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ЭКОНОМИКА ОБРАЗОВАНИЯ И ЗДРАВООХРАНЕНИЯ

Учебно-методическое пособие

по дисциплине « Экономика образования и здравоохранения »

Рекомендовано методической комиссией Института экономики и предпринимательства ННГУ для иностранных студентов, обучающихся по направлению подготовки 38.03.01 «Экономика» (бакалавриат) на английском языке

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В настоящем пособии изложены учебно-методические материалы по курсу “Экономика образования и здравоохранения” для иностранных студентов, обучающихся в ННГУ по направлению подготовки 38.03.01 «Экономика» (бакалавриат) на английском языке

Учебно-методическое пособие предназначено для учащихся факультета иностранных студентов, обучающихся по направлению подготовки 38.03.01 «Экономика» и может быть использовано школьниками старших классов, занимающихся научной работой в рамках НОУ.

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1. Introduction to Human Capital Theory

Probably the most important and most original development in economics during the past thirty years has been the idea that the concept of physical capital, as embodied in tools, machines and other productive equipment, can be extended to include human capital as well.

Unsurprisingly, many have reacted critically to the analogy drawn between machines and people, but the rapidly expanding literature has demonstrated the utility of the concept of human capital in two main areas. Firstly, human capital theory has underpinned a wide range of micro-economic studies seeking to explain individual and family decisions relating to education and other matters. For example, to what extent can decisions to undertake tertiary training be explained in terms of a supposed trade-off between lower incomes during the period of study, against higher future earnings once qualifications have been gained?

Secondly, human capital theory plays an increasingly important role in macro-economic studies analysing the causes of economic growth. To take one example, to what extent are the higher relative incomes of advanced industrial countries to be explained with reference to the acquired skills and competencies of their workforces?

Any analogy has its limits and it is important to acknowledge that while educational decisions do indeed impact significantly on the future earnings of students, the proper framework for evaluating educational decisions includes a wider range of considerations. Human capital theory has proved very fruitful but that does not imply that everything can be subsumed within it.

Definitions

Although there is an underlying unity, different writers define human capital in different ways and it is useful to consider a range of uses.

“Human capital. The skills, capacities and abilities possessed by an individual which permit him to earn INCOME.” (*The Penguin Dictionary of Economics*, 1984.)

“A broader view of wealth may indeed be taken for some purposes; … Thus, for instance the carpenter’s skill is as direct a means of enabling him to satisfy other people’s material wants, and therefore indirectly his own, as are the tools in his workbasket; and perhaps it may be convenient to have a term which will include it as part of wealth in a broader sense. Pursuing the lines indicated by Adam Smith, and followed by most continental economists we may define *personal wealth* so as to include all those energies, faculties, and habits which directly contribute to making people industrially efficient”. (Marshall, 1890, 57).

“Since long-run labor supply adjustments involve *current* costs, but *future* returns, they are *investments*, and the theory of long-run labor supply is therefore the theory of decisions to invest in **human capital.** Investments in human beings may take many forms, but it is useful to divide our discussion between those that take place on the job, as part of market work activity, and those acquired elsewhere. Job-associated investment in human capital consists mainly of formal and informal training programmes within firms. Alternatively, schooling, health care, and job search primarily involve activities in which one’s employer has much less direct involvement.” (Fleisher and Kniesner, 1984, 287).

“The definition of human capital used in this report is “The knowledge, skills, competencies and attributes embodied in individuals that facilitate the creation of personal, social and economic well-being” (Organisation for Economic Co-operation and Development (OECD), 2001, 18).

“The concept of human capital is comprehensively defined, and thus embraces “

a) the capacity of interpreting flows of sensory data and structured information required for purposive individual actions and inter-personal transactions among economic agents;
b) the capacity for providing a variety of physical labour service-inputs in ordinary production processes;
c) the cognitive basis of entrepreneurial market activities;
d) the key resource utilised for managing market and non-market production, as well as household consumption activities;
e) the creative agency in the generation of new knowledge underlying technological and organisational innovations." (David, 2001, 5)

Human capital is embodied in the individual

As usually defined, human capital is embodied in the individual, and the national stock of human capital can therefore be thought of as the sum total of the human capital of all those normally resident in its territory.

However the creation of knowledge is clearly a social activity so it is necessary to ask whether a simple aggregation of the human capital possessed by individuals is sufficient. The answer to this is a qualified, yes, provided one accepts the boundaries commonly drawn between human capital, knowledge and social capital. Two quotations will be helpful. The first quotation is on knowledge:

"The main measurement problem that we wish to emphasize here is the problem of measuring the output from innovative activity… That is, knowledge, like physical capital, is produced at an opportunity cost of current consumption, and like physical capital it will allow society to produce more in the future than otherwise, given the same inputs of all other factors of production. So when resources are diverted from producing consumption goods into producing knowledge, there is no more reason to think that the overall level of output or income has fallen than when they are diverted to producing physical capital.

Nevertheless, under standard national income accounting procedures, measured GDP will fall in the first case and not in the second."

The development of individual human capital is therefore intertwined with the social and collective development of knowledge. Human capital and knowledge can be thought of as joint-products, but conceptually, they are distinct and in the ideal would be separately measured.

The second quotation is from the previously cited OECD:

"Human and social capital are closely related to the way in which institutions and political and social arrangements impact on society. However the various elements need to be carefully distinguished, since:

"Human capital resides in individuals.

"Social capital resides in social relations.

"Political, institutional and legal arrangements describe the rules and institutions in which human and social capital work".

Estimating human capital with reference to future earnings

The value of an individual's human capital is dependent on the future stream of benefits that the individual can realise through the use of that capital. Because the future stream of benefits cannot be known with certainty, the value can only be estimated with respect to the expected future stream of benefits. Valuation therefore requires risk and uncertainty to be taken into account.

Furthermore, aggregation of earnings over a stream of time requires knowledge of the individual's time preference. Individual time preference can be thought of as equivalent, in an inflation free and certain world, to a rate of return that would make a person indifferent between spending $1,000 now and spending $1,000, compounded by that rate, at some future point.

In the ideal, the stream of future benefits that needs to be aggregated is the expected stream of utility that will be realised from the investment in human capital.

Estimating human capital with reference to a stream of past investments

To this point our comments have focused on human capital as a measure of the expected future stream of benefits to be derived by the individual from their investment in that capital. In principle, we can also look upon the stock of capital as being derived from a whole sequence of past investment decisions in the acquisition of human capital. An individual's current stock of capabilities and knowledge is the summation of a lifelong stream of events.

Decisions affecting the size and structure of an individual's human capital are made by a great variety of actors, including most notably, themselves, their parents, their employers, the government (through the funding *inter alia* of public education and health systems) and a whole sequence of instructors and mentors.

In the ideal, we would be able to cost and sum each of these flows of inputs. In practice this would be a Herculean task and recourse is had to more summary measures. Schematically one could view an individual's human capital formation as the sum of three streams of costs: those incurred by the individual and the individual's family; those incurred by the individual's employer; and those incurred by central and local government. The present value of these streams of costs would need to be estimated by compounding past costs at some appropriate rate.

In addition to summing individual, family, employer, and government investments, any cost based estimate of the value of human capital would need to allow for the fact that human skills are subject to depreciation. Unlike physical capital, many human skills continue to improve with use, but some skills become obsolescent and human capacities are, of course, subject to the attrition of age and exposed to accidental damage and loss.

Estimating human capital with reference to individual characteristics

The previously cited OECD definition of human capital raises the possibility that an individual's human capital could be described by comprehensively enumerating that individual's knowledge, skills, competencies and attributes.

The obvious difficulty with this approach is that the various characteristics do not have a common unit of measurement and are therefore not easily aggregated, although statistical techniques such as 'principal components' can sometimes get around this problem. We may be able to devise tests that would give measures of people's numerical, verbal, written and social abilities, and of their knowledge base within particular disciplines (sufficiently accurate to approximately rank persons within each category) but this leaves us short of an overall measure. This could be a serious problem if we are interested in making comparisons of human capital between individuals and groups at a point in time or over time.

A recent article by Samuel Bowles and others provides a useful starting point:

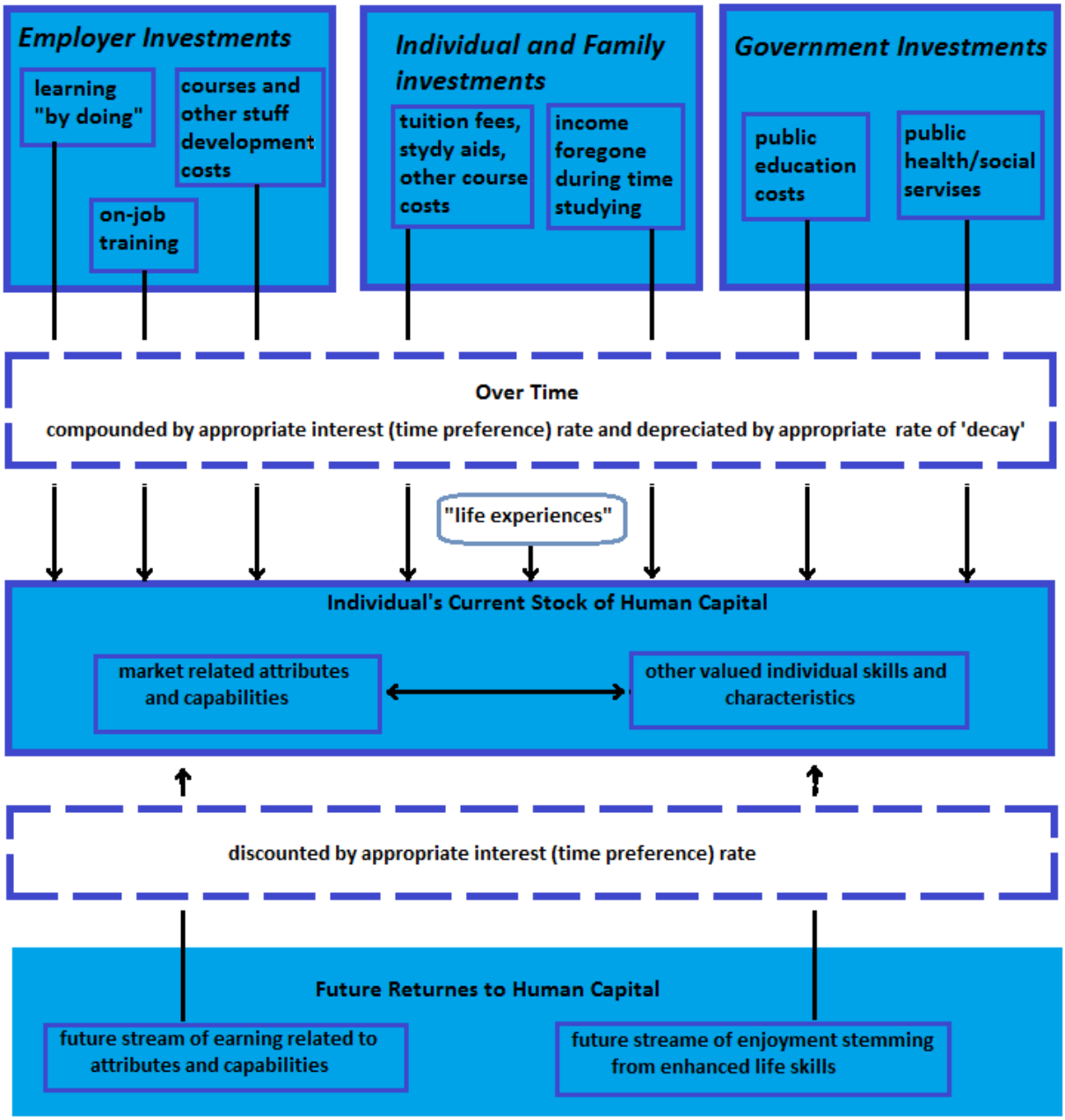
"Enhancing individuals' capacity to succeed in the labour market is a major objective of both families and policy makers, one which in recent years has assumed special urgency with respect to those with low earnings. According to the canonical model, earnings are determined by human capital, which consists of capacities to contribute to production, generically called skills. Individuals possess a vector of these capabilities, c, and sell these on the labour market at hourly prices p, with hourly earnings $w=pc$." (Bowles et al, 2002).

In this formulation is the idea that it is possible, at least in principle, to attach a price, p, to each of the relevant individual capabilities.

A Comparison of the Three Measures

Diagram 1 (on the following page) sketches human capital as a stream of past investments. Human capital can therefore be defined alternatively, as the present value of an expected future stream of returns, as the accumulated sum of a past stream of investment expenditures, or as the sum, measured at a point in time, of the individuals capabilities expressed in some common unit of account. In a perfectly competitive world with perfect information these alternative measures would coincide. In practice of course, the market for human capital, like that for any other capital asset, is characterised by many departures from perfect competition, by uncertainty, imperfect information and continuing change.

Human Capital: As A Stream Of Past Investment



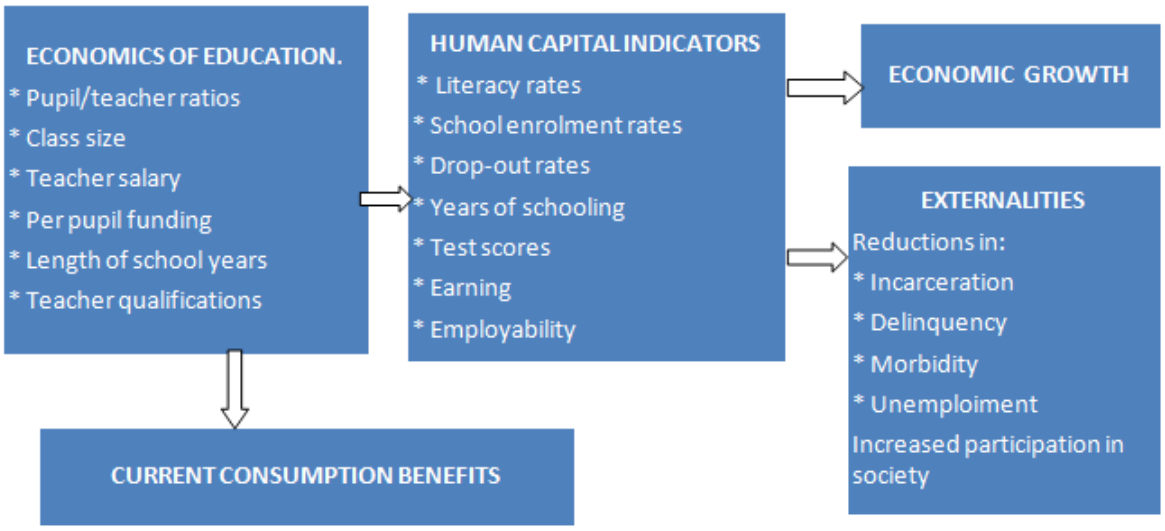
Consequently, we would expect to find in practice, many differences between the accumulated costs of human investment embodied in particular individuals, and realistic assessments of the present value of the income streams likely to accrue to persons with those acquired characteristics.

2. Role of Health and Education in Economics

The previous lecture ended with the observation that we do not see the absence of an all-encompassing widely accepted definition of human capital as an obstacle to its measurement. An implication of this is that various measures are likely to evolve. Inevitably there will be differences in quality. However, while we should always strive to improve the quality of the methodology of the measuring process, the interpretation of the quality of the resulting output will also depend on the uses to which a particular measure is to be put. Hence the opinion above – no single measure of human capital is likely to be suited to all research questions. In this lecture we will discuss key issues to which measures of human capital have been applied, and then mention some other areas where a small amount of literature exists. We also speculate on where else human capital measures may be relevant. The main areas are:

1. economics of education
2. economics of health
3. employability
4. economic growth.

Clearly these areas are not independent of each other. If we interpret economic growth in a wide sense as the ever-increasing ability of the economy to improve the economic, social and environmental welfare of its citizens, then the other issues on the list are really subsets of the last (although again this does not imply the same measure of human capital will apply to both). The inter-relationships may be represented as follows:



Education in economics

Education economics or the economics of education is the study of economic issues relating to education, including the demand for education and the financing and provision of education. From early works on the relationship between schooling and labor market outcomes for individuals, the field of the economics of education has grown rapidly to cover virtually all areas with linkages to education.

Education economists analyze both what determines or creates education and what impact education has on individuals and the societies and economies in which they live. Historically at the World Bank a great deal of emphasis has been placed on determining outcomes to educational investment and the creation of human capital. The primary mission of the economics of education group is to identify opportunities for improved efficiency, equity, and quality of education and promote effective education reform processes; to help improve, among both World Bank staff and clients, knowledge of what drives education outcomes and results; to better understanding how to strengthen the links of education systems with the labor market; and to build and support a network of education economists and build bridges to all those who are interested in their work.

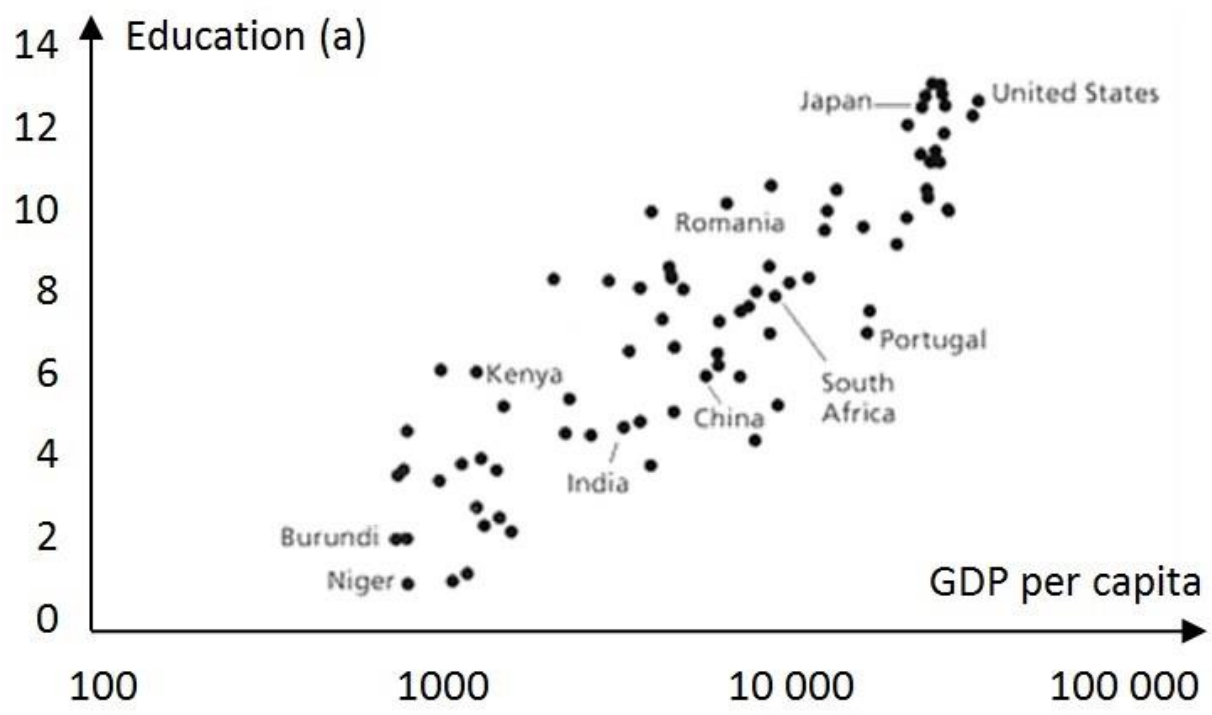
Education as an investment

Economics distinguishes in addition to physical capital another form of capital that is no less critical as a means of production – human capital. With investments in human capital, such as education, three major economic effects can be expected:

- increased expenses as the accumulation of human capital requires investments just as physical capital does,
- increased productivity as people gain characteristics that enable them to produce more output and hence
- return on investment in the form of higher incomes.

Investment costs

Investments in human capital entail an investment cost, just as any investment does. Typically in European countries most education expenditure takes the form of government consumption, although some costs are also borne by individuals. These investments can be rather costly. EU governments spent between 3% and 8% of GDP on education in 2005, the average being 5%. However, measuring the spending this way alone greatly underestimates the costs because a more subtle form of costs is completely overlooked: the opportunity cost of forgone wages as students cannot work while they study. It has been estimated that the total costs, including opportunity costs, of education are as much as double the direct costs. Including opportunity costs investments in education can be estimated to have been around 10% of GDP in the EU countries in 2005. In comparison investments in physical capital were 20% of GDP. Thus the two are of similar magnitude.

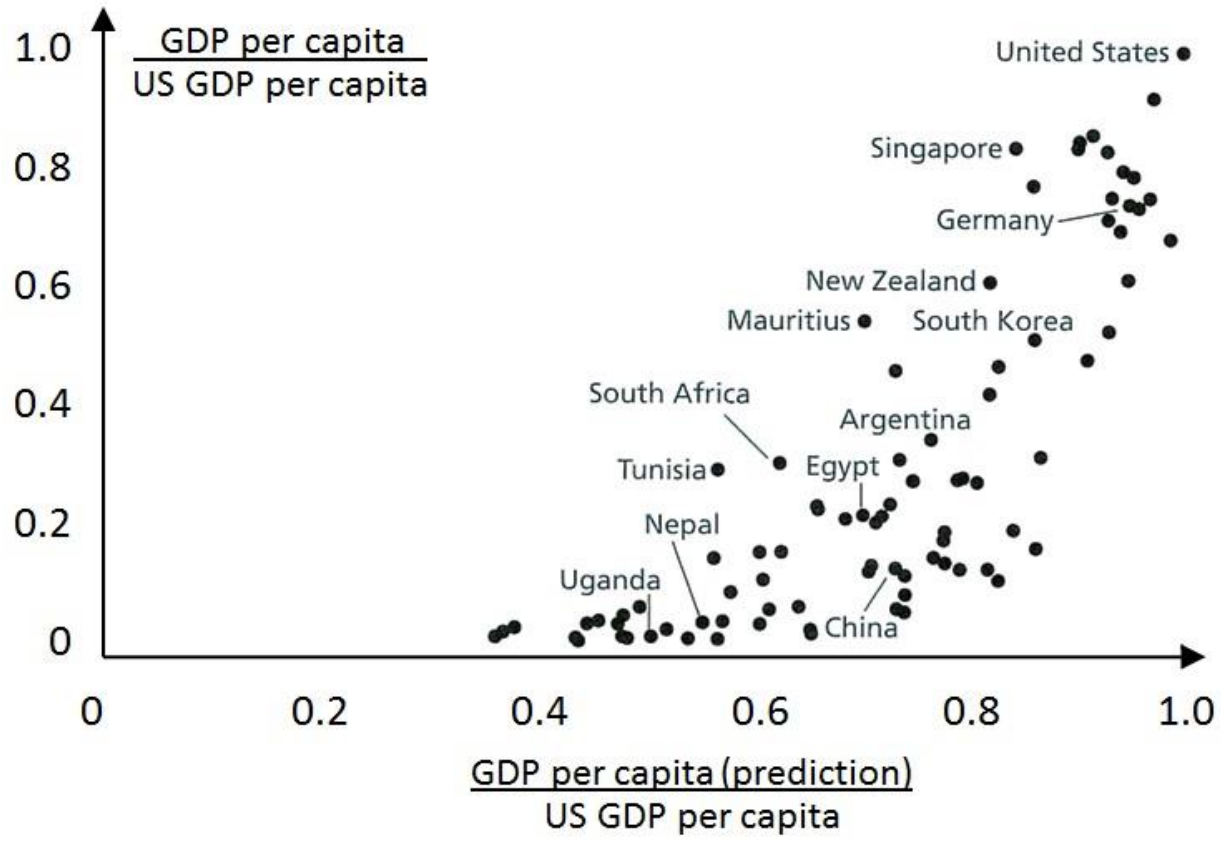


Average years of schooling versus GDP per capita (USD 2005).

Returns on investment

Human capital in the form of education shares many characteristics with physical capital. Both require an investment to create and, once created, both have economic value. Physical capital earns a return because people are willing to pay to use a piece of physical capital in work as it allows them to produce more output. To measure the productive value of physical capital, we can simply measure how much of a return it commands in the market. In the case of human capital calculating returns is more complicated – after all, we cannot separate education from the person to see how much it rents for. To get around this problem the returns to human capital are generally inferred from differences in wages among people with different levels of education. Hall and Jones have calculated from international data that on average that the returns on education are 13.4% per year for first four years of schooling (grades 1–4), 10.1% per year for the next four years (grades 5–8) and 6.8% for each year beyond eight years. Thus someone with

12 years of schooling can be expected to earn, on average, 1.1344 × 1.1014 × 1.0684 = 3.161 times as much as someone with no schooling at all.

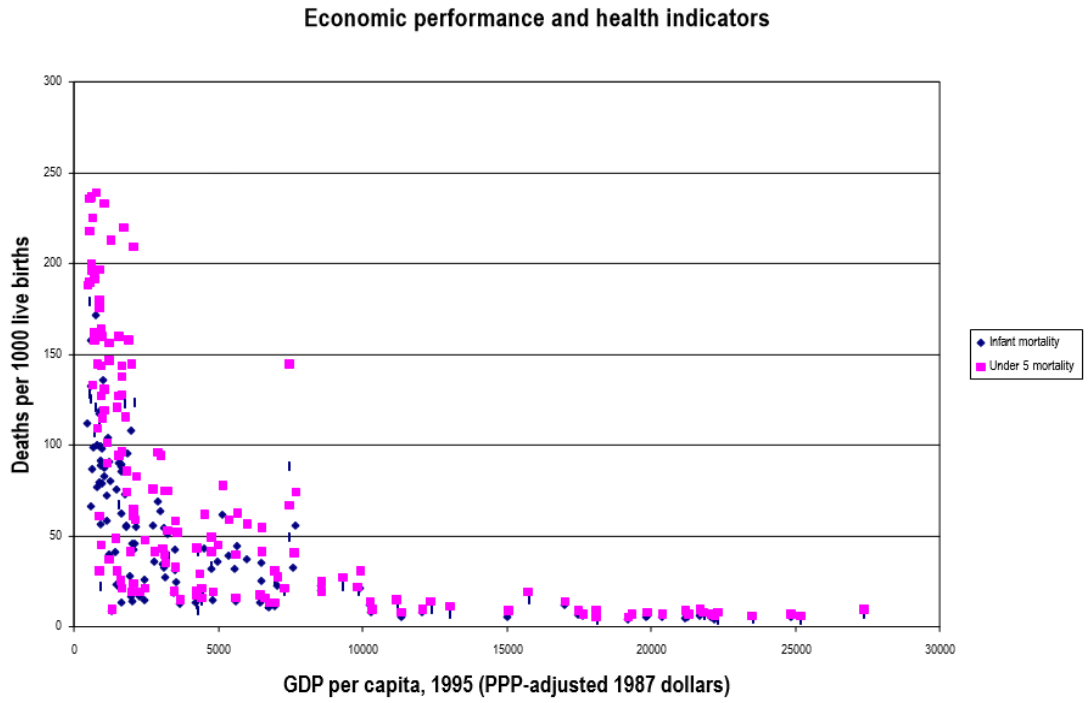


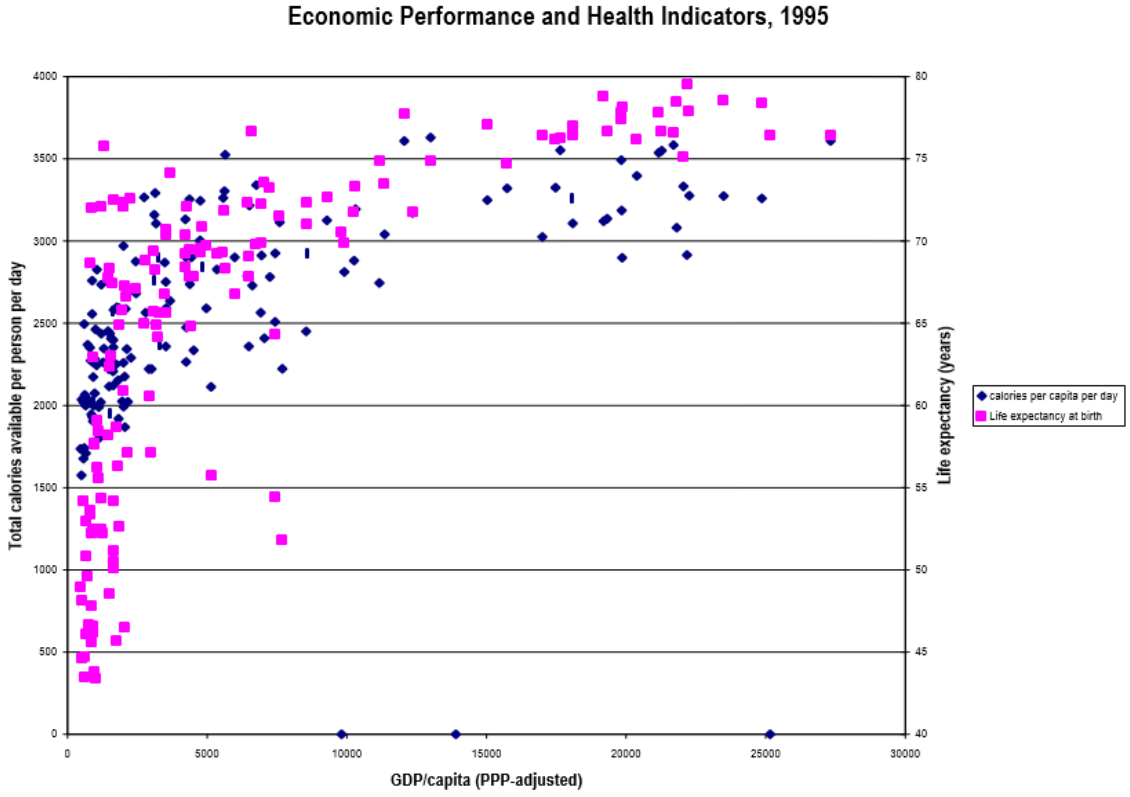
Predicted versus actual GDP per worker. The figure shows how much one would expect each country's GDP to be higher based on the data on average years of schooling

Health in economics

Human health is determined by a number of different factors, but a large number of them are economic. Although we tend to think of changes in human health--usually improvements--as being the result of changes in medical knowledge and technology, the role of medicine in advancing human health is actually very small. A number of large studies by WHO, the RAND Corporation, and many epidemiological studies, have consistently found that the differences in health between individuals--that is, the answer to the question "Why are some people healthier than others?"--is determined primarily by four things: (1) post-secondary education, (2) personal income and wealth, (3) health behavior (following a healthy lifestyle, etc.), and (4) genetic inheritance. These four alone account for 85-90% of the variations in health status. The remaining 10% is shared by a variety of other influences, including the type of job a person holds, what type of neighborhood they live, and health services. As we get healthier and live longer due to our growing wealth, we tend to develop higher expectations about the quality of life and the kinds of services that should be available to us. We become more concerned about non-fatal illnesses that reduce the quality of life, such as depression and obesity, and less concerned about health risks faced by the world's poor, such as malnutrition, dehydration, and infections

Poverty and ill health occur together. According to medical anthropologist Paul Farmer, “studies compiled from the twelfth century onward show that the poor, quite simply, are sicker than the non-poor and that this is true in both rich and poor countries” (Farmer 1999). It is also true across countries. Figures 1 and 2 show the remarkable cross country correlation between output per capita (adjusted for purchasing power parity) and some health indicators in 1995.





Scholars have examined poverty as cause and consequence of poor health. Poverty is detrimental to health because it restricts access to medical care and healthy living conditions. For example, the risk of tuberculosis infection increases

in crowded and poorly ventilated environments like tenements or prisons, and risk of infection with malaria is higher in poorly constructed homes which are less effective at preventing the entry of vector mosquitoes (Farmer 1999; Gunawardena and others. 1998). Furthermore, since both prevention and effective treatment of adverse health events cost money, the poor are not only likely to suffer from ill health more often, but also to have more severe sequelae. Poverty also restricts access to new tools; priority setting in molecular and clinical research and development favors the needs of wealthier populations (Kremer 1999).

Health, however, is also determined by a host of factors unrelated to economic well-being. Geographical, environmental, and biological factors contribute to the epidemiology of many diseases. For example, tropical diseases like malaria are particularly pernicious in certain contexts due to climate, topography, and evolutionary history, and not simply due to poverty (Hamoudi and Sachs 1999).

The robustness of the correlation between health and economic indicators, therefore, suggests that health is also a determinant of economic success. Researchers have been studying this relationship for over 30 years (Mushkin 1962). In recent years, this analysis has received increasing attention (Frank and Mustard 1994, Schultz).

Health impacts directly on household income and wealth, labor productivity, labor force participation, savings and investment rates, demographic factors, and other human capital factors. The fact that health impacts and is impacted by economic performance raises important policy issues; for example, while some would argue that improved health is among the many positive results of successful economic development strategies, other evidence suggests that such strategies must incorporate effective health interventions (Ramirez, Ranis, and Stewart 1997; Gallup, Sachs, and Mellinger 1998). Human well-being is unarguably an end in itself, but a better understanding of the complex relationships between health and economic growth is important for proper priority setting and policy implementation. This paper will explore the body of evidence that health is a

determinant of economic performance, and will identify some of the important unanswered questions.

Treatment cost and lost labor productivity

The most proximate costs of illness to individuals and their households include the costs of treatment and lost work time. For example, one cost of illness study finds that treatment of a single episode of malaria in Tigray Ethiopia, costs the affected household $0.80 to $1.60, and results in about 12-26 days of work lost. Therefore, the annual private cost of malaria in this region amounts to an average of 5-8% of household income. Mead Over and others estimate the average total cost of treatment and foregone productivity in Tanzania resulting from a single HIV infection to be about $2462-$5316 in 1985 dollars, or about 8.5%-18.3% of per capita income (Over 1992,). Similarly, a study of multiple sclerosis in the United States suggests an annual cost in terms of lost earnings and treatment expenses to each affected household of $5336 per year in 1976 dollars; aggregated, these costs amounted to about 0.04% of total US GDP in 1976 (Inman Vol. 69:651-60). In most countries, at least some of the costs of health care are subsidized by the government; therefore, treatment and prevention costs are also borne by the public sector.

Furthermore, while many traditional cost of illness studies have sought to quantify the costs of lost work time due to illness, workers who do not deliberately change their work habits in response to illness can also be expected perform sub-optimally during the term of their illness.

T.P. Schultz and Aysit Tansel (Schultz and Tansel 1996, Vol. 53:251-86) suggest a methodology for quantitative assessment of this impact. They employ a wage function which relates productivity to health status, education, the square of post-schooling experience, and parental experience. Using data from Côte d'Ivoire and Ghana in this function, they find that on a "disabled day" a worker in Côte d'Ivoire can be expected to be over 10 percent less productive, and a worker in

Ghana can be expected to be 11.7 percent less productive than if he or she were in good health.

Another cost of ill-health is lost time associated with higher levels of child mortality.

When a larger proportion of children die, the net cost of raising each child which does survive increases. David Reher (Reher Vol. 49:519-36) has speculated on this cost in terms of lost parental time. Using data on structures and levels of infant and child mortality in historical contexts as well as modern developing countries, and speculating based on ethnographic data on the proportion of maternal and paternal time devoted exclusively to child-rearing, Reher finds that under conditions of high child mortality, each child who dies before the fifth birthday represents an average loss of 1300-1800 hours of parental work time, depending on the specific structure of mortality patterns. In order to ensure three children who survive until the age of five, therefore, parents would have to "waste" 800-3000 hours on children who would not survive.

In addition to infectious and chronic illness, nutrition is an important health factor which has long-term human resource impacts. John Strauss and Duncan Thomas's (Strauss and Thomas 1998) review evidence that height and body mass index (as an indicator of strength) are both determined largely by nutritional factors. Using data from Brazil and the United States, they find that these variables are positively correlated with wages after controlling for differential ages and education levels.

In addition, poor nutrition may have long term costs to individuals by impairing cognitive development. Infants who receive micronutrient supplementation have been observed to develop better motor skills than peers who did not receive supplementation; motor skill development is widely employed as an accurate predictor of overall cognitive development (Hauser 1998, Sigman and Whaley 1998). Development of stature and strength is extremely sensitive to nutritional inputs and overall health during early childhood and adolescence;

improved conditions later in life will not fully reverse the impacts of malnutrition and illness during this period (Martorell 1998).

Demographic impacts

Health may also affect the economic performance of communities through its impacts on demographic factors. Shorter life expectancies, for example, inhibit investment in education and other forms of human capital, since there is greater risk that each individual will not survive long enough to benefit from the investment In addition, a larger proportion of the population which is dependent—consuming more resources than it produces— has a detrimental effect on rates of savings and capital investment, and hence on subsequent growth (Kelley and Schmidt 1996). Widespread incidence of disability, injury, and illness inflate these dependency ratios. Childhood diseases like malaria prevent a large proportion of birth cohorts from maturing to economically productive ages. AIDS is a primarily adult disease with important demographic impacts. By decimating the urban professional class in many African countries (about a quarter of 15-49 year olds in Zimbabwe, Zambia, South Africa, and Botswana were living with HIV at the end of 1998) and producing millions of orphans each year, AIDS directly reduces the size of the economically active population (UNAIDS 1999,; Gregson, Garnett, and Anderson 1999).

Furthermore, fertility decisions may be made in part by a need to ensure a given number of survivors, or in response to childhood mortality experience. T.P. Schultz (Schultz 1997) demonstrates a statistically significant inflating effect of child mortality on total fertility.

Therefore, it is possible that where childhood mortality rates are very high, countries may become caught in a demographic trap, with high fertility rates leading to greater demand for household and community resources, large proportions of which are “wasted” on children who do not survive to economically productive age.

The vicious cycle of adverse health events

Present ill health often begets future ill health by increasing the likelihood of apparently unrelated debilitation in the future. The most dramatic example is the role played by the HIV pandemic in the spread of tuberculosis. In addition, research suggests that protein deficiency in mothers during pregnancy may result in lower birth weights, and increase the offspring's long-term risk of cardiovascular disease (Godfrey and others. 1996, Hoet and Hanson 1999,). Childhood health and nutrition also appear to play a very important role in determining the extent and severity of chronic conditions later in life (Fogel 1992). Many infectious illnesses, including malaria and tuberculosis, require complex cell-mediated immune responses; poor overall health and nutrition reduce the effectiveness of these responses, increasing the likelihood that infection with these diseases will be more severe, resulting in long-term disability or death (Farmer 1999).

Empirical evidence of the long term impact of health on economic performance

Health and the industrial revolution

The past several decades have brought unprecedented improvements in life expectancy worldwide, although these improvements have not been uniformly distributed. Economic historians have begun to consider the importance of trends in health in determining patterns of economic growth. Robert Fogel posits a "technophysio" evolutionary process, which is similar to genetic evolution in that it involves biological changes over time, but distinct in that it is faster, less stable, more directly anthropogenic, and extremely recent. The primary outcome of this process over the course of the past 300 years (beginning with the onset of the second agricultural revolution) has been extremely rapid population growth and longer life expectancy, driven primarily by improvements in nutrition. As a result, Western Europe over this period has seen rapid increases in both labor force participation rates and the average number of calories available for work,

increasing productivity by about 0.3 percentage points per year. This trend, according to Fogel, accounts for about half of Britain's economic growth over the past two centuries. Modern developing economies, just as pre-industrial Europe, have low rates of labor force productivity and reduced levels of productivity per worker due to widespread stunting and malnutrition.

Wealth, geography, and other health determinants

The role of geography and other factors in predicting health

While income is an important predictor of overall health and well-being, many geographical and demographic factors also play an important role. Here, we explain life expectancy at birth and under 5 survival rates as functions of an array of economic, infrastructural, geographic, and other variables. Under 5 survival is itself a major predictor of life expectancy at birth, since the first five years of life have historically been by far the most precarious before old age. (However, in the next decades, increasing proportions of 15-49 year olds worldwide will succumb to the AIDS pandemic; this will no doubt affect the relative importance of child mortality in predicting life expectancy). Therefore, the models which explain these two variables are likely to be very similar.

In addition to income, factors which may be expected to account for under 5 survival on a national level include population density, the competence of primary caregivers, the prevalence of certain important childhood diseases, nutritional factors, and other geographic factors. Sparser populations are more difficult for health services to reach; increasing population density, therefore, would be expected to improve a child's chances of surviving to the fifth birthday. Ethnographic studies indicate almost universally that at the household level, women provide most of the direct care for children; many child survival programs, therefore, have sought to improve women's education (Thomas, Strauss, and Henriques). Female literacy rates function as an indicator of women's accessibility to these outreach efforts, as well as their overall ability to remain informed about issues vital to their children's survival; increasing literacy rates would be expected

to improve childhood survival. Other devastating infectious diseases, including pneumococcal pneumonia, respiratory disease, diarrheal diseases, and meningitis have a powerfully negative impact on child survival; cross country data on incidence rates of these diseases, however, is sorely lacking, and therefore cannot be included in this analysis.

Table 2 reports under 5 survival rates (survivors per 1000 live births) as a function of these variables.

Survivors to age 5 per 1000 live births, 1995	1	2	3	4
Log PPP GDP per capita, 1995	102.036 (3.40)**	108.175 (3.60)**	133.697 (4.21)**	135.324 (4.24)**
Log PPP GDP per capita squared, 1995	-5.096 (2.88)**	-5.694 (3.15)**	-7.051 (3.74)**	-7.073 (3.73)**
Log population density, 1995	3.157 (1.99)*	2.539 (1.62)	3.673 (2.25)*	4.478 (2.89)**
Adult literacy (female) 1995	1.342 (5.19)**	1.330 (5.28)**	1.184 (4.61)**	0.915 (8.87)**
Adult literacy (male) 1995	-.592 (1.61)	-.631 (1.77)	-.443 (1.23)	
DPT coverage, 1994-95	30.925 (2.18)*	27.354 (1.93)	24.992 (1.79)	19.867 (1.44)
Falciparum malaria risk, 1994	-36.026 (4.73)**	-34.624 (4.28)**	-32.504 (4.05)**	-33.103 (4.12)**
Log calorie supply/capita/day, 1995	-11.349 (0.63)		-56.022 (2.21)*	-66.459 (2.69)**
Log g protein available/person/day, 1995		16.048 (1.37)	42.336 (2.55)*	42.807 (2.61)*
Dummy: Island or archipelago	4.891 (0.73)	8.645 (1.28)	8.103 (1.22)	
Dummy: Central/Southern Africa	-24.546 (3.26)**	-21.616 (2.95)**	-24.721 (3.36)**	-28.000 (3.93)**
Constant	459.132 (2.70)**	300.846 (2.14)*	505.895 (3.04)**	559.456 (3.39)**
Number of observations	133	132	132	132
R-squared	0.90	0.90	0.90	0.90

Absolute value of t-statistics in parentheses
* significant at 5% level; ** significant at 1% level

Table 3 reports infant survival as a function of these variables.

Infants surviving per 1000 live births, 1995	1	2	3
Log PPP GDP per capita, 1995	60.932 (3.27)**	69.769 (3.77)**	83.325 (4.20)**
Log PPP GDP per capita squared, 1995	-2.980 (2.71)**	-3.634 (3.25)**	-4.359 (3.70)**
Log population density, 1995	1.731 (1.76)	1.693 (1.75)	2.299 (2.27)*
Female literacy rate, 1995	0.600 (9.34)**	0.581 (9.06)**	0.570 (8.92)**
DPT coverage, 1994-1995	18.509 (2.19)*	17.158 (2.05)*	16.973 (2.04)*
Falciparum malaria risk	-14.571 (3.14)**	-12.119 (2.46)*	-10.693 (2.16)*
Log calorie supply/capita/day, 1995	2.051 (0.18)		-27.805 (1.81)
Log g protein available/capita/day, 1995		15.628 (2.15)*	28.738 (2.81)**
Dummy: Island or archipelago	2.735 (0.66)	4.942 (1.21)	4.298 (1.06)
Dummy: Central or Southern Africa	-16.545 (3.69)**	-14.623 (3.32)**	-15.668 (3.56)**
Constant	582.962 (5.58)**	506.570 (5.83)**	606.414 (5.93)**
Number of observations	134	133	133
R-squared	0.89	0.90	0.90

Absolute value of t-statistics in parentheses
* significant at 5% level; ** significant at 1% level

Table 4 reports child survival in 1980 as a function of these variables.

Table 4

Survivors to age 5 per 1000 live births, 1980	1	2	3	4
Log GDP per capita, 1980	118.043 (3.07)**	89.825 (2.29)*	106.867 (2.84)**	15.920 (3.82)**
Log GDP per capita squared, 1980	-6.205 (2.66)**	-4.481 (1.89)	-5.372 (2.33)*	
Log population density, 1980	3.796 (2.64)**	3.875 (2.82)**	4.462 (3.22)**	4.132 (2.98)**
Female literacy rate, 1977-1985	0.587 (4.88)**	0.587 (4.97)**	0.631 (5.31)**	0.633 (5.39)**
Falciparum malaria risk	-26.035 (2.44)*	-26.482 (2.71)**	-20.418 (1.93)	-26.893 (2.71)**
Log Calorie supply/capita/day, 1980	25.272 (0.84)	1684.131 (1.81)		2417.093 (2.82)**
Log Calorie supply squared/capita/day, 1980		-105.974 (1.79)		-152.685 (2.79)**
Log g protein available/capita/day, 1980	-.822 (0.04)		439.274 (2.02)*	
Log g protein squared available/capita/day, 1980			-51.462 (1.97)	
Dummy: sub-Saharan Africa	-32.616 (3.70)**	-32.112 (3.81)**	-34.628 (4.03)**	-32.348 (3.78)**
Constant	161.985 (0.79)	-6215.691 (1.74)	-546.577 (1.23)	-8792.821 (2.62)*
Number of observations	92	92	92	92
R-squared	0.90	0.90	0.90	0.90

Absolute value of t-statistics in parentheses
* significant at 5% level; ** significant at 1% level

Table 5 reports log of life expectancy at birth as a function of these variables.

Log life expectancy at birth, 1995	1	2	3	4	5	*6*	*7*
Log income per capita, 1995	0.124 (1.27)	0.037 (3.80)**	0.038 (3.72)**	0.038 (3.87)**	0.036 (3.71)**	*0.015* *(1.87)*	*0.012* *(1.52)*
Log income per capita squared, 1995	-.005 (0.89)						
Log population density, 1995	0.012 (2.32)*	0.011 (2.44)*	0.011 (2.32)*	0.009 (1.91)	0.011 (2.31)*	*0.003* *(0.83)*	*0.004* *(1.32)*
Female literacy rate, 1995	0.002 (2.01)*	0.002 (5.44)**	0.002 (5.35)**	0.002 (5.62)**	0.002 (5.20)**	*0.001* *(1.81)*	*0.001* *(1.87)*
Male literacy rate, 1995	0.000 (0.07)						
DPT immunization rate, 1995	0.013 (0.31)						
Risk of falciparum malaria, 1994	-.117 (3.73)**	-.121 (4.21)**	-.117 (3.58)**	-.122 (4.25)**	-.121 (4.20)**	*-.079* *(3.45)***	*-.054* *(2.96)***
TB incidence per 1000 population, 1996	-.024 (2.23)*	-.022 (2.16)*	-.022 (1.98)	-.021 (2.03)*	-.023 (2.23)*	*-.009* *(1.15)*	*-.019* *(3.17)***
Log refugees per capita, 1996	-.859 (1.90)	-.897 (2.10)*	-.923 (2.08)*	-1.003 (2.32)*	-.887 (2.07)*	*-.478* *(1.43)*	
Log calorie supply/capita/day, 1995	3.567 (1.39)	4.381 (2.03)*	3.602 (1.19)	3.193 (1.38)	4.369 (2.02)*	*1.942* *(1.16)*	*2.643* *(1.62)*
Log calorie supply squared/capita/day, 1995	-.230 (1.40)	-.281 (2.05)*	-.232 (1.20)	-.207 (1.40)	-.280 (2.03)*	*-.125* *(1.17)*	*-.168* *(1.61)*
Dummy: sub-Saharan Africa	-.083 (3.27)**	-.088 (3.73)**	-.089 (3.47)**	-.082 (3.38)**	-.087 (3.64)**	*-.054* *(2.90)***	*-.057* *(3.84)***
Dummy: post-socialist transition	-.041 (2.15)*	-.037 (2.20)*	-.038 (2.16)*	-.038 (2.26)*	-.035 (2.01)*	*-.048* *(3.73)***	*-.048* *(3.83)***
Log g protein available/person/day			0.333 (0.51)				
Log g protein available squared/person/day			-.038 (0.48)				
Dummy: Central or Southern Africa				-.036 (1.35)			
Dummy: island or archipelago					0.013 (0.70)		
Survivors to age 5 (per 1000 live births)						*0.002* *(8.33)***	*0.001* *(8.61)***
Constant	-10.422 (1.05)	-13.272 (1.57)	-10.896 (1.00)	-8.551 (0.94)	-13.236 (1.56)	*-4.912* *(0.75)*	*-7.692* *(1.20)*
Number of observations	103	108	107	108	108	*107*	*133*
R-squared	0.92	0.93	0.93	0.93	0.93	*0.96*	*0.94*

Absolute value of t-statistics in parentheses
* significant at 5% level; ** significant at 1% level

Table 6 shows regressions of the change in infant mortality rates over two periods against economic, nutritional, and geographic variables.

Change in infant mortality rate (deaths per 1000 live births), period:	1980-1995	1970-1992
Infant mortality rate, beginning of period	-.461 (13.35)**	-.496 (16.13)**
Change in log GDP per capita over period	7.233 (2.15)*	-2.512 (0.65)
Change in daily calorie supply per capita over period	-13.993 (1.43)	-13.638 (1.44)
DPT vaccine coverage, beginning of period	-.269 (3.64)**	
Change in DPT vaccine coverage over period	-.247 (3.24)**	
Falciparum malaria index, beginning of period	10.287 (2.04)*	19.902 (4.08)**
Change in falciparum malaria index over period	2.175 (0.29)	27.064 (3.37)**
Sub-Saharan Africa (dummy)	9.661 (2.45)*	11.996 (2.78)**
Sierra Leone, Rwanda, and Zambia (dummy)	47.445 (7.19)**	52.191 (6.70)**
Constant	20.207 (2.93)**	-2.787 (0.94)
Number of observations	78	78
R-squared	0.82	0.84

Absolute value of t-statistics in parentheses

* significant at 5% level; ** significant at 1% level

3. Investment in and Returns to Education and Health. Parental Investment in Children

In the course of development, few processes are as intertwined with economic growth as human capital accumulation. Schooling makes workers more productive, speeds the development of new technologies, and better equips parents to raise skilled children, all of which promote economic growth. Growth, in turn, incentivizes investment in human capital. Causal links point in every direction, traversing phases of the lifecycle as well as generations.

The entangled role of human capital is not limited to aggregate income growth, however. Education exhibits complex dynamic relationships with several components of wellbeing, including health. For example, education affects health in adulthood; life expectancy affects educational investment in childhood; and the health and education of parents—particularly mothers—affect both outcomes in their children. Just as with income, these relationships are likely to be especially important in developing countries, where levels of both schooling and health are low but have risen rapidly over the past half-century (Becker et al. 2005, Barro and Lee 2011).

This lecture gives an overview of the current state of knowledge on the relationships linking health and education in developing countries. To emphasize the dynamic aspects of these relationships, the chapter will trace them out first within a generation, between childhood and adulthood, and then across generations, from parents to children. It will focus on reduced-form evidence of these effects rather than efforts to precisely pin down mechanisms, for two reasons. First, the existing literature—especially that on developing countries—has simply generated more evidence on these reduced-form relationships. Mechanisms have received some attention (see, e.g., Cutler and Lleras-Muney 2010), but the evidence comes primarily from wealthy countries, and even that evidence remains sparse.

Second, the reduced-form evidence on dynamic links casts in stark relief the potential joint role of education and health in accounting for the intergenerational persistence of disadvantage. That is to say, the children of unhealthy and uneducated parents grow up to be unhealthy and uneducated parents themselves. Others have proposed similar arguments about the intergenerational dynamics of the relationship between health and socioeconomic status, more broadly construed (Cutler et al. 2011, Currie and Vogl forthcoming). But the links between education and health, which typically lie at the crux of these arguments, can by themselves account for the dynamics. Given the current extent of inequalities in income, human capital, and health in developing countries, the links between education and health may prove important in shaping long-term trends in the levels and distributions of both variables.

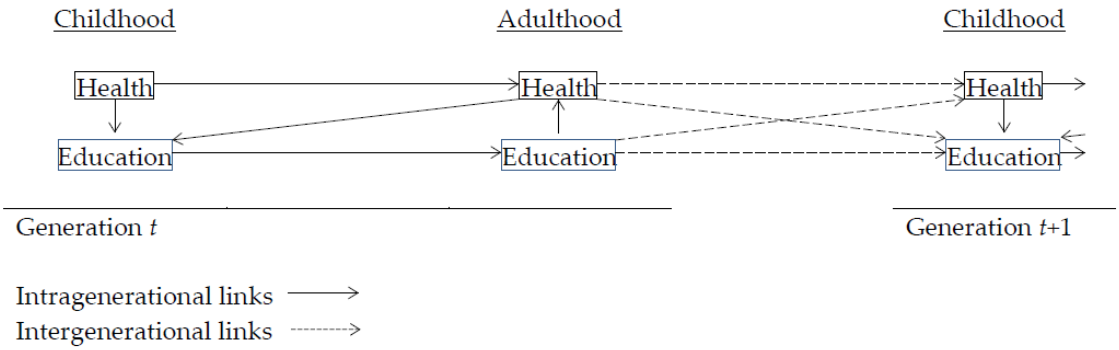
Associations between health and education are not new, but with such tangled causal pathways, these associations sometimes prove to be uninformative. The recent literature in economics has made its main contribution in causal inference. Analyses of natural experiments and prospective trials have shed new light on long-standing hypotheses. They have also improved our ability to interpret careful associational studies, which are in many cases more generalizable than experimental studies but less internally valid. These advances have been key to identifying both the direction and the timing of effects in the causal system linking education and health. With this better understanding of what matters and when, policymakers will be better equipped to identify opportunities for well-targeted policies.

Mapping the Relationship between Education and Health

With its numerous pathways, the causal system linking education and health may seem convoluted. However, one can represent it in a simple but informative diagram. Figure 1 traces out the links between education and health, first over the lifecycle and then across generations. Each arrow represents a causal link that has empirical support in the literature. The solid lines signify intragenerational links—

in other words, causal links that operate within a single person—while the dashed lines correspond to links that work across generations within a family.

Causal Links between Health and Education



The system lays out a roadmap for the rest of the chapter. In childhood, good health improves educational outcomes. Additionally, the expectation of good adult health increases schooling investments in childhood. Both health and education persist from childhood to adulthood, at which point education boosts health. But adults are also parents, so their circumstance in middle age spills over onto the next generation. Healthier mothers have healthier children and more educated children. Conversely, parental education promotes both the health and the education of the next generation. At this stage, the causal system repeats in the next generation. In the remainder of the paper, I will focus on the subset of the arrows in Figure 1 that connect health and education.

Intergenerational Links

1 Effects of Childhood Health on Educational Outcomes

1.1 Educational Outcomes in Childhood

We begin in childhood, where abundant evidence suggests that health affects school enrollment and academic achievement. Health enables children to travel to school, concentrate, and think clearly, all of which may improve educational

outcomes. Until recently, the evidence has primarily taken the form of cross-sectional associations between children's health and their educational outcomes. Behrman (1996) surveys several such studies from the 1980s and 1990s, which show strong positive relationships between anthropometric measures of child health—such as height—and schooling outcomes in a wide range of settings. But Behrman ultimately critiques these studies for inadequately addressing issues of causality and omitted variables.

A few analyses published at the same time or after Behrman's critique make some headway on these issues by focusing on within-family variation. Analyzing data from Ghana, Glewwe and Jacoby (1995) estimate models with family fixed effects, finding that shorter siblings start school later than their taller brothers and sisters. More recently, Bharadwaj et al. (2010) analyze twin pairs and sibling sets in Chile, showing that twins or siblings born at higher birth weight perform better on exams. Within-family comparisons of this type eliminate concerns about family-level omitted variables, although they leave some concern about how parents allocate scarce resources among children with observably different health.

Analyses of natural experiments in disease eradication, micronutrient supplementation, and health care provision have also made progress on causal identification.

2 Effect of Life Expectancy on Investment in Education

Unlike the effect of child health on education, which is rooted in the technology of skill formation, the effect of life expectancy on human capital investment is at its core about optimizing choices by households and individuals. According to the standard reasoning, if an individual expects a longer time horizon to reap the returns to human capital, then that individual will invest more. Analyses of macroeconomic data offer limited support for this hypothesis. Although adult mortality is negatively associated with secondary school enrollment, Lorentzen et al. (2008) find that the relationship is not robust to the inclusion of covariates. However, given the paucity of high-quality data on adult mortality in most

countries and the difficulty of assessing causality from cross-country associations, the macroeconomic patterns are suggestive.

Indeed, two microeconomic analyses have yielded convincing evidence that reductions in adult mortality risk increase human capital investment. First, Jayachandran and Lleras-Muney (2009) use the near-elimination of maternal mortality in Sri Lanka as a natural experiment in adult mortality. Parts of the country with higher baseline maternal mortality rates (and therefore larger subsequent declines in maternal mortality) saw larger increases in female educational attainment. Second, using data from Africa, Fortson (2011) shows that subnational regions that were hardest hit by the HIV/AIDS epidemic have also experienced the largest declines in education since the start of the epidemic.

3. Effect of Education on Health in Adulthood

A long-standing literature reports positive associations between education and health in adults in wealthy countries. As Cutler and Lleras-Muney (2008) note in their survey chapter on the topic, the mechanisms linking the two variables are not fully known. To the extent that the association reflects an effect of education on health, important mediators of this effect may include income, working conditions, health-related knowledge, cognitive ability, patience, attitudes towards risk, and cultural capital (especially in interactions with health providers). Similar associations are evident in data from developing countries, although studies are rarer.

Both natural experiments and prospective trials suggest that while education can affect health, such effects may depend on characteristics of the population and the material being taught in school. Several studies use compulsory schooling laws in the U.S. and Europe as instruments for education, with mixed but mildly positive results; some indicate positive effects on health and longevity, while others indicate no effect. Unfortunately, no similar studies exist on developing countries.

However, longitudinal follow-up of the recent spate of education-related randomized controlled trials in developing countries has begun to yield useful results on health behavior in young adulthood. In one study, Jensen and Lleras-Muney (2012) analyze a program in the Dominican Republic that gave teenage boys information about the return to schooling. The information led the boys to stay in school longer, to delay the onset of heavy drinking, and to reduce smoking at age 18. Across the Atlantic in Africa, Bandiera et al. (2012) estimate the effects of a program that sought to provide adolescent girls with both vocational training and information about risky health behaviors. HIV-related knowledge and condom use both increased. Less promising results have emerged from a Kenyan study on the medium-run impacts of a school subsidy program (Duflo et al. 2012). Although the program increased schooling for both boys and girls, follow-up data show at best weak impacts on sexual behavior and STD infection. Together, these studies suggest that keeping boys 'off the streets' and equipping girls with health information may be key to any effect of education on health in young adulthood.

Intergenerational Links

Effect of Parental Education on Child Health

In the context of poor countries, by far the most widely studied education-health association is that between maternal education and child health. Following Caldwell's (1979) canonical study of child mortality in Nigeria, a large literature has emerged on this topic. The literature bares widespread correlations between maternal education and child health, measured by illness, anthropometry, or death. Based on data on Brazilian children's heights, Thomas et al. (1991) argue that educated women's access to information explains much of the correlation. On the other hand, several studies question the extent to which the correlation reflects a causal effect running from maternal education to child health, as opposed to omitted variables. Desai and Alva (1998) show that the relationship is not always robust to the inclusion of socioeconomic and community-level covariates. Wolfe and Behrman (1987) and Strauss (1990) find that it weakens upon the inclusion of

a fixed effect for the mother's sib ship or for a multifamily household. However, one could interpret many of Desai and Alva's covariates as mediators of the relationship rather than confounders, and the inclusion of fixed effects exacerbates problems related to measurement error. The results of the revisionist literature are therefore inconclusive.

Analyses of natural experiments support a causal interpretation. The most compelling evidence comes from the United States, where Currie and Moretti (2003) demonstrate that local college openings improve birth weight and gestational age. But some results are also available for developing countries. Among Indonesian women, for example, exposure to a school construction program reduced mortality rates among their children (Duflo and Breierova 2004).

Parental Health Affects Child Education

Parental health also affects children's schooling outcomes. Two mechanisms stand out in the literature. The first is indirect: healthier mothers have healthier children, who in turn become better-educated adults (Almond and Currie 2011). For instance, in utero exposure to the 1918 influenza epidemic decreased educational attainment for the cohort born in 1919 in the United States (Almond 2006), Brazil (Nelson 2010), and Taiwan (Lin and Liu 2011). This effect implies that a mother's health is key to the skill development of her child.

The literature also highlights a second mechanism through which parental health affects child education: parental death. Good evidence comes from the HIV/AIDS epidemic, which has orphaned more than 15 million children (UNAIDS 2010), some 90 percent of them in Africa.

Across Africa, orphans have lower school enrollment rates than the biological children of their caretakers (Case et al. 2004). Furthermore, in South Africa (Case and Ardington 2006) and Kenya (Evans and Miguel 2007), the timing of parental death is associated with the timing of school dropout. The same is true in Indonesia (Gertler et al. 2004), where parental deaths typically have little to do to HIV/AIDS. One can thus view the African results as representing a more general effect of

losing a parent. Nevertheless, given the scope of the continent's orphan crisis, the results are most relevant there.

4. Measuring Health, Education and Economic Growth. Statistical Approach

Evaluation of Existing Statistical Series

If education and health enhances welfare by increasing human capital, governments and individuals will want to know how much to invest in education, and what forms this investment should take. Are such influences equally important at all stages of learning or long-life, and is investment in education or health subject to diminishing returns? Measures of human capital are pervasive in this research.

Taking the public investment perspective to answer this question it would need to have a measure of human capital which satisfies two conditions:

 It should be sufficiently well defined empirically such that the contribution of formal education or health is measurable.

 The output measure for formal education or health should be associated with (or at least point to) the sorts of resources and educational policies that are under the control of research purposes.

Recall that what is desired is a measure of the human capital generated by formal schooling or health condition, and a link between this and what we can broadly label reachable resources. We can re-express this as the need to consider:

 The effect of the *quantity* and *quality* of education or health on students' human capital outcomes – future incomes, for example.

 The effect of measurable inputs on the *quantity* and *quality* of education or health.

Below we examine education.

Quantity of education

As noted above, there are different views of what formal education is supposed to provide in the area of human capital. And from a practical viewpoint, there is the added complication of the time horizon over which measurement is

sensible. Is education to provide a skilled and flexible work force to improve the nation's competitiveness and enhance economic growth – as per our 'first' role for human capital measures above, or is it to improve the knowledge, skills and quality of life for all citizens (via higher self-fulfillment, ability to participate in a democratic society, etc.)? To what extent do these objectives overlap and to what extent might earnings provide an appropriate output measure, especially of the former?

In terms of the *quantity* dimension of education, a common approach in the literature is to measure the effect of additional years of education on test scores or future earnings. It is concluded, almost without exception, that additional education has a positive effect on both outcomes. However, researchers differ on the magnitude of the effect.

Quality of education

Researchers who attempt to estimate the effect of the quality of education on students' human capital outcomes typically use measures of resources as a substitute for the unobservable 'quality' variable. Measures of resources usually include pupil/teacher ratios, class size, teacher salary and per/pupil funding. From a policy point of view, using such proxies for quality might be desirable as policy-makers would like to know the effect of the resources which they can control, but these measures probably do not do justice to the complexity of the educational process. The process by which the inputs are combined is likely to be at least as important as the level and type of the resource inputs.

With regard to the economics of education, most studies properly consider the possible confounding effects of innate ability and family/social background on the measured link between formal education and human capital. Other variables which tend to receive less attention are the funding mechanism (whether funds are allocated so that schools achieve the same increment in human capital across students, or whether schools with students of greater need are given more funding so that all pupils achieve a given educational standard), delivery (bulk funding,

central resourcing), the use of vouchers, public versus private education, school size (economies of scale and subject range versus bureaucratic load and less school cohesion), and school management and governance styles.

One of the previous lecture had an output focus; looking at the various uses to which measures of human capital could be applied. The two main areas of use are in ascertaining the effects of educational resources on educational outcomes and in understanding economic growth, although these areas are not totally discrete. This is because the input series used to analyze growth overlap with the output series in the education research. We might envisage this relationship as something like the following:

	Uses of Measures of Human Capital			
	Education		Growth	Well-being
Measures of Human Capital				
Investment (eg costs of schooling)	X			
	↓			
Education (eg mean schooling years)	X	→	X	
Cognitive ability (eg literacy)	X	→	X	X
	↓			
Return (eg earnings premiums to educ)	X	→	X	X
Others (eg health)	X	→	X	X

It strongly recommends the development of direct measures of a range of individual attributes, as indicators based on just the formal education system (whether output or input focussed) are deficient, while those based on investment and wage differentials are too indirect.

Literacy measures

Adult literacy is a key component in human capital, but it is usually too simplistic a measure to be very useful. In the OECD's International Adult Literacy Survey, literacy is divided into prose literacy, document literacy and quantitative literacy.

- Prose literacy – knowledge and skills needed to understand text information such as news reports and fiction.
- Document literacy – knowledge and skills needed to understand documents such as timetables, application forms, maps, tables, etc.

 Quantitative literacy – knowledge and skills needed to apply arithmetic operations such as calculating interest on a loan, balancing a cheque book, completing order forms, etc.

For each category there are five levels of performance and scores in the range 0-500. The conceptual basis of these measures of literacy is they are not synonymous with education or training. They were also designed to allow empirical testing of the relationship between literacy and earnings – a useful feature in the context of the analysis of human capital and economic growth.

Nevertheless, in keeping with its brief the report presents a wide collection of measures that are currently available, albeit that most of them are imperfect with respect to the above desiderata. They are summarised in Tables 3.1 and 3.2.

Stock Measures

The "stock" measures in Table 3.1 are essentially variations on the following:

Main Types of Human Capital Stock Measures

Education	Cognitive Ability
Educational attainment	Literacy
Years of schooling	Numeracy
	Science skills

Educational measures are generally confined to formal education. Eurostat (2001) makes the point that non-formal education and informal learning also contribute to an individual's human capital. Non-formal education includes activities such as evening school and vocational training – activities which are organised but occasional. Informal learning activities tend to be less organised, less structured and not taught. Examples include reading, and self-instruction computer aided learning.

The concept of the IALS has been extended to the International Life Skills Survey so that skills other than literacy may be also be compared internationally. The domains included are numeracy, problem solving, teamwork, practical cognition and computer familiarity. A report is due in 2002. This list is based on employability considerations.

The Cross-Curricular Competencies project seems to have evolved into the Programme for International Student Assessment, which addresses the domains of reading, mathematics and science. It draws on the Third International Mathematics and Science Study (TIMSS), which is probably the most internationally consistent and wide, attracting 38 countries in its 1999 study.

Health Measures

It was noted above that nutrition and health care underpin learning potential. However, the reverse also holds, that greater human capital improves one's ability to be healthy. See for example Grossman and Kaestner (1996). Nordhaus (2002) takes a different approach by looking at the contribution that improved health has had on living standards. The concept is fairly simple, longer life expectancy and less time off work for ill health raises national output. Nordhaus then goes a stage further by linking improvement in health status to improvements in education. That is, well-educated workers tend to be better at looking after their health than poorly educated workers.

Schultz (2002) presents a rather novel approach whereby earnings are linked to human health capital, with the latter measured by height. Height is considered to be a lagged indicator of childhood nutrition and lifetime health status. (This does not pre-empt a role for genetics).

Because of the simultaneity between earnings and health status Schultz uses the technique of Instrumental Variables instead of Ordinary Least Squares regression. He demonstrates that the latter gives results, which are considerably biased – downwards. In the education literature various authors note that while human capital theory treats the costs of acquiring education as investment (in human capital), some of the benefits of education also accrue as consumption benefits. With respect to human health capital Schultz notes that this observation is probably even more true of expenditure on health. Currently consumption benefits accrue to both children and parents from parental spending on their children's health. The research by Schultz and Nordhaus shows that health status has an effect

on human capital (and thereby on earnings) that is separate from the effect of education, although this effect is augmented by education. Given also a reinforcing effect from good health to education and it is clear that there are interactive effects operating in both directions. We have not sighted any research that disentangles these effects. Hence the effect of health on human capital (and vice versa) would appear to be a potentially fruitful avenue for future research. A further step still is to follow the paradigm of education research by analyzing which health interventions actually contribute to human capital and earnings. In the education literature earnings are used to measure the gain in human capital that is attributable to more or better education. Care is needed to ensure that measurement is not biased by confounding influences such as ability and family background. This caution recognizes that differences in education between individuals are not necessarily well correlated with earnings. Conversely though, broader measures of human capital may exhibit more correlation with earnings. Here then is another possible use for human capital measures; analysing the extent to which income inequality, or more particularly wage inequality, can be explained by differences in human capital.

It is apparent from the discussion in this lecture that the various uses of measures of human capital do not really fall neatly into the areas of:

- ascertaining the effects of resources in education
- distinguishing the effects of health on economic growth
- determining employment suitability
- decomposing economic growth
- decomposing earnings inequality.

There are many overlaps. Measures of human capital are inputs in some areas and outputs in others. And, as noted at the start of this lecture, different measures suit different research questions. While a brief survey of the literature has certainly revealed that some measures are far superior to others, a diversity of measures is likely to continue to prevail – for both practical and theoretical reasons.

Moving beyond the straight economics sphere many authors note that there are numerous dimensions of personal and national development, which are likely to be enhanced by greater human capital. Such dimensions include health (for its own sake, not just as a means of obtaining higher earnings), lower crime, the appreciation of arts and culture, and of science and reason, and capacity to enjoy freedom. These areas take us beyond the ambit of this paper, but they are not unrelated. In particular can these other consequences of human capital development be identified and separated from the effects of human capital on these same variables via economic growth? We will bear this question in mind when we look at existing (and potential) statistical measures of human capital in the following lecture.

Economic Growth measures

As noted above, the most important use (and probably most common use) of human capital measures is in understanding economic growth.

There is a wide literature on explaining differences across countries in GDP per capita, and on why some countries consistently manage faster economic growth than others. (eg Denison (1967), Barro (1991), Gundlach (1995), and Hanushek and Kimko (2000) among others).

Most researchers recognize the importance of the skills of a country's citizens in raising GDP per capita (and the virtuous circle this link can generate). Clearly, a wide definition of human capital is required here as economic growth captures not only the direct benefits to the individual of investment in human capital, but also the positive externalities that a skilled population encompasses, as manifested by informed democratic participation leading to good policy-making by governments, social cohesion, better health etc.

The early growth literature typically used measures of human capital such as:

Adult literacy rates – while an undeniable component of human capital it completely disregards the level of literacy, the type of literacy, and the contribution

of additional skills in numeracy, analytics, technical knowledge etc. Also, literacy levels often do not correspond to educational levels.

School enrolment rates – a measure with little theoretical credibility as it relates largely to people who are not in the labour force and therefore provide almost no contribution to current GDP, and it is a flow rather than a stock (which is what human capital is) – indeed it is not even the flow in the desired stock.

The need to use a stock variable has meant that more recent studies have tended to use average years of schooling (see for example Krueger and Lindahl (2001)). This stock measure has typically been constructed in one of three ways:

1. From enrolment data using a perpetual inventory type method commonly used for measures of non-human capital stock.

2. Using lagged enrolment data projected to average years of schooling on the basis of past relationships between enrolment rates and years of schooling.

3. By direct computation from data from censuses and surveys.

Consistently with this viewpoint the OECD writers define social capital as "networks together with shared norms, values and understandings that facilitate co-operation within or among groups" (41).

Other writers use the term in other ways. For example, Joel Sobel (2002), in a recent review article writes: "Social capital describes circumstances in which individuals can use membership in groups and networks to secure benefits. This formulation follows the definition offered by Bourdieu (1986): 'Social capital is an attribute of an individual in a social context. One can acquire social capital through purposeful actions and can transform social capital into conventional economic gains. The ability to do so, however, depends on the nature of the social obligations, connections and networks available to you."

Sobel continues: "This formulation treats social capital as an attribute of an individual that cannot be evaluated without knowledge of the society in which the individual operates."

We do not discuss social capital further in this report but the contemporary emphasis on the concept, and its close interconnection with human capital, suggest that developments in this field should be monitored.

Table 3.1

Stock Indicators of Human Capital (adapted from OECD [1998])

	Indicator	What it shows	Usefulness and limitations	Data availability and sources	Country-availability
A	Educational attainment of the population aged 25-64.	Percentage who have gained upper-secondary and tertiary level qualification.	Internationally standardized measure of educational level reached. But does not measure any specific set of knowledge and skills.	OECD collects comprehensive data on all countries, based on *International Standard of Education* (ISCED) definitions.	
B	Average "years of schooling" of the population aged 25-64.	Estimated average number of years spent in completed episodes of primary, secondary and tertiary education.	Gives single figure for stock of human capital based on attainment, but takes a year of education as a constant unit regardless of level. And same limits as (*a*) above.	Source data as for *(a)*, but relies on estimating the average number of years associated with each attainment level.	
C	Educational attainment of the adult population broken down by age.	Percentage who have gained at least upper-secondary education in the 25-34 and 35-64 age bands.	Indicates generational differences due to changes over time in youth attainment rates. But does not separate out the effect of adult education.	Source data as for *(a)*.	
D	Educational attainment and qualification rates broken down by gender.	Differences between men and women: (*i*) in upper secondary attainment among adults aged 25-64 and (*ii*) in current upper secondary qualifications rate.	Compares historic gender biases with present trends in education systems.	Attainment rates: as for *(a)* Qualification rates: *Education at a glance* - OECD *Indicators* (1997), 324.	
e	Overall distribution of literacy skills in adult population.	Percentage performing at each of five levels of measured literacy in three domains.	Gives a direct measure of a set of skills with economic relevance. Results not attributed solely to education.	*International Adult Literacy Survey* results for 12 countries, published by the OECD in 1995 and 1997.	
F	Literacy by sector of economic activity.	Percentage of workers in selected industries with high (levels 4/5) and low (1/2) literacy levels on 'document scale'.	Focus on those in employment, not total population. Shows how literacy tends to be highest in more knowledge-based industries.	*International Adult Literacy Survey* results for 12 countries, published by the OECD in 1995 and 1997.	
G	Literacy by educational attainment.	Average literacy score in each country of people with respective attainment levels.	Shows how much difference education makes to literacy in each country, and also allows comparisons across countries of literacy among people with similar education attainment.	As for *(f)*.	
H	Proportion of work force in research and development.	Labour resources involved in innovation and pushing out knowledge frontiers.	While this reflects a certain level of human capital in the work force, it is also an investment indicator of the type presented in Table 3.2	Well documented in OECD countries, but definitions are not clear-cut.	

Table 3.2

Investment Indicators of Human Capital (adapted from OECD [1998])

	Indicator	What it shows	Usefulness and limitations	Data availability and sources	Country availability
a	Share of national income devoted to education and training.	Public and private expenditure on formal programmes, as a percentage of GDP.	Estimates overall resources devoted to investment. Excludes informal learning. Imperfectly compares national effort relative to need: countries with higher youth populations need to spend more.	Comprehensive data on public programmes available but limited availability of data on private spending.	
b	Average spending per student, by educational level, relative to income per capita.	Average annual expenditure on a student at primary, secondary and tertiary education, as a percentage of GDP per capita.	Shows how much effort is devoted to each student, relative to each country's means. Takes no account of variations in investment due to participation rates outside compulsory schooling.	As for *(a)*.	
C	Spending on public labour market problems.	Expenditure as a percentage of GDP, classified by type of participant.	Shows direct expenditure by governments to improve workplace skills. Excludes some employment service spending relevant to human capital that is not strictly on training.	Data incomplete. See annex to the *Employment Outlook* OECD, (1997*a*).	
d	Spending by enterprises on training.	Expenditures as percentages of total labour costs.	Gives a rough indication of the scale of spending by firms. But much private human resource investment is hidden.	Data from various surveys (including EU Labour Cost Survey) is incomplete, and not strictly comparable.	
E	Family computer ownership.	Percentage of households with personal computers.	Gives one indicator of a familybased resource that aids human capital investment.	Data for twelve countries provided in *Information Technology Outlook*, OECD (2000).	
f	Employee participation in job related training.	Percentage who report having undertaken training in specified periods.	Gives a rough idea of the proportion involved in some kind of training, but does not distinguish length or quality. Data from different sources are not always comparable.	Several household, enterprise and administrative sources are available including the *International Adult Literacy Survey* and the *European Labour Force Survey*.	
G	Participation by different groups in job-related and other education and training.	Breakdowns by economic status, age, gender, educational attainment.	Detailed comparisons for a limited number of countries.	IALS. Most breakdowns available for about 10 of the twelve countries. But for some categories (*eg* unemployed people), sample sizes limit validity of results.	
h	Average duration of job-related training.	Annual hours of training undertaken- *(i)* per person with any training *(ii)* average for all employees.	Qualifies indicator *(f)* by showing quantity of investment rather than just the percentage of employees making some investment.	Hours of training available from IALS. *European Labour Force Survey* classifies participation by length of course.	
i	Time spent in learning.	Time spent in training of various sorts (*eg* field,[11] type, and delivery mechanism).	Also useful would be contextual information on who pays, reason for participating, satisfaction with the learning event, working arrangements, childcare facilities and general obstacles to learning. – noted by Eurostat (2001, 23).	Data tend to be sporadic and not consistent across countries or time. Source is mostly timeuse surveys.	
j	School enrolment rates.	Analogous to participation in training.	Some researchers assume that enrolment in school is proportional to rate of human capital accumulation. As discussed in Section 2, this is problematic.	Data is widely available.	

5. General Theory of Human Capital Development

The concept of development

Health and education are both components of human capital and contributors to human welfare.

Human Capital Development Theory concludes that investment in human capital will lead to greater economic outputs however the validity of the theory is sometimes hard to prove and contradictory. In the past, economic strength was largely dependent on tangible physical assets such as land, factories and equipment. Labor was a necessary component, but increases in the value of the business came from investment in capital equipment. Modern economists seem to concur that education and health care are the key to improving human capital and ultimately increasing the economic outputs of the nation. (Becker 1993)

In the new global economy hard tangible assets may not be as important as investing in human capital. Thomas Friedman, in his wildly successful book, "The World is Flat" (2007), wrote extensively about the importance of education in the new global knowledge economy. Friedman, not to be confused with the famous economist Milton Friedman, is a journalist. His popular book has exposed millions of people to human capital theory. The term itself is not introduced, but evidence as to why people and education (human capital) are vital to a nation's economic success, is a common reoccurring theme in the book.

The concept of human development centers around the notion that human welfare depends on various dimensions, many of which are not well captured by conventional measures of economic income (see Griffin and Knight, 1990; UNDP, 1990). Particular attention has been given to using measures of health and education as welfare indicators in addition to GDP per capita. Education, good health and longevity are intrinsically valuable outputs. In conventional measures of

economic output, health and education's contribution is measured essentially by the costs of producing the outcomes, i.e. expenditures on schools and medical facilities. Such a procedure identifies inputs rather than outputs. The valuation of both health and education is difficult as both are goods with attributes different from most types of goods produced in an economy. Whilst high incomes may be conducive to health, health cannot be directly purchased like material goods and services. Health and education are often subsidised by the state and in some countries education is compulsory for certain minimum length of times. Many, if not most, health and education services are produced by the public sector. Governments play a direct part in providing services very directly linked to human welfare.

Essential Elements of the Theory

Before examining the evolution of the Human Capital Theory I want to provide an overview of the theory's essential elements so the scope and meaning of the theory are clear. The following is an academic definition from two researchers at Brown University: Individuals live for two periods. In the first period of their lives individuals devote their entire time for the acquisition of human capital. The acquired level of human capital increases if their time investment is supplemented with capital investment in education. In the second period of their lives, individuals supply their efficiency units of labor and allocate the resulting wag income, along with the interest income, between consumption and transfers to their children. (Galor & Moav, p. 14) Becker (1975) refers to these "forgone earnings" that people relinquish to invest in human capital accumulation. This situation is the application of "… an old and powerful concept that is the heart of economic theory, the concept of opportunity cost – to the costs of spending time in school or training." (Bowman, p. 25) This sense of an investment for the future is a key characteristic of the theory. "The investment aspect is essential in the human capital theory. The acquisition of human capital through education and training is

an investment in the sense that the individual foregoes current income for increased earning potential in the future." (McNabb inNübler, 1997) People, companies, and societies must consider what they could be giving up while formal education or training is underway, and also keep in mind what the potential rewards may be for this investment. I will examine this opportunity cost concept from the perspective of the corporation whose business environment is undergoing fundamental change.

Theory Evolution

In the 1960s, Theodore Schultz and Gary Becker developed Adam Smith's original notion [described in The Wealth of Nations] that investment in education and skill formation was as significant a factor in economic growth as investment in physical plants and equipment – the phrase human capital was born. (Schuller & Field, 1998)In 1960, Theodore W. Schultz became the President of the American Economic Association (AEA). In his presidential address to the AEA, Schultz presented his views on the impact a person's investment in education and training can have on the potential for productivity in an economic system – the impact of human capital. (Schultz, 1961) At the time, the Malthusian "Law of Diminishing Returns" was prevalent, with its ominous predications of global poverty due to the finite nature of capital resources such as land, water, metal and so forth. Schultz saw that the quality of the workforce was a variable element in the economy and could be improved to increase the human variable in the economic equation, and therefore increase productivity. Schultz was awarded the 1979 Nobel Prize in Economic Sciences for his life's work. (The Nobel Foundation, n.d.)In 1964, Gary S. Becker advanced the Theory of Human Capital in his book "Human Capital." (1975, 2nd ed.) Through his analysis of census data, he provided empirical "rate of return" data demonstrating that an investment in training and education to increase one's human capital was as important (and measurable) as an investment in other forms of capital. Becker also received the Nobel Prize in Economic Sciences, awarded in 1992. (The Nobel

Foundation, n.d.)A significant aspect of this theory is that the investment in knowledge, skills and health would not only benefit the individual; it could also increase an employers or country's human capital resource pool and potential productivity. However, if sufficiently skilled labour was plentiful, such as in developing countries or service industries requiring minimum skills, most employers do not see the need to invest in their employees' education. (Galor & Moav, 2001)However, as the essential skill set for many "knowledge worker" jobs becomes more complex and the demand for highly-skilled employees rises, employers should see a direct productivity benefit by investing in their employees' capabilities through training programs and the funding of post-secondary education. (Galor & Moav, 2001

Human and Physical Capital

Human capital is a broad concept which identifies human characteristics which can be acquired and which increase income. It is commonly taken to include peoples' knowledge and skills, acquired partly through education, but can also include their strength and vitality, which are dependent on their health and nutrition. Human capital theory focuses on health and education as inputs to economic production. This is in contrast to the concept of human development which views health and education as intrinsically valuable outcomes to be placed alongside economic production as measures of human welfare. In understanding the role of human capital as an input into development it is necessary to consider the possible links between human capital, other forms of capital, income and growth. While it is true for every country, for which there is data that more educated people earn more than less educated ones it does not follow that there is a simple relationship between investing in people and countries becoming richer. Human and certain forms of physical capital may be complementary. The problem in investing is to match skills with machines. It is not a question of either investing in people or investing in machines, both are necessary. Even more important is the

issue of how much to invest in alternative forms of capital equipment and skilled labour. The answer to that question is unlikely to be the same for all countries or to remain unchanged over time.

The role of human and physical capital in growth

We begin by a consideration of the links by which investment may affect the growth of output. Both physical and human capital directly impact on the productive capacity of an economy. However such direct effects may not be the most important. More human capital may itself affect the rate of growth of physical capital. If human and physical capital are complements then increasing human capital raises the rate of return on physical capital. The underlying rate of technical progress in an economy, by which is meant the increase in output due to factors other than measured inputs, may depend on how much educated labour there is in the economy. Rates of return on investment must consider both the direct and indirect effects of such investment. In assessing the effects of human capital on output we have both macro and micro evidence. We present both in the following lectures

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ЭКОНОМИКА ОБРАЗОВАНИЯ И ЗДРАВООХРАНЕНИЯ

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