

Schultz, T. Paul

Working Paper

Integrated Approaches to Human Resource Development

Center Discussion Paper, No. 719

Provided in Cooperation with:

Yale University, Economic Growth Center (EGC)

Suggested Citation: Schultz, T. Paul (1995) : Integrated Approaches to Human Resource Development, Center Discussion Paper, No. 719, Yale University, Economic Growth Center, New Haven, CT

This Version is available at:

<https://hdl.handle.net/10419/160640>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

ECONOMIC GROWTH CENTER

YALE UNIVERSITY

P.O. Box 208269
27 Hillhouse Avenue
New Haven, Connecticut 06520-8269

CENTER DISCUSSION PAPER NO. 719

INTEGRATED APPROACHES TO
HUMAN RESOURCE DEVELOPMENT

T. Paul Schultz

Yale University

January 1995

Note: Center Discussion Papers are preliminary materials circulated to stimulate discussions and critical comments.

This paper was originally prepared for the World Bank as a background to the Human Resource Strategy Paper, Human Resources Development and Operations Policy.

For their comments on a previous draft, the author thanks G. Psacharopoulos, H. Patrinos, G. Ranis, R. Chase, B. Herrick, A. Judd and other participants in Bank workshops. These views are only those of the author and do not reflect those of The World Bank.

Abstract

Development priorities among human resource programs should be determined primarily on the basis of expected productive returns on these investment activities, arrived at in much the same manner as among nonhuman resource development programs. What distinguishes human resource development programs are the special problems of calculating the value added by the programs over the life of an individual and assessing the opportunity and direct costs of the private and public resources allocated to produce these enduring stocks of human capital.

This paper seeks to integrate conceptually knowledge of the economic contribution of human resource investment programs. First it is argued that human resource programs will contribute more to development if they are allocated to those activities that have the highest internal rates of return. Although high private rates of return may be necessary to attract the investment of private resources of participating individuals and families, public subsidies to human resource programs should also be based on a clear superiority of social returns over private returns or a palpable market failure that prevents private individuals and families from investing the socially optimal amounts in particular activities. The paper outlines how the private and social returns are calculated, and how the personal distribution of benefits from programs may be quantified to inform decision makers.

Key Words: Education, Health, Labor Productivity, Development

I. Introduction

Development priorities among human resource programs should be determined primarily on the basis of expected productive returns on these investment activities, arrived at in much the same manner as among nonhuman resource development programs. What distinguishes human resource development programs are the special problems of calculating the value added by the programs over the life of an individual and assessing the opportunity and direct costs of the private and public resources allocated to produce these enduring stocks of human capital. Poverty alleviation is also a salient feature of many basic human resource programs that advantageously combine efficient high returns and an equitable distribution of those returns to deserving poor persons, i.e., those who have providently saved and invested in their future but had bad luck or entered life with unusually poor endowments and with little collateral to borrow against.

A program's capacity to increase the productivity of an individual may not be fully apparent for decades. Human capital cannot be bought and sold, and, therefore, there are no markets from which to infer in the short run how much the value of human assets is increased by a program. Because of this limitation, many conceptual and statistical simplifications are needed to approximate from a cross-sectional survey the lifetime productive returns that can be expected from a human resource program. However, these limitations of human resource analyses are not fundamentally different from those faced when evaluating long-run infrastructural investment programs in which privatization is not a practical means to price the output of the program.

The market and nonmarket productive returns to human resource investments -- whether they are in sectors dealing with child nutrition and survival, adult health, schooling, labor mobility, or family planning -- are likely to be interdependent and vary according to the local scale of each program. Thus, the return on any one level of investment activity depends on how it is combined with earlier and later human resource investments in this and other human resource programs. Consequently, human resource programs should be evaluated together,

conceptually and empirically, if private and public resources are to be allocated efficiently among these programs and between this sector and others.

Social objectives other than efficiency should also be considered in such an integrated human resource framework in order to assess properly who benefits from programs and why. Social externalities of human resource programs may justify public subsidies, but only selectively? Credit markets are widely assumed to be an important constraint on the capacity of the poor and disadvantaged to realize relatively high private market returns through investment in their children's human resources and their own. In these cases, care must be exercised to target public subsidies or credit provisions to those persons and activities where such failures of the credit market are a serious impediment to achieving an efficient level and composition of investment.

II. Rate of Return

The discount rate that equalizes the discounted costs and discounted benefits of a project is its internal rate of return. It is a standard means of ranking the profitability of investment projects in a well-functioning capital market and yields a unique ordering of projects if large costs are not incurred at the end of an asset's life, as when disposal costs are substantial. This does not seem to be limitation of the rate of return concept when used to evaluate human resource investments.

There are often costs and benefits associated with a human resource investment that are not borne by the investor. Consequently, a private rate of return that is relevant to the private investor's maximization of expected wealth may not be the social rate of return that is relevant to the social planner. The critical criterion for the social planner is that the suitably discounted surplus of social over private benefits must exceed the social costs that are not borne by the private family. Consequently, the social planner must first satisfy the private return criterion to have private individuals invest in or use the human resource program, and then satisfy the requirement that incremental social returns justify social costs.

Measurement of Returns to Schooling and Training

Most economic analysis of human resources has focused on the returns to education. In the 1950s and 1960s economists sought to explain sources of economic growth that were not accounted for by the traditional measures of labor and capital inputs (Kuznets, 1952, 1966; Abramowitz, 1956; Denison, 1962; T.W. Schultz, 1960). Becker (1964) attributed the difference in average earnings between workers with a four-year college degree and those with only a twelve-year high school degree to their attending college. He compared the discounted value of this age-earnings stream of benefits to the opportunity cost of the earnings a student forgoes to attend college plus the direct costs of college tuition, materials, and fees. After additional adjustments and refinements in his working assumptions, Becker computed what private internal rate of return a U.S. male high school graduate might expect to receive from his investment in college education, based on age-earnings cross-tabulations from the 1940 and 1950 U.S. Censuses. The average percentage increment in wages associated with an extra year of schooling is a reasonable approximation for the private internal rate of return to that year of schooling, given the simplifying assumptions that the age differences in wages in the cross section predict lifecycle returns and that the opportunity costs of not working for a year approximate the private cost of completing a year of schooling (Mincer, 1974).

Mincer (1974) then hypothesized how returns on postschooling experience or on-the-job training accumulated over the lifecycle, which helped him explain the upward sloping profile of earnings with age after an individual leaves school. Many subsequent studies have replicated these patterns, finding in general that the slope of the wage function with respect to years of postschooling experience is steeper in countries that have invested more heavily in schooling and in which economic growth has been more rapid. For example, the age-earnings slope is steeper in the United States than in Ghana, but it is steeper in Japan than in the United States (Mincer and Higuchi, 1988). The earlier mandatory retirement age in Japan than in the United States is offered as an additional explanation for the steep Japanese wage profile (Clark and Ogawa, 1992).

The policy implications of these returns to postschooling training are less clear than those related to the returns to schooling, because the cost of the training cannot be directly measured and the transferability of the training to a new job is uncertain. In the case of schooling, the period of attendance in years can be inferred with or without adjustment for repetition, even though this neglects length of school year, the student's attendance, and school quality. There is no consensus on how to measure the share of a worker's time invested in on-the-job training or postschooling experience. Nor is it easy to distinguish between firm-specific human capital, which is specific to the worker-firm match, from general human capital, which can be readily transferred to another job. Only general human capital should be paid for entirely out of the worker's gross wage, since it is embodied in the worker, whereas the cost of firm-specific human capital should be shared by worker and employer, possibly through some form of long-term employment contract. The gap between actual net wages paid the worker and gross labor productivity, which could provide the incentive for such long-term contracts, is, unfortunately, empirically elusive.

Mincer (1974) provided a conceptual framework for empirically summarizing wage differences across persons of different education levels and durations of postschooling experience. His approach has become the standard form for log-linear wage regressions in which the estimated coefficient on completed years of education could, under certain simplifying assumptions, be interpreted as the private rate of return to an additional year of schooling. For two decades this wage function has been modified, extended, and generalized in many ways to assess whether the particular functional form, empirical specification, or estimation method proposed by Mincer leads to biased estimates of private returns to full-time schooling.

With large representative household surveys now available from most countries of the world, the empirical patterns found between schooling and wages have shown themselves to be robust, suggesting private wage returns to schooling are substantial in virtually all countries. Returns are particularly evident in countries experiencing a minimum of stable macroeconomic conditions, a mobile

market for workers, and an economy open to international trade and competitive pressures exerted by technical change in the world economy. Some simplifications such as constant returns to different levels of education are readily relaxed by allowing the proportionate effect on wages of years of schooling to vary across levels of schooling, even nonparametrically (Lam and Schoeni, 1993). The omission of wage-determining variables representing the ability of workers, or family wealth, was initially thought to bias upward Mincer's estimates of the returns to education, whereas efforts to include these variables in the wage function can be shown to bias downward estimates of schooling returns, because they worsen the problem of errors-in-measurement of education (Griliches, 1977; Lam and Schoeni, 1993). Several decades of searching for improved specifications of the wage function have not fundamentally altered the early interpretation of the data, insofar as it suggests basic levels of schooling earn a handsome return for the private individual and, undoubtedly, contribute to more rapid aggregate economic growth.

It is often noted that, as a rule, private returns appear to decline at higher levels of schooling within a particular country, and, at a specific level of schooling, e.g., secondary, returns are generally lower in more advanced countries where a larger fraction of the population has acquired that level of schooling. But since the return on an investment in skills is not a function of only the relative supply of workers with that skill, but also the derived demand for those skills in the domestic economy, there are many exceptions to the above empirical regularities. For example, private returns to secondary schooling often appear to exceed returns to primary schooling, frequently in countries that have experienced rapid recent growth and have managed to provide complete primary schooling to the vast majority of their youth (Schultz, 1993; Jain, 1991). The expectation is, nonetheless, that as private and public schools are able to expand to catch up to the demands for their graduates, returns to more advanced levels of schooling will secularly decrease toward the level earned on other forms of human and nonhuman capital in the country (Psacharopoulos, 1989).

Returns to technical training and vocational education are more difficult to predict or describe with a few generalizations. They appear sensitive to labor market conditions and to the transferability of the skills they impart. Ranking of returns to vocational and general educational opportunities is therefore unpredictable a priori, perhaps because fewer evaluation studies have focused on vocational training programs, or because these programs are more heterogeneous across countries and even within countries (e.g., Vijverberg, 1993). For example, vocational training for men and women often focus on producing skills relevant to entirely different occupations, e.g., car mechanics versus secretaries, that may parallel existing gender differences in occupations, for which market scarcities, public costs, and duration of training may differ.

Wage returns to vocational education should, therefore, distinguish between men and women and among preparatory courses, assessing the direct costs and opportunity costs of the time of students. Few labor force surveys, or even evaluation studies, collect the needed information on the provider, fees, duration of study, and occupational specialty of vocational education that would allow a confident estimation of the private and social returns to these training programs.

Returns to Health and Productivity

Health human capital has received less study than education, although it was singled out from the start as a critical part of "Investment in Human Beings" (T.W. Schultz, 1962), along with on-the-job training, migration, labor market information, and measuring investments and growth residuals. The recent achievements in advancing world health are as remarkable as those of education. Since the Second World War the expectation of life at birth in developing countries has increased at about twice the rate achieved by the high-income countries during the period of their most rapid health progress. In the industrialized countries, life expectancy increased about one year per decade from 1870 to 1940, whereas since 1950 life expectancy increased about two years per decade in the low-income countries. Is the catching up in education and

health among the less developed countries due to their more rapid growth in this recent period than that experienced in the earlier period by the industrialized countries?

Longevity may be determined by investments in nutrition and health-related forms of consumption that increase along with personal income. But increments to longevity overtime in low-income countries since 1950 exceed those we can explain by per capita real income growth, based on the cross-sectional relationship between income and longevity. Preston (1980) has proposed that after controlling for income, the unexplained (residual) time trend in longevity can be attributed to improvements in public and private health technology. Solow (1957) came to a similar view of technological change as being a name for the residual time trend, after economic growth in output per worker was regressed on capital per worker. To give Preston's interpretation of health technology more substantive content, it should be explicitly measured as a stock of useful knowledge, or the inputs must be specified and observed that are thought to produce that stock of knowledge. Including this stock of technology or its determinants in the regression for longevity change should reduce the importance of the residual time trend.

However, to estimate with confidence the returns to health human resource programs, much additional work will be needed. First, a measure of health must be selected and a methodology developed to assess the impact of private and public resources on that health objective. Then, a pecuniary value must be assigned to the health objective to convert the costs and benefits into the same monetary units. Major problems remain to be resolved before measures of the returns to health and nutrition programs will be widely accepted. However, 30 years ago some specialists in education also regarded the efforts to calculate the returns to education as flawed, if not misguided (Vaizey, 1961).

Where does one begin in summarizing what is known about the production of health? If reduction in mortality is selected as the indicator of health improvement, program evaluation will require the measurement of deaths for a representative population for which many given characteristics are known,

including variation in local availability of public health programs or welfare policies. Unfortunately, the registration of deaths and population enumerations needed to construct even crude death rates are rarely reliable in low-income countries and are not linked to socioeconomic characteristics even in high-income countries. Thus, vital registration statistics are unlikely to provide a basis to evaluate health program effectiveness in the developing countries in the near future.

Case-control comparisons of samples drawn from "clinical" populations are not a reliable basis for estimating relationships between medical treatments, environmental risks, and health outcomes, unless these clinical data can be combined with the analysis of representative samples that include both the healthy and clinically observed (Hsieh et al., 1985).

Representative household surveys hold the greatest promise for estimating without bias the determinants of health outcomes in terms of contextual information on individuals, families, and access to community health and welfare services. Public resource allocation decisions to the health sector will be better informed in the future when they are based on analyses of household sample surveys. Some progress has already been made in using these surveys to test how private and public features of families and communities are correlated with health outcomes.

Surveys often ask women how many births they have had and the survival status of their births. Demographers have concluded that these retrospective responses can be a reliable basis for estimating the level of child mortality, and the individual responses are analyzed for evidence on the determinants of child mortality (Hobcraft, 1984). The mother's schooling tends to be the most important factor in reducing child mortality (Cochrane et al., 1980; Mensch et al., 1985). Household permanent income is also associated with better child health outcomes in some studies. Reducing malnutrition increases the probability of child survival, but this health input is governed by the family and constrained by its income. Consequently, local food prices are used as instrumental variables to predict nutritional intakes, and studies confirm higher

food prices increase child mortality as well as nutritional stunting and wasting (Strauss, 1986; Thomas et al., 1990; UN, SCN News, 1992). Access to local health and family planning facilities are also found to be sometimes correlated with lower child mortality rates, but the connection is not as uniform or of such a magnitude that public health programs can be thereby interpreted as being a major factor accounting for variation in child mortality across low-income societies (Rosenzweig and Schultz, 1982). How households allocate their private resources to preventative and curative health inputs, including nutrition, may be of importance for understanding cross-sectional differences in child-health outcomes in low-income countries, but little is known on this score.

Moderate-sized household surveys are unable to estimate adult mortality reliably because of its infrequency. Surveys have not yet perfected means for measuring uniformly adult morbidity because subjective self-response bias can be serious. Consequently, anthropometric (objective) indicators of nutritional status have received the most study; first for children, where they confirm the same relationships as for child mortality (Thomas et al., 1990), and then more recently for adults (T.P. Schultz, 1994). Height and weight have become accepted standards for assessing the health and nutritional status of adult populations among biologists, economic historians, and finally development economists. Historical aggregate time series studies complement contemporary analyses of individual cross sections from representative household surveys (Fogel, 1991).

Improvements in nutritional status can have reinforcing short-run and longer-run effects on the health and productive potential of a population. Current calorie intake may enable workers to perform more demanding tasks. Excess nutritional intake over basic metabolic requirements and those required for current work activities add to body stores of energy, increasing weight for a given adult height. Increases in weight, given height, before reaching obesity, are associated with lower mortality (Waller, 1984) and greater productivity as measured by higher wages, particularly at very low levels of calorie intake (Strauss, 1986; Behrman, 1993; T.P. Schultz, 1994).

In the longer run, improvements in child nutrition also lead to increases in height, within certain biological limits (Falkner and Tanner, 1986). Adult height is thought to be particularly sensitive to nutritional deficits at early ages, including those experienced by the mother which influence the rate of uterine growth of the child and its weight at birth. Studies suggest the height of a child by age four is a discriminating indicator of previous nutrition and the burden of childhood disease, and that this early measure of height is a reasonably accurate predictor of adult height (Martorell and Habicht, 1986; Martorell, 1993). Adult height predicts lower mortality, lower chronic adult morbidity, and increased productivity (Fogel, 1990, 1991).

Historical analyses of levels and changes in height in West European populations in recent centuries document substantial changes in the stature of men. Sustained growth in height occurred in most European populations in the 19th and 20th centuries, as they caught up to the nutrition levels achieved by the U.S. population by the late 18th century. Although it is not possible to disentangle confidently the role of increased nutrition from that of decreased exposure to infectious diseases, many scholars attribute this secular increase in height in Europe to improvements in nutritional intakes and mainly to the consumption of more calories (McKeown and Brown, 1955; Fogel, 1986, 1994; Komlos, 1989; Floud et al., 1990). Fogel (1994) estimates that 30 percent of the growth in labor productivity in the United Kingdom from 1780 to 1980 can be attributed to improved nutritional status of the population. If one knew the opportunity cost of this increased nutrition, the productive rate of return on this health investment could be calculated, and it would presumably be substantial.¹

Given the complexity of the biological processes determining health, and the long lags between the time when health inputs are consumed and the time when health outcomes are produced, research on nutrition has relied increasingly on indicators of net health outcomes -- such as adult height -- rather than trying

¹This gain in average productivity may also be attributable to the decrease in variance in nutritional status which reduced the proportion of the population with very low levels of nutrition and who are thus disproportionately at risk of death and much less productive lives.

to quantify all the inputs and to describe the production functions that underlie human growth and health status (Fogel, 1991). Moreover, as long as health and nutrition inputs are themselves allocated within families and societies in response to unobserved (by researchers) healthiness of individuals and their productive roles and the preferences of family members, direct estimates of health technology or of the effects of health inputs on health outcomes can be quite misleading. This heterogeneity bias will occur even if all health inputs are accounted for and the researcher correctly knows the functional form of the health production process (Rosenzweig and Schultz, 1983). Clearly neither of these conditions is normally satisfied.

Most analyses of health technology have focused on the least ambiguous (and most final) outcome: mortality. Anthropometric indicators, such as birthweight, height for age, and body mass index (BMI defined as weight divided by height squared), are justified as measures of health by their correlation with age-specific mortality and morbidity. There is, of course, also the justification that they can be readily measured in a household survey whereas mortality and morbidity cannot.²

Private and Social Returns

Returns to human resource investments can be calculated from information on the benefits and costs of the investment and can be reckoned from three

²The collection of physical limitations on daily activities may provide a useful measure of adult health among the elderly. It remains to be seen whether these indicators of health morbidity are correlated with mortality and affected by similar behavior and program interventions (Strauss et al., 1993; Stewart and Ware, 1992). In high-income countries, where advanced medical technology can increasingly maintain life but with deterioration in the "quality" of that life (e.g., permanent loss of consciousness), society may wish to measure quality of life and to assign it a value (Broome, 1993; World Bank, 1993). This value of life quality, moreover, must be measured in units that are commensurate with preserving life itself, for different groups, and with increasing the individual's productivity. The loss of life from "premature death" has been combined with the disability-adjusted length of life to provide one candidate for a summary indicator of health sector output, but its usefulness is debated (Preston, 1993). These questions involve complex ethical and economic issues that may be less salient in setting public health priorities in low-income countries today than in the industrially advanced countries. However important, they are beyond the scope of this paper.

perspectives: the individual's; the family's; and society's as a whole. The private individual's projected net gain in productivity associated with the investment is offset by the private opportunity costs -- that is, productive time lost to the family -- and direct private costs. Individuals are assumed to maximize their lifetime wealth by investing first in forms of human and physical capital that earn them the highest internal private rates of return.

In calculating the cost of a human resource investment from the perspective of the society, public sector subsidies are added to the private costs. In addition there may be social benefits from the human resource formation process that are not captured by individuals, due to their productivity, altered behavior, or diverse externalities. One externality is a change in the taxes an individual pays, which may occur because of increased labor productivity, but may be augmented or diminished by changes in the amount of time supplied to those work activities that are actually taxed. More educated workers tend to work more outside the home in activities that are more readily taxed. For women, education is associated with increased supply of labor to taxed activities, but wives of more educated men supply fewer hours of labor to such work (T.P. Schultz, 1991). Men's wage labor supply tends to be relatively unresponsive to increases in education and may decline with education in some low-income countries (Mohan, 1986). In total, the taxable labor supply is likely to increase with women's education and to decrease with men's education. To the extent that women's education broadens the tax base, it reduces the tax rate required to achieve a government's revenue goal and, thus, reduces tax-induced allocative distortions. Because of the distinctive gender differences in labor supply response patterns, this social benefit is greater when educating women than men.

Education of women influences their health, longevity, and welfare as well as that of their children (Cochrane et al., 1980; T.P. Schultz, 1993; Strauss et al., 1993). Education of women also influences family size. If these effects embody social as well as private benefits, they are externalities of women's education that should be taken in account in setting public sector priorities. Public subventions are already available to welfare programs that improve child

health, nutrition, and schooling, and, through family planning programs that help couples avoid unwanted births. The marginal cost of achieving these outcomes by direct welfare programs provides then one basis for assigning a social opportunity value to the social externalities of women's education as it indirectly affects child health and birth control.³

With no consensus on how to quantify and evaluate the social externalities of education, the common practice is to calculate social returns to education by simply adjusting private returns downward to allow for the public sector net expenditures on education and thus to ignore potential offsetting external benefits (Psacharopoulos and Woodhall, 1985). Differences between social and private returns are the relevant criteria for society to allocate public resources among competing human resource programs to maximize social welfare. More attention should be directed to the task of measuring both returns to meet the needs of the policy maker.

Between the individual and the society there exists a more difficult to define intermediate level of aggregation -- the family -- or, more specifically, parents who have some interests in and responsibility for their children or possibly other relatives. How are motivations of parents to be characterized? One view of the family is that it provides a context for people to transfer resources over time and between generations (Kotlikoff and Spivak, 1981). The family may not be able to internalize all of the individual private returns to human capital investment across family members because credit markets facing parents are imperfect. This credit market failure could explain the common practice of extending public subsidies to human resource programs, such as means-

³For example, Birdsall (1992) hypothesizes that a specific amount of environmental degradation could be prevented if population growth were slowed. Three policy interventions are considered to achieve this goal: (i) energy taxes; (ii) expenditures on family planning that promote the adoption of contraception; or (iii) expenditures on female education that decrease fertility. She suggests that energy taxes might be initially a cost-effective policy, but as the tax is increased, the two social programs that lower fertility to slow population growth would become more cost effective than the energy tax at the margin. Which of the social programs would be would depend on the region of the world since family planning cost effectiveness varies widely. This ignores, of course, other gains associated with these alternative social welfare programs such as capacity of women's education to increase female productivity.

tested pricing of health, nutrition, family planning and education goods and services, and, of course, student loans for those without wealth to use as collateral.

In their investments in and transfers to children, parents need not treat all of their children equally. The private returns to human resources may differ across children. The family must then consider whether to be guided only by efficiency, in other words maximizing total private returns, or whether to also assign a value to equalizing consumption opportunities among their offspring. Society can arrive at its own evaluation of these competing aims of efficiency and equity and then seek to modify the behavior of the family if needed, or in other words, if social goals diverge from the family's revealed preferences.

In the case of health, there are social benefits in the reduction of infectious disease. The benefits from reduced exposure to illness tend to be nonlinear and can involve complex offsetting costs, such as with preventing diseases that are relatively minor if experienced in childhood but which can be more debilitating if experienced for the first time as an adult (Molineaux and Gramiccia, 1980). Nonetheless, it is widely thought that there are substantial external benefits to improvements in health associated with control of infectious and parasitic diseases (Hammer, 1993).

III. Other Performance Criteria and Preconditions for Success

Increasing the productivity or average wage of the population is an indicator of program efficiency. It has been emphasized here to provide an initial, relatively uniform measure of program achievement on which to compare human resource investments across sectors. Clearly other goals are also relevant to funding choices among public programs. How should efficiency be used in combination with other dimensions of achievement?

Poverty Alleviation

Many studies suggest that basic human capital investments (nutrition, preventive health, education), if they can be targeted effectively to poor

families, have higher returns than if they are uniformly provided to all segments of the population. Such a coincidence of efficiency and equity in human resource development projects could avoid the need to choose between these objectives. Families are assumed to invest first in the human resources of its members that pay the highest returns, working their way down the investment schedule to the point where marginal returns to family human capital are no higher than the family can earn in the competitive market on physical assets (Becker, 1967). The poor, because they own fewer assets to offer as collateral, incur a higher cost of borrowing that includes a larger risk premium to invest in human capital. This is one possible explanation for why the poor are observed to demand fewer human resources, even when they could expect to earn on them a higher private return than on their physical capital. The importance of this hypothesized relationship should nonetheless be evaluated by empirical studies. An alternative hypothesis is that the poor may prefer not to invest in the human capital of particular family members, even when their cost of borrowing is the same as for the non poor. In this case, human capital credits for the poor should be evaluated against other targeted redistributive programs, such as school fellowships for girls in poor families.

As a large share of a birth cohort invests in a certain minimum level of human capital, it may become increasingly costly and less economically justified to extend that level of human capital to the remaining few. For example, to reduce drop-out rates in secondary schools from five percent to one percent might require, in a heterogeneous society, a large investment in better schools and more enforcement efforts. In the United States, studies of wage returns to education have for some time found an anomalously low level of private returns to elementary schooling (Murphy and Welch, 1990; Card and Krueger, 1992). In any particular birth cohort, a few of the least able or least motivated may not gain much productive knowledge or vocational skills from attending an additional year in the classroom. One explanation for this pattern is individual heterogeneity that may become more salient in the lower tail of the distribution in a population. For example, a disproportionate share of workers with the least

education in the United States are immigrants, and immigrants tend to be positively selected on other unobserved productive characteristics, such as ability and motivation.

Individual heterogeneity may also account for nonuniform returns across a birth cohort in other forms of human capital investment. The biological efficiency of individuals to convert nutrition into productive work may be heterogeneous, accounting for the variation in nutritional intake even in a population with similar economic opportunities (Srinivisan, 1981; Sukhatme and Margen, 1982). The utility realized through migration from a low-wage region to a high-wage region may also diminish as the majority of a population departs, leaving behind only those who assign an unusually high value to the psychic value of staying in the location of their birth.⁴ Thus, returns to any particular margin of human resource investment may be expected to diminish as a growing fraction of a population makes these investments for a wide variety of reasons that are difficult to quantify.

Managing human resource investments for development requires anticipating how the rate and composition of aggregate growth affects the derived demands for educated workers, and thereby affects the returns to schooling. These demand effects, together with the available relative supplies of educated workers, determine the returns on education in a closed population. Models of human resource returns based on dynamic projections of demands and supplies are not yet a reliable forecasting tool, but the development of such systematic management methods for human resource sectors should be a high priority for operations and research. Studies suggest that the structure of output, composition of employment, openness of the economy to trade and technical change all contribute to the derived demand for more educated workers. High technology industries are associated with higher returns to schooling by sector, but this may also reflect selectivity of persons entering into high technology sectors who are more able

⁴For example, the utility derived from location-specific cultural features may be less important to the more educated individuals who are more mobile. The more cosmopolitan educated worker may also assign more value to amenities in higher-wage areas.

and better educated, or it could signal the complementarity of on-the-job training and schooling in fields of rapid technological change (Gill, 1989; Gill and Khandker, 1991; Mincer and Higuchi, 1988; Choi, 1993). Increases in the share of the employment in services, commerce, and manufacturing are associated with increased female participation in the labor force, and perhaps enhance market returns to women's education (Schultz, 1990).

Education is hypothesized to help entrepreneurs as well as workers exploit new profitable productive opportunities. Returns to schooling are thus observed to increase in periods of disequilibrium and changing prices and technology (T.W. Schultz, 1975). Research that leads to new technological opportunities and productive inputs in a sector enhances the returns to better educated workers and managers, as first documented among farmers in the United States (Welch, 1970), and more recently reconfirmed in rural India during the Green Revolution (Foster and Rosenzweig, 1994).

To develop a firmer understanding of how the changing structure of an economy impacts on the derived demands for education and other skills, the wage structure associated with various forms of human capital must be monitored at frequent intervals within more economies and across economies, based on a comparable measurement methodology. The stylized Mincerian wage function should be the starting point for summarizing the wage structure, but in addition, different birth cohorts (of different ages in the cross section) should be disaggregated to provide a more sensitive indicator of the wage premia paid to younger workers who have been recently educated. From the wage outcomes for the young, researchers can assess how much productive value is being added to the workforce by the current distribution and quality of education. If wage premia increase at a specific level of schooling, it may signal a bottleneck in the expansion of that type of schooling and justify the encouragement of private sector as well as public sector expansion to satisfy the evident aggregate derived demand for these skills. Conversely, collapsing wage returns to a specific margin of education may signal the need to reconsider further expansion of that level of education (Cf. case of Korea in Choi, 1991; Ryoo et al., 1993).

Of course, in addition to the productive efficiency argument for human resource social investments, there is also a justification to reduce income inequalities by making more highly educated labor less scarce, assuming that there is still private demand for the educational facilities (Cf. Brazil, where decreasing returns to education in the high-income regions has contributed to reducing social inequalities, Almeida dos Reis and Barros, 1991).

There are some activities engaged in by educated workers or particular types of trained workers that yield significant social externalities, and these spillover benefits that the individual cannot privately capture may justify focused public investments in higher education. This may be justified despite the overall tendency for there to be only moderate social returns to higher education (Psacharopoulos and Woodhall, 1985; Psacharopoulos, 1994). Research and development of new technologies that are diffused at relatively little cost among many small competitive firms can have a large social payoff, but not necessarily provide the producer of these technologies with a competitive private return. These conditions can exist when agricultural plant and animal breeding programs enhance the productivity of relatively small-farm producers of cash crops like cacao, coffee or even sugarcane. If the output is domestically consumed and is relatively costly to export (i.e., untradable), such as potatoes, yams, cassava, or pulses, the social benefits are likely to accrue mainly to domestic consumers in the form of lower consumer prices for basic foodstuffs (Birkhauser et al., 1991). Public subsidies may therefore be warranted on efficiency grounds for some specific human capital generating activities that also create production externalities for the society, such as agricultural training, research, and extension activity. In general, however, it is likely that social externalities associated with education diminish at higher levels of education as it becomes more technically specialized to serve a specific vocation in the labor force.

Another way in which public training can generate social returns in excess of private wage returns is by educating students to perform specific functions in the public sector. For example, by educating primary and secondary school

teachers, the output of the public sector normal schools should contribute to lowering the price of teachers and hence reducing the cost of educating the next generation of students, whether they attend public or private schools. The limitation with this argument for subsidizing teacher training programs is that as the wage for teachers decreases, a growing share of the graduates may take jobs in other sectors at better pay, or migrate to better paying teaching positions abroad, or establish unions that resist the decrease in teacher salaries. The public subsidy should be concentrated in professions where employment is heavily concentrated in the public/private human resource development sectors, where international mobility is limited, and where public sector unions are not able to sustain noncompetitive wages. If this argument is extended to justify subsidizing the training of doctors and engineers, occupations for which private returns are often ample, governments should recognize that trained individuals may migrate abroad to employ their skills where they are in most demand. The justification for subsidized teacher training depends, however, on the strong assumptions that wages of teachers are free to seek their own level as the supply of teachers increases and that teachers have relatively few employment opportunities abroad. If instead employment in the public education sector becomes a lifetime sinecure, in which wages cease to be closely related to the scarcity of teachers and their job performance, then the economic argument for subsidizing teacher training collapses, as it may for internationally mobile doctors and engineers.

Market Failures and Efficiency Wages

Many hypotheses have been advanced to suggest why increasing wages above labor's marginal product could call forth increased output (Bliss and Stern, 1978 a,b; Stiglitz, 1976; Akerlof and Yellen, 1986). If employers recognize that better pay induces workers to labor more productively, and employers capture these productive gains, firms will behave in a socially efficient manner and pay the extra "efficiency" wage and internalize the benefits.

The economic problem arises when the employer or individual does not understand the connection between a human resource investment and production, or the employer does not capture the benefit to the worker from the human resource investment, or the worker cannot borrow to make the initial investment. An efficiency wage distortion could arise with early childhood health and nutritional investments, when parents are poor and poorly understand the long-term repercussions of neglecting these early investments. In contrast, the current calorie intake of an adult may affect her or his body-mass-index and labor output in a relatively short time. This situation would seem more readily resolved by longer-term employment contracts to internalize more of the gains from current nutrition and health care. But in much of the world, casual day-labor markets persist for many workers. It is common to observe wages being paid partly in food consumed on-the-job, perhaps to mitigate this externality. Self-employment, piece-rate wages, share tenancy, and many other labor payment schemes may also be a response to these incentive design problems. Landless and assetless workers may still have insufficient calories to work at an economically efficient level, given the local price of nutrients and the increment to marginal product that extra nutrition would release (Foster and Rosenzweig, 1993; Dasgupta, 1993).

Several studies have suggested that the productive returns to labor of extra calories are high at very low calorie levels, and these returns decline and become difficult to discern at moderate levels, of say 2,200 calories per day (Strauss, 1986; 1993). These patterns are observed in the pool of family labor working in family farms or among individuals working as day-wage labor. There is also suggestive evidence among children that the mortality-reducing effect of child weight becomes steadily smaller as the child approaches the "standardized" weight growth path for a given age. Diminishing returns to human resource investments are evident at many margins.

It would, of course, be a serious sign of market failure if malnourished individuals did not know the productive gains they could secure from improved nutrition and chose to spend their increased wages predominantly on other forms

of consumption than nutrition. Although one study drew the conclusion that the income elasticity of demand for nutrition is approximately zero in India (Behrman and Deolalikar, 1988), most evidence suggests that at low calorie levels increments to income significantly increase nutrient intake. However, as incomes rise, consumers shift from purchasing more calories to consuming higher quality foods (i.e., proteins and better tasting foods). These nutritional patterns are dynamically complicated by several factors that are not perfectly understood: (i) seasonal variation in the marginal product of labor that differs by age and sex, e.g., highly productive in plowing or harvesting periods, at least for some members of the community; (ii) prices of food varies by season, suggesting that durable body stores of weight are accumulated at less cost in and after harvest periods; (iii) credit markets also vary in their interest rates over the year; (iv) buffer stocks of food are subject to variable rates of depreciation or spoilage; and (v) climate uncertainty affects both family real income opportunities and wage opportunities (Payne, 1989; Latham, 1993; Strauss, 1993; Musgrove, 1993; Sahn et al., 1984).

Many of these issues are increasingly being studied. Nutritional supplements of calories and micronutrients can be a high-return, public-sector activity for particular groups that cannot borrow or in cases where employers of migratory or casual labor do not capture the social gains of nutrition and health investments for their workers (Levin, 1986; Levin et al., 1991; Politt et al., 1989; Behrman, 1993). The specific conditions should be defined under which these market failures arise and are exacerbated, and then programs should be designed to target these groups efficiently. General nutritional programs may not always be a good human resource development strategy. Food supplementation programs depress market prices for food, and thereby lower incomes to other poor agricultural workers and reallocate resources away from agriculture where they may be efficiently employed. The distributional benefits of untargeted nutrition programs are thus doubtful. Understandably, food AID and PL-480 food export promotion programs may be more popular among farm lobbies in high-income, food-exporting countries than they are among the recipient countries.

Migration may also be a human resource formation activity that receives less than socially optimal investments. Empirical evidence suggests that underinvestment in migration occurs most commonly among the least educated and the lowest income groups. If the time costs of migration and of job search at destination during which employment is interrupted are the primary opportunity costs of interregional migration, and these periods of unemployment are expected to be uniform across workers, then the ratio of wages between high-wage regions and low-wage regions is proportional to the private rate of return to migration. This is analogous to interpreting the percentage increase in wages associated with an extra year of schooling in the wage function to be a rough estimate of the private return to schooling (Mincer, 1974). In the case of migration, however, the factor of proportionality is unknown, unless the expected time spent migrating and finding a job is known in units of "opportunity-cost" years (T.P. Schultz, 1982). According to this indicator, interregional wage ratios are larger for less-educated than for more-educated workers in many labor markets, in both high- and low-income countries. Also, the frequency of migration is greater among the more educated, even when controlling for wage and unemployment differentials between origin and destination regions (T.P. Schultz, 1982). What is not known is whether the lack of migration among the least educated is due to their (i) lack of credit, (ii) lack of information about job opportunities in other regions, or (iii) stronger preference to stay in their native location.

Subsidizing migration is also complicated because loans to encourage resettlement are difficult for the public sector to implement and enforce, and federal forms of government are not conducive to programs that encourage outmigration, even when it is the poor that are being helped to leave a region. Most public sector migration programs are consequently designed to encourage the movement of settlers into frontier or underdeveloped regions. In such migration development schemes, there are always clearly defined economic interest groups that stand to gain from increasing the population in the destination region, such as the government of that region and those who own the region's land and natural resources. Case studies of migration-development schemes of this form suggest

that they tend not to be cost-effective, as illustrated by Indonesia, Brazil and Bolivia, and they also have unwanted environmental and distributional consequences.

Gender and Ethnic Group Benefits

Human resource investments in women have increased relative to those made in men in most countries during this century, proxied by both years of education attained and years of longevity. The shift in the gender composition of human capital formation occurred as women entered more frequently into the market labor force, particularly into wage employment outside of the family (T.P. Schultz, 1993). These trends have occurred more rapidly in Southern Europe, Latin America, and East and Southeast Asia, and more slowly in South and West Asia. Africa exhibits marked differences in female to male education, with women receiving relatively little in West, East, and North Africa until recently, whereas there is more parity between the sexes in education in Southern Africa. Mortality differences have increasingly favored women in the high-income countries, and to a lesser extent in Latin America and East and Southeast Asia. In several countries of South and West Asia males continue to outlive females. The frequency of low birthweight infants is another anthropometric inverse indicator of adult female nutritional status, and this indicator is widely observed to fall with the onset on modern economic growth (Ward, 1993).

Increases in returns to education and health investments of women relative to the returns on these investments of men could account for the shifting emphasis toward women's human capital. If, as noted earlier, there is a general tendency for returns to human resources to be higher at lower levels of investment, then the increased investments in women's human resources could be further justified because the margins of investments for women will involve more basic and presumably higher return activities than for men.

The effects of height, an indicator of childhood nutrition, on wage rates of women in urban Brazil are of a similar substantial magnitude to those for men, but the wage returns to BMI are lower for women than for men (Thomas and Strauss,

1992). In Côte d'Ivoire and Ghana, the proportionate increase in wages of women and men associated with height is not dissimilar; however, the log wage effects of BMI are more significant and substantial for women than for men (T.P. Schultz, 1994). The relative wage returns of education for women appear to be about the same magnitude as for men in low-income countries (Schultz 1989, 1993). However, in some countries in Southeast Asia where women have achieved approximately the same levels of primary education as men, but considerably less secondary education, private returns to secondary schooling are noticeably higher for women than for men, as in Thailand from 1975 to 1989 and in Indonesia in recent years (T.P. Schultz, 1993; Deolalikar, 1993).

Encouraging more human resource investments in women may have the appeal of investing in the human capital of the poor, for these investments earn a higher than average private rate of return and benefit a lower income group. However, in contrast with the malnourished and least educated in a society, women are not all poor. Consequently, rather than underwrite broad subsidies for human resource programs that favor women, it may be more efficient to target those public subsidies on programs that primarily enhance the human resource investments in poor women or poorly educated women.

There are undoubtedly other ethnic and racial groups in most populations that in the past have received less than the average level of human resources (Psacharopoulos and Patrinos, 1993). Investing more in these groups may be justified because they are impoverished, and also because they are efficient users of these subsidies, if their returns are privately high and market failures prevent them or their families from borrowing to invest in themselves. These cases should be empirically disaggregated and carefully studied, moreover, for often other dimensions of human resource programs serving residentially segregated ethnic and racial groups may differ from the national average, such as their quality or simply the public resource intensity of the services provided. Therefore, distinguishing among the types and levels of schooling, health care, etc. that are publicly provided to disadvantaged groups is likely to show that they receive fewer public inputs and may, therefore, currently not

gain as much as other groups from access to these diluted public services. Returns to quality-adjusted human resource investments for these groups may be even higher than suggested by the simple patterns in access and productivity.

IV. Conclusions

This paper has sought to integrate conceptually knowledge of the economic contribution of human resource investment programs. First it is argued that human resource programs will contribute more to development if they are allocated to those activities that have the highest internal rates of return. Although high private rates of return may be necessary to attract the investment of private resources of participating individuals and families, public subsidies to human resource programs should also be based on a clear superiority of social returns over private returns or a palpable market failure that prevents private individuals and families from investing the socially optimal amounts in particular activities. The paper outlines how the private and social returns are calculated, and how the personal distribution of benefits from programs may be quantified to inform decision makers. Several conclusions are summarized briefly:

- Wage returns to education are common but studies are now needed to show the magnitude of productive returns to other human resource programs -- child health/nutrition; adult health, migration, and family planning -- and the corresponding opportunity cost of advancing these program objectives.

- Private returns to schooling are inferred from studies of wage premia associated with a worker's education, but social returns also need to be estimated for setting policy priorities. To estimate social returns will require suitably disaggregated public sector expenditures for women and men and relevant ethnic target groups, as well as estimates of the value of social externalities of schooling for these alternative levels of schooling and demographic groups.

- The social value of externalities of education programs should be quantified and evaluated in terms of what social resources are currently being

spent to affect directly these same outcomes, such as child health and reduced unwanted and wanted births.

- Families that are credit constrained from investing in their children's human resources need to be identified empirically and programs designed to help them. Some families, even if provided with credit, might invest less than the socially optimal level in some of their children's human resources. Policy instruments and incentives must be targeted to the individual recipient if they are to modify intrafamily investment allocations, such as equalizing the educational opportunities of girls (T.P. Schultz, 1989).

- Social externalities of nutrition, health, health education, and immunization programs should be quantified, such as their effect on the exposure of other groups to costly infectious diseases and the opportunity cost of foregone production by care givers in the family.

- In setting public sector priorities, human resource programs should be evaluated together because it has been shown that cross-program effects are often empirically important. They are neglected in all but a few human resource evaluation studies because of sectoral specialization in funding and implementation and the widespread lack of comprehensive planning in human resources.

- Public and private provision of the same or similar goods leads to cross-program effects that are likely to be substitutes for each other. Analysis of only the public sector, in such cases, can seriously overstate the achievements of public program inputs, because they neglect substitution away from private providers, or crowding out.

- The macroeconomic determinants of the derived demand for educated workers is not now sufficiently well understood to forecast how macroeconomic conditions impact on human resource returns. Considerable basic research is required to sort out how macroeconomic demand forces combine with individual supplies of human resources to determine private returns both during disequilibrium periods of structural adjustment and transition to a less

distorted market economy, and also in the long-run evolution of a growing economy.

- Nutritional supplements of calories and micronutrients may yield a high rate of return in terms of health status and labor productivity and may, therefore, be warranted as a public sector human resource program, if they can be efficiently targeted to populations for whom biological returns are highest.

- Interregional migration among the least educated may be a high private and social return activity in countries where interregional education-age-sex standardized wage differences are relatively large. Innovative public credit and job information schemes should be designed to mitigate this problem, and they must then be scrupulously evaluated to learn which pilot programs deliver the expected payoff and thus justify continued support.

- An empirical regularity of human resource programs is that they tend to exhibit higher than average returns when they are invested in poor people, and hence are often an efficient means to alleviate poverty. Although there is no rule without exceptions, nutritional supplements appear most productive among the very poor or nutritionally most deprived, educational returns are generally higher for the lower half of the income distribution, migration appears to have the highest payoff for the rural, least educated poor, and family planning appears to make its greatest contribution to preventing births among the least educated women. Human resource programs should generally be subsidizing the poor for whom private and social returns tend to be highest.

References

- Abramovitz, M., 1956, "Resources and Output Trends in the United States since 1870, Occasional Paper No. 52. New York: National Bureau of Research.
- Akerlof, G.A., and J.L. Yellen (eds.), 1986, Efficiency Wage Models of the Labor Market. Cambridge: Cambridge University Press.
- Almeida dos Reis, J.G., and R. Barros, 1991, "Wage Inequality and the Distribution of Education", Journal of Development Economics 36(1):117-143.
- Becker, G.S., 1964, Human Capital. New York: Columbia University Press.
- _____, 1967, "Human Capital and the Personal Distribution of Income", Woytinsky Lecture, University of Michigan, Ann Arbor, MI.
- Behrman, J.R., 1993, "The Economic Rationale for Investing in Nutrition in Developing Countries", World Development 21(11):1749-1771.
- Behrman, J.R., and A.B. Deolalikar, 1988, "Health and Nutrition". In Handbook of Development Economics, Vol. 1, eds. H. Chenery and T.N. Srinivasan. Amsterdam: North-Holland Pub. Co.
- Birdsall, N., 1992, "Another Look at Population and Global Warming", World Bank Population, Health and Nutrition Working Paper No. 1020, Washington, D.C.
- Birkhauser, D., R.E. Evenson, and G. Feder, 1991, "The Economic Impact of Agricultural Extension: A Review", Economic Development and Cultural Change 39(3):607-650.
- Bliss, C., and N. Stern, 1978a, "Productivity, Wages and Nutrition: The Theory", Journal of Development Economics 5:331-362.
- _____, 1978b, "Productivity, Wages and Nutrition: Some Observations", Journal of Development Economics 5:363-398.
- Broome, J., 1993, "Qalys", Journal of Public Economics 50(2):150-167.
- Card, D., and A.B. Krueger, 1992, "Does School Quality Matter?" Journal of Political Economy 100(1):1-40.
- Choi, K.S., 1991, "Changes in Wage Profiles in Korea During the 1980s". Processed. Yale University, New Haven, CT.
- _____, 1993, "Technical Change and Educational Wage Differential in Korea", Economic Growth Center Discussion Paper, No. 699, Yale University, New Haven, CT.
- Clark, R.L., and N. Ogawa, 1992, "Employment Tenure and Earnings Profiles in Japan and the United States", American Economic Review 82:(1)336-345.
- Cochrane, S.H., J. Leslie, and D.J. O'Hara, 1980, "The Effects of Education on Health", World Bank Staff Working Paper No. 405. Washington, D.C.
- Dasgupta, P., 1993, An Inquiry into Well-Being and Destitution. Oxford: Clarendon Press.
- Denison, E., 1962, The Sources of Economic Growth in the United States. Washington, D.C.: Committee for Economic Development.

- Deolalikar, A., 1993, "Gender Differences in the Returns to Schooling and Schooling Enrollment Rates in Indonesia", Journal of Human Resources 28(4):899-932.
- Falkner, F., and J.M. Tanner, (eds.), 1986, Human Growth: A Comprehensive Treatise, Vol. 3, 2d edition. New York: Plenum Press.
- Floud, R., K. Wachter, and A. Gregory, 1990, Height, Health, and History. Cambridge: Cambridge University Press.
- Fogel, R., 1986, "Growth and Economic Well Being: 18th and 19th Centuries". In Human Growth, Vol. 3, eds. F. Falkner and J.M. Tanner. New York: Plenum Press.
- _____, 1990, "The Conquest of High Mortality and Hunger in Europe and America", NBER Working Paper No. 16. Cambridge, MA (September).
- _____, 1991, "New Sources and New Techniques for the Study of Secular Trends in Nutritional Status, Health Mortality and the Process of Aging", NBER Working Paper No. 26. Cambridge, MA (May).
- _____, 1994, "Economic Growth, Population Theory and Physiology", American Economic Review 84(3):369-395.
- Foster, A., and M. Rosenzweig, 1993, "Information, Learning and Wage Rates in Low-Income Rural Areas". Journal of Human Resources 28(4):759-790.
- _____, 1994, "Learning by Doing and Learning from Others: Human Capital and Technical Change in Agriculture". Processed. University of Pennsylvania.
- Gill, I., 1989, "Technological Change, Education, and Obsolescence of Human Capital", Economics Ph.D. Dissertation, University of Chicago.
- Gill, I.S., and S.R. Khandker, 1991, "How Structure of Production Determines the Demand for Human Capital", PHRD Working Paper WPS No. 725, The World Bank, Washington, D.C.
- Griliches, Z., 1977, "Estimating the Returns to Schooling", Econometrica 45(13):1-22.
- Hammer, J.S., 1993, "The Economics of Malaria Control", The World Bank Research Observer 8(1):1-22.
- Hobcraft, J., 1984, "Use of Special Mortality Questions in Fertility Surveys". In Data Bases for Mortality Measurement, Population Studies No. 84, Department of International Economic and Social Affairs, United Nations, New York.
- Hsieh, D.A., C.F. Manski, and D. McFadden, 1985, "Estimation of Response from Augmented Retrospective Observations", Journal of the American Statistical Association 80:391 (September).
- Jain, B., 1991, "Returns to Education: Further Analysis of Cross Country Data", Economics of Education Review 10:(3)253-258.
- Komlos, J., 1989, Nutrition and Economic Development in the 18th Century Hapsburg Monarchy. Princeton, NJ: Princeton University Press.
- Kotlikoff, L.J., and A. Spivak, 1981, "The Family as an Incomplete Annuities Market", Journal of Political Economy 89(2):372-391.

- Kuznets, S., 1952, "Long Term Changes in National Income of the United States of America since 1870". In Studies in Income and Wealth, Series II, ed., S. Kuznets. Cambridge, MA: Bowes and Bowes.
- _____, 1966, Modern Economic Growth. New Haven, CT: Yale University Press.
- Lam, D., and R.F. Schoeni, 1993, "Effects of Family Background on Earnings and Returns to Schooling", Journal of Political Economy 101(4):701-740.
- Latham, M., 1993, "The Relationship of Nutrition to the Productivity and Well-being of Workers". In The Political Economy of Food and Nutrition Policies, ed. P. Pinstrip-Andersen. Baltimore, MD: The Johns Hopkins University Press.
- Levin, H.M., 1986, "A Benefit-cost Analysis of Nutritional Programs for Anemia Reduction", World Bank Research Observer 1(2):219-245.
- Levin, H.M., E. Pollitt, R. Galloway and J. McGuire, 1991, "Micronutrient Deficiency Disorders". In Disease Control Priorities in Developing Countries, eds. D.T. Jamison and W.H. Mosley. New York: Oxford University Press.
- Martorell, R., 1993, "Enhancing Human Potential in Guatemalan Adults through Improved Nutrition in Early Childhood", Nutrition Today (January/February):6-14 .
- Martorell, R., and J.P. Habicht, 1986, "Growth in Early Childhood in Developing Countries". In Human Growth, Vol. 3, eds. F. Falkner and J.M. Tanner. New York: Plenum Press.
- McKeown, T., and R.G. Brown, 1955, "Medical Evidences Related to English Population Changes in the 18th Century", Population Studies 9:119-141.
- Mensch, B., H. Lentzner, and S. Preston, 1985, Child Mortality Differential in Developing Countries. New York: United Nations.
- Mincer, J., 1974, Schooling Experience and Earnings. New York: Columbia University Press.
- Mincer, J., and Y. Higuchi, 1988, "Wage Structures and Labor Turnover in the United States and Japan", Journal of Japanese and International Economics 2(June):99-133.
- Mohan, R., 1986, Work Wages and Welfare in a Developing Metropolis. New York: Oxford University Press.
- Molineaux, L., and G. Gramiccia, 1980, The Garki Project. Geneva Switzerland: World Health Organization.
- Murphy, K.M., and F. Welch, 1990, "Empirical Age Earnings Profiles", Journal of Labor Economics 8(2):202-229.
- Musgrove, P., 1993, "Feeding Latin America's Children", World Bank Research Observer 8(1):23-46.

- Payne, P., 1989, "Public Health and Functional Consequences of Seasonal Hunger and Malnutrition". In Seasonal Variability in Third World Agriculture: The Consequences of Food Security, ed. D. Sahn. Baltimore, MD: The Johns Hopkins University Press.
- Politt, E., P. Hathirat, N.J. Kotchabhakdi, L. Missell, and A. Valyasevi, 1989, "Iron Deficiency and Educational Achievement in Thailand", The American Journal of Clinical Nutrition 50:687-697.
- Preston, S.H. (ed.), 1980, "Causes and Consequences of Mortality Decline in LDCs during Twentieth Century". In Population and Economic Change in Developing Countries, ed. R.A. Easterlin. Chicago: University of Chicago Press.
- Preston, S.H., 1993, "Health Indices as a Guide to Health Sector Planning". In The Epidemiological Transition, eds. J.N. Gribble and S.H. Preston. Washington, D.C.: National Academy Press.
- Psacharopoulos, G., 1989, "Time Trends in the Returns to Education." Economics of Education Review 8(3):225-331.
- _____, 1994, "Returns to Investment in Education: A Global Update", World Development, September.
- Psacharopoulos, T., and H. Patrinos, (eds.), 1993, Indigenous People and Poverty in Latin America: An Empirical Analysis, Latin American and the Caribbean Technical Department, No. 30. Washington, D.C.: The World Bank.
- Psacharopoulos, G., and Z. Tzannatos, 1992, Women's Employment and Pay in Latin America, The World Bank.
- Psacharopoulos, G., and M. Woodhall, 1985, Education for Development. New York: Oxford University Press.
- Rosenzweig, M.R., and T.P. Schultz, 1982, "Child Mortality and Fertility in Colombia: Individual and Community Effects", Health Policy and Education 2:305-348.
- _____, 1983, "Estimating a Household Production Function", Journal of Political Economy 91(5):723-746 (October).
- Ryoo, J-K., Y-S. Nam, and M. Carnoy, 1993, "Changing Rates of Return to Education over Time: A Korean Case Study", Economics of Education Review 12(1):71-80.
- Sahn, D.E., R. Lockwood, and N.S. Scrimshaw, (eds.), 1984, "Methods for the Evaluation of the Impact of Food and Nutrition Programmes." Food and Nutrition Bulletin Supplement 8. Geneva: United Nations University.
- Schultz, T.P., 1982, "Notes on the Estimation of Migration Functions". In Migration and the Labor Force, ed. R.H. Sabot. Boulder, CO: Westview Press.
- _____, 1989, "Women and Development: Objectives, Framework and Policy." Working Paper WPS-200, Women in Development Division, Population and Human Resources Department, The World Bank, Washington, D.C. (April).
- _____, 1990, "Women's Changing Participation in the Labor Force", Economic Development and Cultural Change 38(3):457-488.

- _____, 1991, "International Differences in Labor Force Participation in Families and Firms", Economic Growth Center Discussion Paper No. 634, Yale University, New Haven, CT.
- _____, 1993, "Investments in the Schooling and Health of Women and Men: Quantities and Return", Journal of Human Resources 28(4):694-734.
- _____, 1994, "Human Capital and Development", paper for presentation at 22nd International Agricultural Economics Association meeting, Harare, Zimbabwe, August 28, 1994.
- Schultz, T.W., 1960, "Capital Formation in Education." Journal of Political Economy 68(4):571-583.
- _____, 1962, "Investments in Human Beings", Journal of Political Economy 70(5)part 2, supplement.
- _____, 1975, "The Ability to Deal with Disequilibria", Journal of Economic Literature 13:827-846.
- Solow, R.M., 1957, "Technical Change and the Aggregate Production Function." Review of Economics and Statistics 39(3):312-320.
- Srinivasan, T.N., 1981, "Malnutrition: Some Measurement and Policy Issues", Journal of Development Economics 8:3-19.
- Stewart, A.L., and J.E. Ware, Jr. (eds.), 1992, Measuring Functioning and Well Being. Durham, NC: Duke University Press.
- Stiglitz, J., 1976, "The Efficiency Wage Hypothesis, Surplus Labor and the Distribution of Income in LDCs", Oxford Economic Papers 28:185-207.
- Strauss, J., 1986, "Does Better Nutrition Raise Farm Productivity?" Journal of Political Economy 94(2):297-320 (April).
- _____, 1993, "The Impact of Improved Nutrition on Labor Productivity and Human Resource Development". In Political Economy of Food Consumption and Nutrition Improvements, ed. P. Pinstrip-Andersen. Baltimore, MD: The Johns Hopkins University Press.
- Strauss, J., P. Gertler, O. Rahman, and K. Fox, 1993, "Gender and Life-Cycle Differentials on Patterns and Determinants of Adult Health", Journal of Human Resources 28(4):791-837 (Fall).
- Sukhatme, P.V., and S. Margen, 1982, "Autoregulatory Homeostatic Nature of Energy Balance", American Journal of Clinical Nutrition 35:355-365.
- Thomas, D., and J. Strauss, 1992, "Health, Wealth and Wages of Men and Women in Urban Brazil", paper presented at Bellagio Italy conference on "Investments in Women", processed, Yale University.
- Thomas, D., J. Strauss, and J-H. Henriques, 1990, "Child Survival, Height for Age and Household Characteristics in Brazil", Journal of Development Economics 33:197-234 (October).
- United Nation, 1992, "Food Prices and Nutrition", SCN News, No. 8, Administrative Committee on Coordination - Subcommittee on Nutrition, Geneva.
- Vijverberg, W.P.M., 1993, "Educational Investments and Returns for Women and Men in Côte d'Ivoire", Journal of Human Resources 28(4):933-974.

- Waalder, Hans Th., 1984, "Height, Weight and Mortality: The Norwegian Experience", Acta Medica Scandinava 77:279-303. Suppl. No. 679, Stockholm.
- Ward, W.P., 1993, Birth Weight and Economic Growth: Women's Living Standards in the Industrializing West. Chicago: University of Chicago Press.
- Welch, F., 1970, "Education and Production", Journal of Political Economy 78(1):35-59.
- World Bank, 1993, World Development Report 1993. New York: Oxford University Press.
- Vaizey, J., 1961, The Economics of Education. London: Faber and Faber.