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Economics and Human Biology 1 (2003) 207–221

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ECONOMICS  
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HUMAN BIOLOGY

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# Human capital, schooling and health

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Received 14 February 2003; received in revised form 14 February 2003; accepted 14 February 2003

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## Abstract

A consensus has been forged in the last decade that recent periods of sustained growth in total factor productivity and reduced poverty are closely associated with improvements in a population's child nutrition, adult health, and schooling, particularly in low-income countries. Estimates of the productive returns from these three forms of human capital investment are nonetheless qualified by a number of limitations in our data and analytical methods. This paper reviews the problems that occupy researchers in this field and summarizes accumulating evidence of empirical regularities. Social experiments must be designed to assess how randomized policy interventions motivate families and individuals to invest in human capital, and then measure the changed wage opportunities of those who have been induced to make these investments. Statistical estimation of wage functions that seek to represent the relationship between wage rates and a variety of human capital stocks may yield biased estimates of private rates of return from these investments for a variety of reasons. The paper summarizes several of these problems and illustrates how data and statistical methods can be used to deal with some of them. The measures of labor productivity and the proxies specified for schooling and adult health are first discussed, and then the functional relationships between human capital and wages are described. Three types of estimation problem are discussed: (1) bias due to omitted variables, such as ability or frailty; (2) bias due to the measurement of an aggregation of multiple sources of human capital, e.g. genetic and socially reproducible variation, which may contribute to different gains in worker productivity; and (3) errors in measurement of the human capital stocks. Empirical examples and illustrative estimates are surveyed.

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*JEL classification:* J24; I12; I21

*Keywords:* Health; Productivity; Human capital; Schooling; Returns

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## 1. Introduction

Child and adult survival and schooling have increased rapidly in the second half of the 20th century. According to some measures, health and education in the low-income countries are

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catching up to the levels in the high-income countries (Schultz, 1993). Does convergence in these forms of human capital between the world's poorer and richer populations promise to narrow international differences in productivity and, if so, by how much? To answer such questions, the relationship between survival and schooling, on the one hand, and personal productivity, on the other hand, should be quantified in a variety of countries. Even then, difficulties remain in comparing the productive quality of schooling within and across countries, and in measuring health status as a human resource. The social return to human capital incorporate social subsidies in the production of the capital and benefits from the capital enjoyed by individuals other than the responsible family unit that is altruistic in valuing positively the enhanced productive capacities of other family members. Public investments in schooling and health should be guided by the distinct priorities implied by these social rates of return. An example where private and social returns might diverge would be the control of infectious diseases where external social benefits arise from reduced contagion.

At the level of the nation, recent periods of sustained growth in total factor productivity (i.e. growth in economic output that is not explained by increases in inputs of physical capital, land, or labor hours) are closely associated with improvements in a population's schooling, nutrition, and health (Schultz, 1961; Kuznets, 1966; Denison, 1967; Barro and Sala-i-Martin, 1995). At the level of the individual, statistical studies of random sample surveys and censuses reveal significant positive partial correlations between wages, earnings or income and a worker's schooling, nutrition, and health, stratified by sex and controlling for age or post-schooling experience (Strauss and Thomas, 1995). Macro- and micro-data organized according to these parallel conceptual frameworks strongly suggest that these relationships have a causal basis. Nonetheless, estimates of the magnitude of productive returns to investments in education and health are subject to considerable uncertainty and are qualified by limitations in data and analytical methods. This paper reviews the problems that occupy researchers in this field and draws attention to the accumulating evidence of empirical regularities. Establishing the magnitude of these returns to schooling and health is a first step to concluding how much the convergence in these forms of human capital across and within countries can contribute to narrowing inter- and intra-country inequalities.

Investment of time and resources in the formation of human capital increases the productive potential of workers (and increases as well consumer benefits and leisure) that are realized over a lifetime. Measuring the internal rate of returns to human capital calls for an inter-temporal analysis of costs and benefits of birth cohorts over their lifetimes. Most data pertain to cross-sections, however, that describe inputs and outcomes in one period of time across different individuals grouped by age. Demographers recognize the limitations of such synthetic constructs from cross-sectional data designed to represent cohort experiences over time. Assumptions are necessary to translate cross-sectional evidence into human capital lifetime investment returns (Mincer, 1974). Whether these working assumptions are an innocuous simplification or a serious limitation on our knowledge remains to be determined. Growing examination of repeated cross-sections allow statistical samples of cohorts to be followed as they grow older and long prospective panels describe individuals over time, subject to attrition bias. Both of these approaches may reduce our reliance on cross-sectional data to infer within cohorts the determinants and consequences of human capital. Sample surveys that collect information on the life histories of respondents may

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