of-return associated with education. A recent Australian study finds that supply and demand characteristics for each category of education tend to be dominant factors in earning differentials (Borland, 1996).

The factor markets in developed countries demonstrate the requirement for additional formal education in the work force. Market recognition is highlighted by the fact that the percentage of

jobs requiring only high school education is declining, while the percentage of jobs requiring a college degree is increasing.[8] Additionally, the slopes of the age-earning profiles for high school graduates continues to flatten (Hanushek, 1996). This shallow profile demonstrates reduced earnings of high school graduates at each median age calculation. Market requirements tend to exacerbate this divergence of wages between different levels of attained education.

The shapes of the age-earning profiles are sensitive to market conditions and requirements for an educated workforce adept at implementing advanced technology. The growing earnings gap between United States college and high school graduates demonstrates this sensitivity (Levy, 1995). Levy finds that human capital is becoming an increasingly important determinant of earnings. The supply characteristics between high school graduates and college graduates are significantly different. Among men aged between 25 to 54, 27 percent have four years of college or more, while 48 percent have a high school diploma or less. Earnings for college graduates are still growing in real terms; while the real wages for high school graduates are falling.

The demand for educated labor, and the prevailing earnings increment associated with attained levels of education, is a derived demand dependent on the level of technology and advanced systems used by employers (Borland, 1996). Accordingly, the rates-of-return associated with higher education should be higher in technologically advanced countries. Naturally, the rates-of-return are also affected by the supply of graduates with high levels of attained education and the elasticity of substitution among educated workers (Borland, 1996).

A criticism that is occasionally leveled at rates-of-return studies concerns data usage or the limitation of data. Specifically, a major complaint is the use of cross-sectional data. Recent studies have attempted to find methods of developing longitudinal data sufficient for estimating age-earning profiles and rates-of-return. While the

studies have severe limitations in their methodology (specifically shifting demographics), one study provides a particularly interesting method of emulating a longitudinal estimate (Arias and McMahon, 1996). The authors contend that cross-sectional data does not pick up the variation in employment profiles associated with shifting technologies and the subsequent supply and demand changes. Additionally, they claim that these shifts have differential impact on different age-earning profiles. The method of adjusting the cross-sectional data is referred to as "dynamic rates-of-return" and uses a series of cross-sectional data to adjust the age-earning profiles.[9]

The authors conclude that conventional static rates-of-return tend to overstate actual returns when the net earning trend is downward and understate it when the trend of the net earnings differential is upward. They also note that dynamic profiles are smoother over time than conventional profiles. This data is national level data and may be inappropriate for some forms of estimating; however, it does provide a sensitivity analysis of returns to changing socio-economic conditions. When computing conventional and dynamic rates-of-return from 1980 through the mid 1990s, the dynamic returns for males and females are 4 percent and 5 percent higher than conventional cross-sectional rates.

Human capital, productivity, and economic growth must be contextualized demographically. Migration can provide a ready source of human capital or drain human capital from a region. Human capital, as with most forms of capital, is employed efficiently when the returns to the capital are high. Accordingly, a review of migration research provides insight to the efficiency of human capital and conditions for employing human capital to garner productivity and economic growth.

SECTION 3

MIGRATION

Labor migration and its affects on human capital, has been a significant research topic among social scientists since the 1960s. The literature tends to fall into two broad categories: the determinants of migration and the consequences of migration. Earlier research typically focused on the causes of migration. As the United States became a more mobile society, the research increasingly started addressing the consequences associated with migration.

Determinants of Migration

Economists tend to view migration as a function of rational individual choice and utility maximization. If there is a net economic advantage to be gained, mainly due to increased earnings, then labor will tend to migrate from one geographical location to another (Hicks, 1932). A variety of studies are directed at testing Hick's propositions. These studies look at both gross migration and net migration. Gross migration consists of a single flow of labor from one location to another. Net migration is the net difference between the flows from and to a geographical location (Greenwood, 1975).

Gross migration studies tend to adopt a gravity type migration model (Greenwood, 1975). These studies hypothesize that migration is directly related to the size of the origin and destination population (i.e., rural to urban migration) and inversely related to distance (Carrothers, 1956; Isard, 1960; Olsson, 1965). The behavioral basis for reduced levels of migration as distance increases has been attributed to distance serving as a proxy for both the transportation and psychic cost of movement.

Lansing and Mueller (1967) conclude that the direct costs of moving in most cases are a very nominal sum of money. They suggest that the two major factors associated with the importance of distance as a factor in migration include:

- The benefits associated with migration, that may in fact be small; hence, a small cost may discourage migration.
- The psychic costs involved in migration are substantial and closely related to distance.

Economic theory suggests that an individual will maximize the net present value (NPV) of benefits and costs associated with any decision. In the migration decision, income is important in the decision process (Greenwood, 1975). The relevant income is critical in the calculation of the present value of expected future benefits associated with net returns. Sjaastad (1962), building on the human capital models of Becker, Schultz, and Mincer, connects the decision to migrate to the human capital model where current wages serve as a proxy for the future stream of net returns. Sjaastad believes that income is the major determinant in the decision to migrate. In a similar study, Perloff *et al* (1960) finds that income and job opportunities provide a better explanation of immigration than they do of out-migration.

Galloway (1969) reports that migration tends to occur at the end of a period of investment in human capital. This typically happens at the completion of college or study for an advanced degree. Accordingly, much of the return associated with migration may actually be due to the investment in human capital. Lansing and Mueller (1967) conclude that unemployment serves as a motivation that encourages young well-educated and trained individuals to migrate, especially if they tend to live in small towns.

Becker (1964) finds that both level of education and age tend to have an effect on the decision to migrate. As age increases, the worker has a shorter work life remaining and a reduced net positive benefit from migration. Becker also finds that employment information and job opportunities increase with additional attained education. Galloway (1969) argues that as an individual ages, security and family ties increasingly reduce the likelihood that an individual will migrate. Wertheimer (1970) concludes that greater returns are associated with migration at an early age and education tends to reduce the importance of tradition and family ties. In the past, ethnic patterns of migration tended to be different from general patterns of migration (Rebhun, 1997). However, Rebhun now reports that ethnicity is a relatively unimportant indicator of migration while

attained education and economic opportunity are better indicators of migration.

Additionally, education increases awareness of opportunities in other locations. This awareness weakens the tendency for individuals to remain at their present location. Schwartz (1973), controlling for age, finds that education ameliorates the effects of distance on migration. Schwartz reasons that labor markets for the better educated are more national than the markets for less educated. The correlation between education and migration increases as the distance of migration increases (Suval and Hamilton, 1965). O'Neill (1970) modifies Hamilton's proposition by stating that this correlation applies to the college-educated only. In a study attempting to determine the causes of migration from Canada to the United States, the dominant factor is to attain higher education degree from the United States (Comay, 1971). Comay finds that attaining a United States degree breaks down the barriers associated with "psychic" costs as well as provides access to an enhanced labor market. Frey (1994) reports that the best educated are more in-tune to labor market shifts and are the best able to exploit these shifts. Frey also reports that age and attained education continue to be a driving force in migration.

In conclusion, the determinants of migration tend to revolve around a few well-accepted propositions:

- Migration tends to occur from low to high-income areas.
- Age and education are personal characteristics that are important in influencing migration.
- The younger and the more educated the individual the greater the probability that the individual will migrate.

Consequences of Migration

The literature tends to be concerned with two effects of migration: market efficiency and externalities associated with migration (Greenwood, 1975). Sjaastad (1961) notes that gross migration reflects the degree to which changing supply and demand conditions among

industries is reshaping the labor force. Becker (1964) notes that in competitive firms workers are paid wages equal to the marginal product of labor. If firms invest in workers, through training and experience, they may pay the workers a wage in excess of the marginal product of labor in an attempt to retain these employees. Greenwood (1975) concludes that inter-regional wage differentials dissipate over time with migration and suggests that the degree of efficiency depends on externalities associated with migration.

Greenwood points out that labor is not homogeneous and migration is selective. Migration tends to be the highest among the best educated. The application of the human capital theory to the analysis of "brain drain" exemplifies the externalities associated with migration. Romans (1974) illustrates this externality with the assertion that there are spillover costs associated with social investment in education (social returns) that are lost to a geographic area if recipients later migrate. Johnson (1965) notes that the region that loses people educated with tax subsidies also loses the ability to recoup the investment by taxing the higher income associated with the education. Weisbrod (1964) offers a complementary argument: migration of the better-educated, better-paid (hence higher taxed) people, in or out of an area, has a significant effect on the tax burden and government services of the less-educated people. Haque and Kim (1995) conclude that closed economies, or economies not prone to high levels of migration, should subsidize all levels of education; however, areas suffering "brain-drain" due to high levels of migration should only subsidize lower levels of education. Haque and Kim specifically evaluate international migration; however, this point is not lost on state legislatures. Strathman (1994) calculates that for every one percent increase in out-migration, state appropriations for higher education are reduced by $100 per student.

Schwartz (1971) agrees that there are externalities associated with migration but concludes that migration may be a measure of economic (labor) efficiency. Schwartz suggests that low ratios of net to gross migration reflect an efficient past and present migration, which reflect higher regional equality. The relationship between net to gross migration and education level would be expected to be inverse (i.e., as education level increases the ratio of net to gross migration decreases). Schwartz concludes that the level of information is an increasing function of the level of education.

In summary, migration can be both an indication of the efficiency of the regional and national economy; however, migration may cause externalities for local or state economies. These externalities usually take the form of lost future tax revenues, which reduces the returns on the education subsidies, provided by the local or state government. However, in a more global sense the migration of human capital reflects efficiencies associated with productive resources. As people gain more education, and are able to move to where the human capital is most productive, then the aggregate production function is optimized and economic efficiency is enhanced.

SECTION 4

HIGHER EDUCATION RATES-OF-RETURN STUDIES

There are numerous studies concerning rates-of-return associated with education. Mincer (1958, 1974), Becker (1964), and Schultz (1961) set the methodology parameters. In these ground breaking human capital studies significant positive private and social rates-of-returns are calculated. Psacharopoulos (1973, 1981) evaluates rates-of-returns, for all levels of education, associated with developed and developing countries. He finds positive rates-of-return for all levels of education; however, rates vary by level of education depending on whether the country is developed or developing.

There are a myriad of rates-of-return studies by researchers and various government agencies. Many of these studies are associated with private rates-of-return or degree specific rates-of-return and are generally unrelated to social rates-of-return for state-funded education.

Summary of State Rates-of-Return Studies

The state studies find that there are positive returns to education; however, the returns vary significantly from study to study. The following table summarizes these findings:

The rates-of-return appear disparate; however, the following considerations explain a large amount of the variance among studies:

- The studies are based on different time periods with different inflation expectations and labor market supply and demand conditions.

- Differing economic expansion or multiplier effects associated with higher education earnings.

- Most studies use variants of the Elaboration Model to fit the structure of the study; these variants produce slightly different results.

- The data for the models are different; some models use US Department of Commerce cross-sectional survey data and some models use state specific longitudinal data.

- The construction of age-earning profiles differ among studies; some studies are for bachelor's degrees, while other studies are for differing levels of attained education (i.e., some college, associate's, bachelor's, etc.).

- Economic conditions may vary considerably from region to region and state to state.

All of the studies are consistent in demonstrating that the rates-of-return on education are positive and generally yield returns exceeding other forms of public investment.

The review of subjects related to the relationship

State Rates-of-Return Studies

Study	Method Employed	Rates-of-Return
Texas Study (Devereux, et al, 1987)	NPV and IRR Model using Denison's methodology for Social Accounting; aggregated rates including technology programs.	$60,000 per graduate (NPV); 12.0 percent real since 1970
Oklahoma Study (Penn and Dauffenbach 1995)	Elaborate Method - uses PUMS 1990 data (cross-sectional) to develop age-earning profile; aggregated rates for above high school	8.0 percent nominal; 10.0 percent nominal with moderate out-migration
Alabama Study (Gunther 1997)	IRR - Modified Elaborate Method; uses starting salary differentials extended over work life for age-earning profile; data based on University of Alabama (UA) graduates; aggregated rates for UA graduates	4.3 percent real; 7.3 percent nominal
Illinois Study (McMahon 1997a)	IRR - Modified Elaborate Method; uses Illinois specific longitudinal data; returns through bachelors level	19 percent nominal for males; 18 percent nominal for females
Tennessee Board of Regents Study (Ukpolo and Dernburg 1998)	IRR - Elaborate Method, uses cross sectional data developed for the March 1993 Current Population Survey.	Combined real rates-of-return* Associate's: 16 percent. Bachelor's: 12 percent. Advanced: 12 percent.

* Associate's represents a 2-year post-secondary degree;

Bachelor's represents a 4-year post-secondary degree; and

Advanced is post bachelor's study.

between education, productivity, earning, and rates-of-return demonstrates the complexity and diversity of this issue. By reviewing past studies of rates-of-return on education, one can easily visualize how the analysis and research has evolved and matured. At each step in the evolution, new issues and complexities of debate have added to the development of rates-of-return analysis. New data sources, better subdivisions of demographic data, improved statistical techniques, and the synthesis of the on-going dialectic provide a more inclusive picture of the benefits associated with education, economic growth, and the resulting calculation of rates-of-return associated with education.

These advancements are certainly confirmed by McMahon's (1997b) analysis of the social benefits of life-long learning and the development of new methods analyzing rates-of-return to education (Arias and McMahon, 1996). The use of synthesized material illustrates the growing maturity of rates-of-return studies.

There is nearly ubiquitous acceptance that the rates-of-return on higher education in the United States are high. While there may be debate about the proportion of economic growth associated with education, there is a high degree of acceptance that education is a major contributor to economic growth. The co-mingled nature of explanatory variables contributing to economic growth makes it difficult to isolate the precise proportion with any degree of precision.

Bills and Klenow (2000), studying the relationship between school and growth, conclude that causality of schooling causing growth is difficult to define. They suggest that only one-third of economic growth can be directly related to schooling. Their study posits that economic growth and technological change may require more schooling. Additionally, the study suggests that omitted factors that may be coincidental to both schooling and growth need to be more fully explored. Many of these "omitted factors" may actually be micro variables of the human learning process.

SECTION 5

MICRO VARIABLES

What are the micro variables, or omitted variables, that may be coincidental? It is obvious that education that encompasses literacy and numeracy skills directly affects economic growth in human capital studies. However, these primary skills are foundation skills for higher level learning that fuels economic growth. Taken literally, all forms of capital are by-products of human capital. Certainly, the skills, or learning variables, encapsulated in the accumulated human capital that spurred the innovation to create our society exceeds literacy, numeracy, and basic science skills.

The roles of critical and creative thinking, problem solving skills, motivation, culture, and communication must play a major role in creating our complex economic society. Education, both formal and informal, must play a role in developing these complex human capital variables. The economic research referenced in this paper clearly demonstrates a relationship between productivity, education, and growth embodied in human capital. Regretfully, the studies do not identify the complex variables and processes involved in converting education to productive human capital.

If knowledge is truly borderless, one must seek across the broad spectrum of accumulated knowledge and integrate this knowledge to define the variables linking education and economic growth. These defined micro variables can then serve as a basis for analysis, examination, and establishing a baseline for policies to grow the economy. It is inadequate to claim that education has high rates-of-return, therefore, we should seek more education without first defining how education creates high rates-of-returns. Concomitantly, it is unacceptable to modify education policy, or favor one form of education over another, without fully understanding how education variables interact to form productive human capital.

Education Micro Variables

The process of acquiring human capital begins with learning. In order to establish the micro variables, the process and purpose of learning must be defined. Jeanne Ellis Ormrod (1999) defines learning as the "Means through which we acquire not only skills and knowledge but values, attitudes, and emotional reactions as well." How we learn tends to be generalized by two major schools of thought: Behaviorism and Cognitivism. Behaviorism suggests that learning is a relatively permanent change in behavior due to experience. Alternately, Cognitivism states that learning is a relatively permanent change in mental associations due to experience. These two views differ in terms of *what* changes when learning occurs. Both views of learning suggest that changes are based on experience and are relatively permanent. One view dwells on responses to behavior and the other on thought processes.

Ormrod (1999) further suggests that principles of learning identify factors that consistently influence learning and describe the particular effects of these factors. Theories of learning explain the underlying mechanisms involved in the learning process. The learning process, as defined by the alternate theories, may be embodied in formal education, life experiences, training, and culture. The extent that these learning experiences contribute to economic growth depends on the degree of contextualism or generalization embodied in those experiences.

Jac Fitz-enz (2000) believes that formal education provides a human capital baseline; however, he places a priority on developing human capital in a learning organization that understands how to tie human capital to performance (contextualism). Fitz-enz elaborates on how human capital must be specifically tied to economic performance conditioned by organization culture dedicated to leadership that serves the needs of stakeholders, financial performance, and customer focus.

Tying the learning process to performance is key to understanding how education and experience variables lead to human capital. The process of defining all of the variables may well be a life's

work, or more. Yet, beginning to integrate learning variables into economic studies moves forward the study of human capital.

A Beginning

The limited list of variables that will be developed begins with social learning theory (Bandura, 1986). At the risk of oversimplification, with the belief in parsimony, social learning theory provides several important learning principles:

- People can learn by observing the behaviors of others and the outcomes of those behaviors (vicarious learning).
- Learning can occur without a change in behavior.
- The consequences of behavior play a role in learning.
- Cognition plays a role in learning.

Accordingly, modeling and symbols play a significant role in the learning process.

Memory Theory (Ormrod, 1999) provides useful principles about how memory is structured and functions thus affecting learning:

- Attention is essential for learning.
- Memory activation and schemata structure aids understanding and learning (elaboration).
- Different people may attend differently to the same stimulus and they only process a limited amount of information at a time (attending).
- Memory is selective.
- People construct knowledge based on perceptions (constructed and contextual knowledge).
- Elaborative rehearsal facilitates storage of knowledge in long-term memory (elaboration in learning).
- Rote learning does not necessarily condition isolated information to knowledge. Information must be meaningful to become knowledge (contextual and elaboration).

- Relating known knowledge to new information creates meaningful learning that aids understanding or comprehension (elaboration).
- Visualization, verbalization, and physical activities aid meaningful learning (contextual and multiple learning methods).
- Knowledge can be divided between knowledge of facts, or declarative knowledge, and how to do things, or procedural knowledge and these type of knowledge should be connected for effective learning (elaboration and multiple learning methods).
- Concepts, a class of objects or events, can be divided between concrete and abstract concepts. Individuals tend to learn concepts first in concrete form then as abstract form (model development and integration).

Metacognition encompasses how a person's awareness of their own learning and cognitive processes, and their consequences of regulation of those processes, can lead to enhanced learning and memory. Ormrod (1999) reminds us that self-knowledge about our thinking and learning process is itself a variable of learning that is important in human capital development. As an individual becomes aware of their own cognitive processes they can use strategies to enhance self-regulated learning. This self-regulating process can enhance meaningful learning, memory organization, and elaboration. The self-regulated learner is characterized by the following traits:

- Ability to identify important information.
- Engages in comprehension monitoring.
- Skilled in summarizing material they read and hear.

Other principles that affect knowledge transfer and problem solving skills (Gagne, 1985):

- Meaningful learning promotes better transfer than rote learning.
- The more thoroughly something is learned, the more likely it is to be transferred to a new situation.

- The more similar two situations are the more likely it is that what is learned in one situation will be applied to the other situation.
- Varied practice and examples help skills transfer to new situations (elaboration).
- Problem-solving strategies should be developed at meaningful levels (elaboration and contextualism).
- Some prerequisite skills should be practiced until they are learned to the point of automaticity.

The principles, or components of learning tend to be universal, irrespective of the learning theory reviewed. Common themes of contextualism, elaboration, active learning, and motivation are the fibers in the fabric of learning and learning is the principal building block of knowledge.

SECTION 6

CONCLUSION

Immediately, it is apparent that more than literacy, numeracy, and critical thinking are essential in the learning and human capital accumulation process. Many aspects of what we learn, how we learn, and how we apply what we learn are the micro variables building blocks of human capital.

Motivation, memory, schema, elaboration, and contextualism are just a few of these human capital building blocks. These micro variables are not course, degree, or even formal education specific. They are not just resident in science, math, or language courses but are evident in the breadth of human experience and learning. The micro variables are embedded in curricular issues, social issues, and experiential issues.

Broadening the research to understand that how we learn is as important as what we learn is a positive step in understanding human capital. We must begin to broaden the research to focus on the micro variables rather than focusing on levels of attained education, as if one level of attained education can be somehow segregated from all forms of previous

education and learning. By fully appreciating the conditioning effects of learning on human capital, education policies can be redefined to learning policies. Funding of learning can be expanded to reinforce learning that best aids human capital development and economic growth.

Developing rates-of-return studies on education may appear attractive on the surface. However, these studies are too limited to fully explore the rich contextual relationship of human capital and economic growth. Next generation human capital research must embrace the micro variables and the "less definable" characteristics of learning. Only then will economics as a science be able to provide a deeper understanding of economic growth and prescriptive policy guidance for human capital development.

Notes

1. Since Psacharopoulos's research indicates that education forms the basis for employing other labor productivity enhancements, the associated returns should accrue to attained education.

2. Mincer based his findings on the information used by Friedman and Kuznets in *Income from Independent Professional Practice*, New York: National Bureau of Economic Research (1945): 142-151. Eight broad categories were used ranging from service workers up to professional and technical workers. Those occupations that provided lower retirement enhancements and required less preparatory education had longer mean years in the labor force (52) as opposed to professional workers which had the lowest number of years in the labor force (40). Mincer noted that similar patterns were observed in 1930, 1940, and 1950.

3. Based on data found in the US Census of Population (1950), Ser. P-E., No. 5-b: Education, Tables 12 and 13.

4. Mincer notes that Census data available in 1958 and prior periods does not adequately exist to separate the effects of formal and informal education.

5. Table 4, page 300, Mincer (1958) "Occupational Composition and Income Inequality in Industries, US Male Workers, Ten Broad Industry Groups, 1949, 1953, 1954.

6. Becker based his findings on 1950 census data. He suggests that a plausible reason for Mincer's finding that earnings decline prior to the end of working life (age 55-65) may be due to selective retirement before the age of 65. Becker reasons that persons whose earning would decline most might elect to retire early.

7. An example of a benefit to society could be the increased incremental tax revenue derived from higher earnings, lower unemployment, and other measures of increased welfare.

8. 1979 and 1989 earnings figures calculated using the 1980 and 1990 Public Use Micro Sample (PUMS) 1 percent sample.

9. By using the Current Population Reports, Series P-60, collected through personal interviews by the Bureau of the Census, approximately 60,000 households are evaluated each March from 1967 through 1975 (1967-1975, 1980, 1985, and 1990).

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