

# **Health Investments and Economic Growth: An Overview**

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## **Abstract**

Some authors claim that a population's health status affects its income level, implying that investments in health can boost economic growth. At the micro level, some clear causal relationships have been documented from health to earning potential and income. But at the macro level, our reading of the literature is that the effect of health on income is small if it exists at all, and that the determinants of population health likely overlap with those of economic growth. The lack of clarity about the link from health to economic growth is not necessarily a reason to refocus public investment away from the health sector. The pressing problem is to make health spending more effective in improving health outcomes, through improvements in accountability and incentives. The improvements in health status will be worth the effort even if they turn out to have little effect on growth.

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# Health Investments and Economic Growth: An Overview

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## Introduction

Improvements in health status over the last 50-100 years, as measured by a number of indicators, have been nothing short of spectacular. Vaccines, antibiotics, and other pharmaceutical developments have drastically reduced the incidence of illness and death. Economic growth has also helped: richer people are better nourished and educated, and richer countries are more able to afford the public goods (such as water and sanitation, and control of disease vectors such as mosquitoes) that reduce disease transmission.

Do improvements in health themselves help to boost economic growth? This proposition is at the heart of the report of the WHO's Commission on Macroeconomics and Health (2001: i), which states that "extending the coverage of crucial health services....to the world's poor could save millions of lives each year, reduce poverty, spur economic development and promote global security."<sup>1</sup> According to this view, achieving better health care may be able to accomplish what development practitioners, NGOs, economists, foreign aid, and diplomacy have failed to achieve. Some researchers who have found a significant link from health to growth (e.g., Bloom and Canning, 2003) have used this finding to argue for large increases in governmental spending on health.

Both directions of causality between health and income are likely operative, although they are difficult to measure and estimate, and a vigorous ongoing debate about which direction dominates reflects these empirical challenges. A resolution of this debate could boost the urgency of the quest for growth, inform that quest, or both. For example, a finding that economic growth reduced infant mortality could hasten the adoption of potentially growth-enhancing policy reforms. Alternatively, if better population health were found to stimulate economic growth, the full social returns to policies that directly improve health status would be higher than is now recognized, and interventions designed to improve health might be added to the armory of growth-friendly policies to be used in the quest for growth.

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<sup>1</sup> This passage is also quoted by Acemoglu and Robinson (2006).

To help inform decision making on public policy, the present review examines the routes by which improvements in health might indeed increase incomes and growth, and the related evidence. Recent advances in the literature suggest that a link from health to growth may be operational but is difficult to measure, and that its effect is likely to be relatively small.

Better health may lead to income growth, but this does not necessarily mean that governments of developing countries should spend more of their budgets on health care. As Bloom and Canning (2003: 313,) point out, “[t]he key issue is not that spending on health would be good [although some authors question even this assumption], it is whether spending on health is better than other uses of the limited funds available in developing countries.” Public spending on health care might not be the best way to achieve health, let alone growth.

Thus a second goal of our review is to investigate the determinants of health itself, and particularly the evidence on the impact of public expenditure policies on health. Some specific public interventions seem to be very good for health outcomes, while some broader measures seem to have little measurable effect. But overall there appears to be growing evidence that public policies only improve health when institutions are of sufficiently high quality, and that good institutions themselves are likely to have a more important *direct* effect on growth than on growth-through-health.

We caution the reader against expecting to find consensus in the empirical literature on the links from health to growth, or even from health policies to health. A number of papers present unambiguous results but contradict one another. From our reading, the literature is a mix of rigorous scientific investigation and well-motivated advocacy on both sides.<sup>2</sup> Further, when attempting to untangle the link from health to growth, or vice versa, econometric issues of endogeneity and measurement error are particularly problematic and the validity of even the most innovative approaches continues to be debated.

Health status is affected by food and nutrition, public health investments, and individual health care services. In addition, a number of other factors, notably cognitive and non-cognitive educational attainment, deeply affect the predisposition to illness and the ability to ward off and manage illness in adulthood. We review the evidence surrounding all of these influences to gain some appreciation of the link between a country’s investments in “health” and economic growth.

Section 2 below examines the links between health outcomes and economic growth at both the macro and micro levels, encompassing discussion of the econometric and policy issues. Then, because the health-income literature provides no policy guidance on how to improve health—the first link in the putative chain from health to growth—Section 3 reviews the determinants of

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<sup>2</sup> As Dixit (2006: 23) notes in a thought-provoking discussion, conflicting research findings in the growth and development literature “can leave a user who is not an expert in a particular area in a thorough state of confusion and indecision.”

health itself. It emphasizes the crucial role that public investments outside the “health” sector have played in improving health status, and the need for strong institutions within the health sector if investments in health care are to improve health. Section 4 concludes.

## **Population Health and Income: Potential Links and Evidence**

This section reviews the mechanisms by which improvements in a population’s health might lead to increases in income. We then present some basic evidence on the associations between trends in health and trends in national income, across countries and within two large developing countries (India and China) over time, and discuss the challenges faced in interpreting these associations. Against this background, we discuss the findings of studies that investigate the relationship between health and income at different levels of analysis.

### **How might health make you rich?**

The most obvious reason why healthier people might be richer is that they can work harder, longer, and more consistently than others. But can better health increase the *rate* at which income grows?

#### ***Human capital accumulation***

A recurring theme in the literature is that health leads to income growth through its effect on human capital accumulation, and particularly through education—provided that people have sufficient food and satisfactory educational opportunities.

First, children who are healthy may spend more time at school and be better learners while there, preparing themselves to earn higher incomes. Along these lines, Sachs and Malaney (2002) describe a number of channels through which malaria can compromise educational attainment - including by hampering fetal development, reducing cognitive ability, and lowering school attendance.

Second, the health status of adults affects human capital accumulation by their children. A large proportion of human capital investment decisions are made by parents on their children’s behalf. But if parents die, they cannot invest in their children. Orphans do not necessarily suffer a complete withdrawal of adult support, given the social networks in many societies, but they are likely to receive less than when their parents were alive, an issue that is discussed below on economic impact of illness (p. 21). Lorentzen and others (2005), using an instrumental-variables approach, find that the adult mortality rate affects growth less through its influence on education investments than through its influences on fertility and physical capital investments.

### ***Physical capital accumulation***

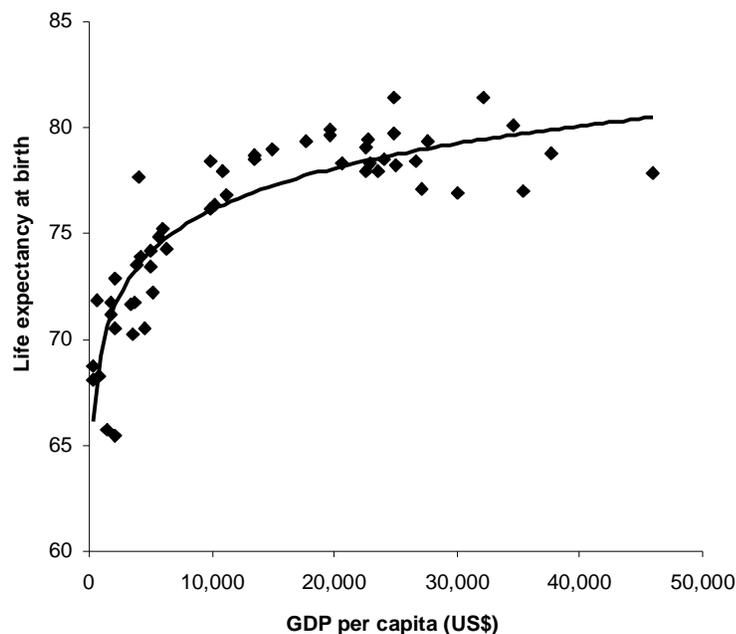
A population in better health may accumulate physical capital more quickly. The most obvious route is through savings, as higher life expectancy (for example) increases the expected length of retirement. Indeed, Bloom, Canning, and Graham (2002) attribute the high growth experience of East Asia to precisely this mechanism. Alsan, Bloom, and Canning (2006) and Sachs and Malaney (2002) highlight the impact that better population health has on inflows of foreign capital, as opposed to increases in domestic savings; this effect is usually thought to operate in situations in which foreign (direct) investment and expatriates (either in the role of staff or consumers) are highly complementary (source). Tourism is the most commonly cited example, as the threat of communicable diseases such as SARS deters visitors and investment, at least in the short term because it suggests high-risk environments (Bell and Lewis 2005).

### **Trends in health and national income**

#### ***Evidence from cross-country studies***

The economics and population-health professions were brought together empirically only in the last 30 years. Preston (1975) presented data on per capita income and on population health status as measured by life expectancy, for a cross section of countries. More recent data confirm his finding of a concave relationship between health status and income (Figure 1), and show that this relationship is becoming stronger over time.

**Figure 1: The Preston Curve, 2001**



Source: World Development Indicators.

This latter fact shows immediately that income, as measured by GDP, cannot be the sole determinant of health; if it were, countries that grew richer over time would simply have moved along the curve defined by a given year's cross-sectional data. On average, countries whose incomes have grown have achieved better health improvements than would have been predicted from the 1975 data.

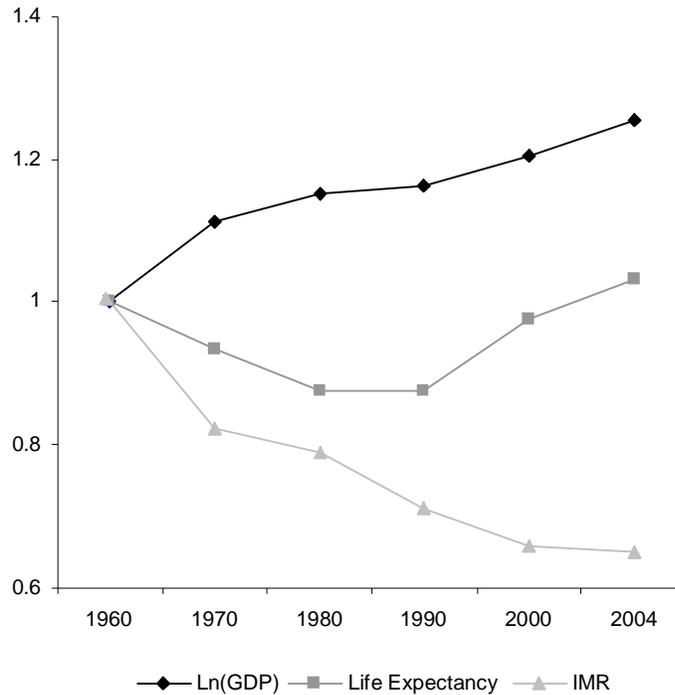
The concave relationship between income and health suggests the importance of income distribution for a country's health status: in a country with highly unequal income distribution, the population at large is likely to be less healthy than would be predicted for countries with the same average income. It is commonly argued that this relationship provides a rationale for redistributing a country's income from rich to poor citizens, so as to raise average health status while keeping average income constant (ignoring the efficiency costs of redistribution). This sounds reasonable if indeed the increases in incomes of the poor will improve their health. However, if one believes that health changes drive income growth, the same concavity properties imply that redistributing *health* from the unhealthy to the healthy (i.e., in the "wrong" direction) would increase aggregate income, with no effect on average health status. The validity, if not the desirability, of each of these interventions thus depends crucially on the direction of causality between income and health.

Although the Preston curve shows a close relationship between income and health in the cross-sectional data, longitudinal data suggest this relationship may not hold within individual countries over time. Figure 2 draws on data presented by Deaton (2006) on the evolution of the cross-country distribution of national incomes and health status between 1960 and 2004. Each curve represents the standard deviation of a variable relative to its value in 1960. The figure shows that per capita incomes have steadily diverged, in keeping with the well-established evidence that incomes in poor countries have not grown fast enough to catch up with incomes in richer countries (Pritchett, 1997; Growth Commission 2008). By contrast, country-level health indicators have converged—until 1990 for life expectancy, and through 2004 for the infant mortality rate.<sup>3</sup> (The reversal of the converging trend in life expectancy in the last 15 years is likely due to the collapse of the former Soviet Union that exhibits high adult mortality, and the explosion of HIV/AIDS in sub-Saharan Africa in the 1990s. HIV/AIDS, while it has implications for children and potentially for their incomes later in life—through its impact on schooling—has a more pronounced impact on adult life expectancy than on infant and child mortality.)

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<sup>3</sup> The infant mortality rate (IMR) measures the number of children born who die before their first birthday per 1000 births. The standard deviation of the under-five mortality rate shows a similar evolution and is not presented in Figure 2. The IMR is a significant factor in life-expectancy calculations, because, particularly in countries with high death rates, the majority of a country's deaths occur in the first year of life.

**Figure 2: Normalized Cross-Country Standard Deviations of Health and Income: 1960–2004**



Source: Data from Table 1 of Deaton (2006).

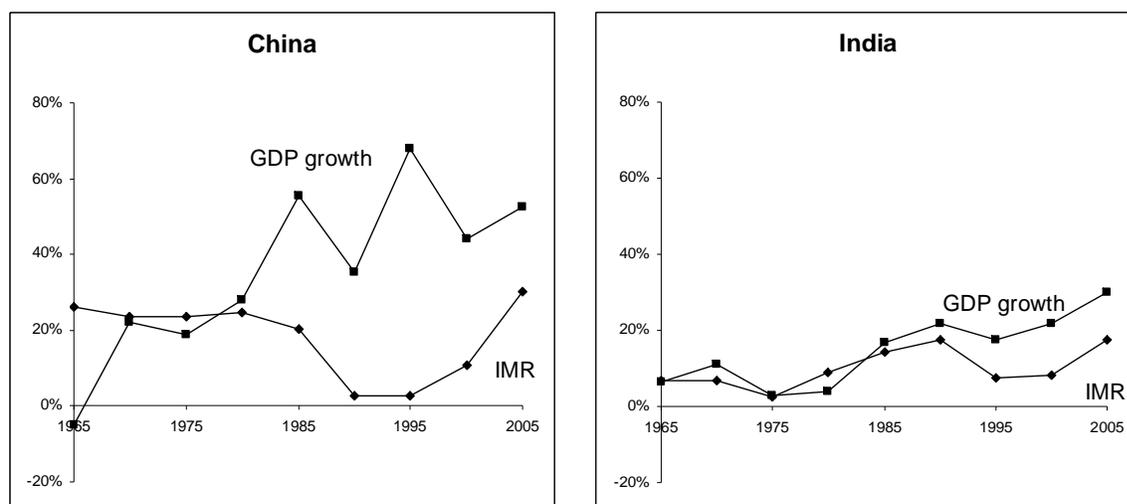
Thus Figure 2 suggests that over time, changes in income seem to be unrelated, or even negatively related, to changes in health status: incomes have continued to diverge, while health status has converged. That is, health status has improved in poor countries at a faster rate than in rich countries (albeit from a lower base), despite the fact that incomes have grown more slowly in poor countries than in rich.

***Trends in individual countries: China and India***

In view of the difficulties and limitations of cross-country comparisons, we summarize the evolution of incomes and health status in two individual countries—China and India—since 1960 in Figure 3. (This exercise follows Dreze and Sen (2002) and Deaton (2006)). The graphs suggest that both these countries have improved their health status and per capita incomes over the last 40 years but that their experiences have differed.

In China the annualized growth rate of GDP is negatively correlated with the annualized rate of reduction of the infant mortality rate (correlation coefficient -0.45, *t*-statistic), while in India the correlation is positive (correlation coefficient 0.77, *t*-statistic). As Deaton (2006) notes, in China the largest gains in health *preceded* the take-off in economic growth.

**Figure 3: Income growth and infant mortality rate reductions in China and India: 1960–2000**



Source: World Bank data as used by Deaton (2006); see his Figure 8.

Note: Each line shows the annualized proportional change for a variable over the preceding five years. IMR is infant mortality rate.

The data from India are perhaps more ambiguous: during that country's period of relatively slow economic growth from 1965 to 1985, the correlation between changes in income and health was tight, but in more recent years, as economic growth has taken off, the rate of improvement in the infant mortality rate has fallen off.

### **Interpreting correlations between health and income: data and estimation issues**

#### ***Limitations of aggregate measures of health and income***

Although relationships between aggregate measures of health and income can be informative they have some limitations, because both indicators are summary statistics of complex, multi-dimensional assessments of human activity and well-being.

In particular, the uses of life expectancy or infant/child mortality rates as measures of health status are not without ambiguity, for both conceptual and practical reasons. First, these indicators attempt to measure aspects of health that might be related to productivity, including the extent to which individuals experience, or are at risk of, bad health, encompassing both morbidity and premature death. For example, in using life expectancy in cross-country analysis, we place too much weight on infant mortality while that measure itself is an imputed variable.

Second, at a practical level, accurate measures of life expectancy require good vital registration data, particularly on deaths. In many developing countries these data simply do not exist, and estimates of life expectancy are

based on child mortality rates, using standard life tables to impute infant mortality levels (adjusting for guesses about mortality risks in the population where necessary). While the cross-country pattern of life expectancy *levels* is likely to be reasonably accurate, data on *changes* in life expectancy may well embody large errors, due to the variety of (unmeasured) causes of such changes.

Third, interventions that affect morbidity but not mortality may well have important effects on productivity that will not be attributed to changes in health status if the latter is measured by life expectancy or infant/child mortality rates. A primary example of such an intervention is the control of the *vivax* strain of malaria, which causes relatively few deaths but high morbidity rates, compared with the more lethal *falciparum* strain. Controlling *vivax* malaria could significantly boost productivity, both directly as adults suffer fewer and less severe attacks, and indirectly through increases in the return to, and hence the level of, schooling for children (Bleakley 2006).

### ***Econometric approaches***

Interpreting the observed correlations between country-level health status and income is challenging. First, it is very likely that higher incomes help improve health status. Second, there may be other factors that affect *both* income and health (Deaton, 2007); for example, these might include the quality of a country's institutions, and its climate, and its disease environment. For both of these reasons, a correlation between income and health might be observed even if there is no direct causal relationship from health to income.

These identification problems are at the root of the lively debate amongst economists and public health researchers, and are well recognized. For example, Bleakley (2007: 73, 74) notes that "simple correlations of public health and economic outcomes are unlikely to measure the causal effect [of health on income] since public health is endogenous. Indeed, it is likely a normal good...." Similarly, in a paper focusing on the impact of malaria, Malaney, Spielman, and Sachs (2004: 143) acknowledge concerns over endogeneity and omitted variables: "[T]he causal effect of malaria on poverty cannot readily be isolated from the effect of poverty on malaria. A second econometric problem lies in the effect of such confounding factors as climate that may drive both poverty and malaria."

Researchers have used a number of procedures to try to overcome these and other estimation problems. Some studies focus on the relationships between measures of population health (such as life expectancy) and national income (such as GDP) and use econometric techniques to correct for endogeneity and omitted variable biases; we refer to these as macro-approaches in the discussion that follows. At the other extreme, micro-approaches examine the link for individuals between health improvements and incomes, with the goal of minimizing identification problems by careful choice of setting. A third strand of the literature combines the macro- and micro-approaches, scaling up micro-level measures of the effects of individual health improvements on incomes to yield

macro-level estimates of the impact of changes in population health on national income. The following sub-sections briefly review the findings of studies using these three approaches.

### **Findings of macroeconomic studies**

If we look at a wide enough range of countries, we find that people in richer countries are on average healthier: they live longer and fall ill less often. A cross-country regression quantifies this correlation. One of the first contributions to this literature was the work of Pritchett and Summers (1996), who concluded that “wealthier was healthier”—i.e., that the causality ran from income to health.

Subsequent work focused on the link between health and *changes* in income: healthier countries might be richer, but do they grow more quickly? Gallup and Sachs (2001) addressed this question and found a strong correlation between the level of population health and income growth. Of course, there are obvious endogeneity and omitted-variable concerns with this kind of exercise, but it offers the tantalizing prospect that a country can raise its income by improving its health.

A range of papers subsequently refined and extended the Gallup and Sachs methodology. Bloom, Canning, and Sevilla (2004) report the results of 13 studies that employ cross-country regressions and all show large effects of health on growth. To try to correct for possible third factors that affect both the level of health and the growth of income, Bloom and others (2004) assess the correlation between changes in health status and changes in income across countries; they find similar results.

The problem of endogeneity affects virtually all of the cross-country studies in this genre, because differences in the levels and growth rates of incomes can plausibly affect levels and changes in health status. The methodological response is to use a proxy indicator for health status (or for changes therein) that the researcher believes does not *directly* affect the level and/or growth of income. Any observed correlation between such an “instrumental variable” and income is then evidence of a causal link from health to income.<sup>4,5</sup>

Gallup and Sachs (2001) use geography as an instrumental variable for health status. The basic epidemiology and biology of infectious diseases means

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<sup>4</sup> Bloom and others (2001) use lagged values of health-related inputs and economic output (and their lagged growth rates) as instruments. However, Weil (2005) questions the validity of this strategy, and claims that “the identifying assumption required...is not explicitly stated or defended.”

<sup>5</sup> Mankiw (1995: 303, 304) goes as far as to suggest that “cross-country data can never establish, for instance, the direction of causality between investment [or health] and growth” (our parenthetical). He notes the implausibility of lagged variables being good instruments, highlights the issue of multi-collinearity—“those countries that do things right do most things right, and those countries that do things wrong do most things wrong”—and illustrates how problems of lack of independence and measurement error (both of which are acute in cross-country regressions) can bias results.

that at any given level of income these diseases are likely to be more prevalent in tropical regions. An impact of geography (distance from the equator) on incomes might then constitute evidence of an impact of health on income. This approach has been questioned in a series of papers (Acemoglu, Johnson, and Robinson 2001; Easterly and Levine 2002; and Rodrik, Subramanian, and Trebbis 2002) that challenge the assumption made by Gallup and Sachs that geography does not affect growth directly, or through its impact on a third factor that is itself important for growth. In particular, these critics illustrate that once the effect of geography on a country's *choice of institutions* is accounted for, geography has little independent impact on incomes. Broadly speaking, tropical/equatorial countries have tended to adopt institutions that are less conducive to economic growth than other institutions, and it is the choice of institutions that induces a correlation between health and income. The stark implication of their findings is that improving health status (by, say, expanding bed-net use against malaria) would have little impact on overall growth, and that institutional reform is what is needed to increase income.

Sachs (2003) admits the possibility that geography affects institutional quality, but takes issue with the finding that this is the *only* effect that geography has. To this end, he conducts a series of cross-country regressions aimed at distinguishing the effect of malaria prevalence—which is highly correlated with geography—from that of institutional quality. Instead of using a simple measure of geography (distance from the equator) as a proxy for health outcomes, which are arguably correlated with income, he constructs two instruments: one for malaria risk, which he calls “malaria ecology” and which is based on climatological conditions and vector prevalence, and a second, using settler mortality and the share of a country's population living in temperate zones, for institutional quality. In all his specifications he finds that both institutional quality *and* malaria risk are statistically significant determinants of income. But even this approach does not escape methodological criticism. In particular, the measured impact of malaria ecology on growth is unbiased only if we believe that malaria ecology does not affect institutional quality.

Aside from the econometric issues that arise when conducting cross-country regressions, one should not rely too heavily on results that selectively exclude some countries. Bloom and Canning (2003) illustrate this point. They analyze how the demographic changes in East Asia that were brought about by health improvements led to increased savings and growth. They then reflect on the experience of Latin America, which had “broadly similar demographic and health conditions,” and note that “East Asia's economy grew explosively, while economic growth in Latin America was stagnant. Latin America's policy environment—with poor labor-market policies, a lack of openness to world markets, and an inadequate education system—was quite different from East Asia's and did not offer the same favorable conditions.....” While it may be that the interaction of good policies with good health is what matters, the comparison

between East Asia and Latin America suggests it is, to first order, simply good *policy* that matters.

A number of recent papers have attempted to identify the impact of health on income and growth by modeling innovations in the health environment that can plausibly be taken as exogenous.

For example, Acemoglu and Robinson (2008) investigate whether advances in the health sciences have affected national income. They analyze the considerable technical progress in drug therapies, vaccines, insecticides, and the dissemination of scientific knowledge through international organizations that occurred in the 20<sup>th</sup> century and find that these advances did not cause a rise in per capita income. For their study the authors construct a measure of how much a country could expect to gain from these technological and institutional innovations—countries with a high incidence of now curable or avoidable diseases would be predicted to have greater gains in terms of reduced mortality—and use this measure as an instrumental variable for actual changes in population health. The idea is that the instrument is correlated with actual health improvements, but not directly with changes in incomes. They find that the advances in medicine significantly raised the growth rate of population, and that income (as measured by GDP) also increased. Since the increase in income did not match the increase in population, real per capita income fell, despite the health improvements. This effect is essentially a general equilibrium phenomenon: labor supply rose while other factors (land, capital) did not adjust, thereby reducing per capita output.

Their result mirrors that obtained by Young (2005), who uses micro data to calibrate a neoclassical growth model with fertility effects, in order to estimate the impact of the HIV/AIDS epidemic in South Africa. Young finds that because of the negative effect of the epidemic on population, capital-labor ratios increase enough to offset any plausible reduction in the rate of inter-generational human capital transmission associated with parental deaths.

Commenting on a paper by Acemoglu and Johnson (2006), Bleakley (2006b) notes that these authors find no impact of health changes on aggregate GDP. He emphasizes that labor market conditions, in particular the extent of un- and under-employment, are crucial in determining the impact of health improvements on measured GDP. Suggesting that a model that assumes capital is fixed is inappropriate, Bleakley notes that in reality the capital stock should have responded over the 40 years covered by these authors' analysis, and that land productivity too is likely to have improved over the period (due to increased urbanization and the green revolution in agriculture).

Several studies of the effects of malaria eradication programs find that the control of disease vector environments has a profound effect on health status and on education and productivity. Cutler and others (2007) examine the impact of a malaria eradication program across Indian states during the 1950s and find that the program increased literacy and primary school completion rates by 10

percentage points, accounting for about half the observed gains in these measures over the period spanning the intervention in malarial regions. Lucas (2005), Hong (2007), and Barecca (2007) all find significant effects of either exposure to malaria or its eradication on a variety of economic outcomes such as schooling, literacy, labor force participation, and/or wealth. These findings call to mind the broad-ranging positive results of the West African Onchocerciasis program, discussed in Section 3 below.

### **Findings of microeconomic studies**

An alternative approach to studying links between health and income is to examine individual and household investments and their effects on household income. The advantage of this approach, given data of sufficient quality, is that we might have more confidence in attributing certain impacts to particular health or other variables.

The disadvantages of a microeconomic approach are that the results may not easily be applicable to other circumstances, and that what may be true at the micro level may not apply for the population at large, because of external or general equilibrium effects. For example, if the labor market rewards individuals solely according to their health rank (healthier people get more job offers), then improvements in one person's health will translate into increases in his/her income, matched by reductions in the incomes of others, and there will be no impact on aggregate incomes. More generally, as in Acemoglu and Robinson (2008), if workers use other factors of production that are in relatively fixed supply, such as land and capital, then health improvements that increase the supply of labor could conceivably reduce average output per worker. Micro-level studies cannot pick up such effects.

Despite these shortcomings, micro approaches provide important insights into the potential impact of health on economic well-being. Below we focus on two broad sources of health-related variation across individuals and see how these translate into differences in economic productivity. The first source of differences among individuals is in the basic inputs to a healthy and productive life; we report on the economic implications of these differences and on the results of interventions to improve nutrition and caloric intake on the one hand, and to enhance early childhood development on the other. The second source of differences is in the incidence of illnesses and access to and use of medical treatments; we report the findings of selected studies on the negative impacts of HIV and malaria on productivity, and on the economic impacts of treatments such as de-worming tablets and antiretroviral therapy.

### ***Impact of interventions affecting early childhood development***

Increasing evidence from economics, psychology, and neuroscience indicates that early investments in young children profoundly affect their long-term physical and mental health, earnings, and well-being. Early experience shapes

brain architecture (Knudson, Heckman, Cameron, and Shonkoff, 2006), and early childhood development has a long reach that affects physical and mental health and well-being later in life (Mustard 2006; Fogel 1994; Drukker and Tassenar 1997). Knudson (2004) has shown that there are sensitive periods for neurological development that affect long-term memory. Thus the critical period for intervention is in the pre-school years. Recent work has produced considerable evidence on the issue.

Heckman (2007) points out the importance of noncognitive skills in preparing children for school, adulthood, and the work place, and his research suggests that both the cognitive and socio-emotional abilities of individuals as children explain many features of their later economic and social performance. Gaps in cognitive ability are established early, and in the US they explain much of the differential in individuals' educational performance across income levels (Cunha and others 2006).

Evidence from meta studies of longitudinal research from seven developing countries suggests that loss of human potential from neglect of infants and young children results in a 20 percent reduction in adult income. Roughly 200 million children in the developing world are at risk of not reaching their potential, largely because of nutritional deficiencies (iodine deficiency, iron deficiency anemia, stunting) and lack of positive adult attention (inadequate cognitive stimulation) (Walker and others 2007).

Grantham-McGregor and others (2007) summarize the scientific and behavioral evidence from developing countries and point to poverty, malnutrition, poor health, and unstimulating home environments as compromising the cognitive, motor, and social-emotional development of children. Their meta-study finds that both poverty and childhood stunting (due to persistent undernutrition) are correlated with poor school performance, lower incomes in adulthood, higher fertility, and inadequate care of their own offspring.

Vitora and others (2008) summarize the results and long-term implications of maternal undernutrition from five developing country cohort studies and review the literature on the same topic. They find that undernutrition can cause structural damage to the brain, and that maternal and child undernutrition result in shorter adults, less schooling, lower productivity, and higher likelihood of children having low birth weights. There is also a link with adult cancer, lung disease, and mental illness, all of which compromise productivity and earnings.

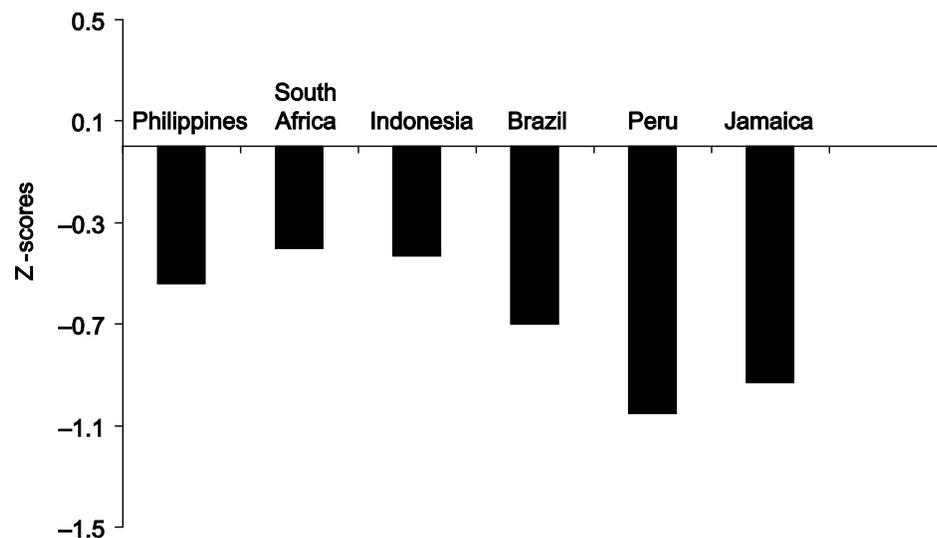
Thomas and Frankenberg (2002) provide a useful review of microeconomic studies of the impact of nutrition on economic outcomes at the individual level. They summarize their findings as indicating that "[w]hile the establishment of this link [from health to income] is not straightforward, the weight of evidence points to nutrition, and possible other dimensions of health, as significant determinants of economic productivity." Walker and others (2007), in a meta-study of risk factors for young children, note that stunted children consistently

show cognitive and educational deficits, although the size of the deficit varies across settings. They argue for intervention to prevent stunting, inadequate cognitive stimulation, iodine deficiency, and iron deficiency anemia.

Longitudinal studies show the relationship between early childhood development and language, intelligence, and criminality. Black and others (2007) show how low birth weights significantly affect on longer-run outcomes such as adult height, IQ, earnings, and education. Verbal exposure by reading and talking has significant effects on children’s verbal skills and language at later stages of development (Mustard 2006: 33). Many studies (cited in Mustard 2006: 37) have shown that children with poor verbal skill development during their first three years of life do poorly in language and literacy in school.

Both stunting and poverty are associated with declines in years of schooling. In Brazil, low-income, stunted children received more than four fewer years of schooling on average, and, once they became adults, earned an estimated 30 percent less income than the average worker (Grantham-McGregor and others 2007).<sup>6</sup> Studies of adult literacy in the US have shown that children with the lowest physical and mental health also perform at the bottom of the distribution in standardized tests (US Department of Education 2002). Figure 4, from Grantham-McGregor and others (2007), shows the cognitive deficits resulting from being in the lowest wealth quintile in the first three years of life.

**Figure 4: Cognitive or Schooling Deficits Associated with Moderate Stunting <3 yrs in Six Longitudinal Studies**



Source: Grantham-McGregor and others (2007).

<sup>6</sup> Stunted children with limited cognitive skills are more likely to drop out and to learn less when they do stay in school (Grantham-McGregor et al 2007).

On the basis of income, the standard deviations in cognitive and schooling deficits of children (z scores) in the poorest 20 percent of households are significant. The five countries featured represent three continents and both low- and middle-income groups, suggesting that culture and location are less important than biology in determining these deficits.

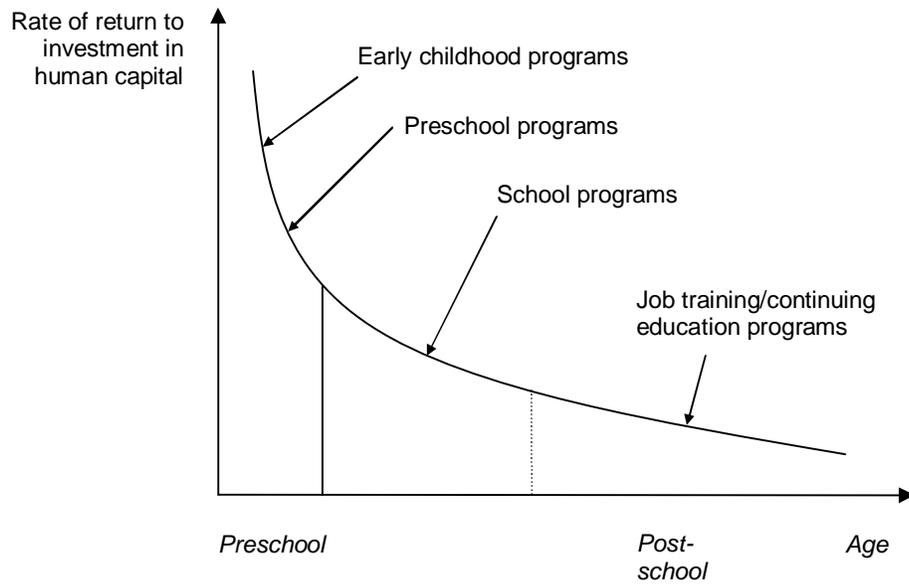
What of the impact of interventions? Cuba, with its extensive interventions for pregnant women and young children, has achieved significantly better performance on literacy assessments, scoring two standard deviations higher, than any other Latin American country (Carnoy and Marshall 2004, as cited in Mustard 2006: 39).

Fogel (2002) and Alderman, Behrman, and Hoddinott (2003) show the importance of specific nutrition interventions in bolstering cognitive development, physical stature and strength, earlier school enrollment, and more regular school attendance, greater schooling and learning, increased adult productivity, and healthier offspring. A recent 35-year longitudinal study of the long-term impacts of nutrition intervention during early childhood provides striking results (Behrman, this volume; Hoddinott and others 2008). Two nutrition supplements were randomly assigned to low-income children in rural Guatemala; children who consumed the protein-rich supplement achieved dramatically better educational performance and labor force earnings. Women who had received the protein-rich supplement during their first three years of life attained 1.17 more years of schooling; their infants' birth weight was 179 grams heavier and their children were a third taller than those of women who had consumed the calorie-based supplement as children. Men who had consumed the high-protein supplement in the first two years of their childhood earned an average wage 46 percent above that of men who had consumed the calorie-based supplement.

Thus the evidence on the value of interventions in the pre-school years is striking. Indeed, recent evidence (Figure 5 and Figure 6) suggests that the economic rate of return to preschool attendance dwarfs the returns to university or job training (Carneiro and Heckman 2003). The lack of attention to early childhood development is very costly (Heckman 2007).

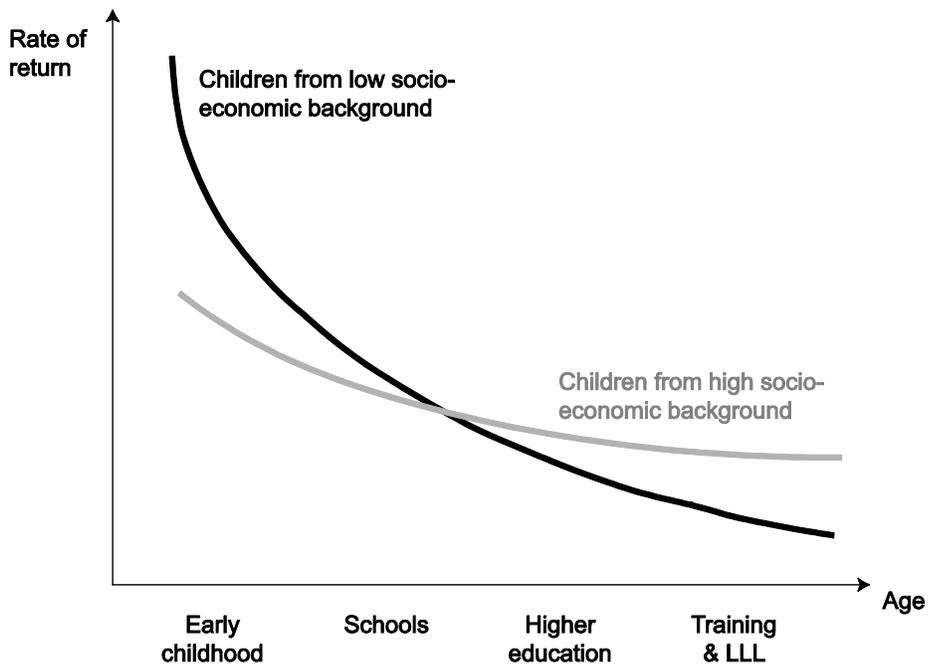
Investments in individual children before the age of three produce more significant impacts than any other social or health investments and at a lower marginal cost (Carneiro and Heckman 2003). Only investments in public health improvements may be more important, but these tend to be complements to, rather than substitutes for, interventions targeted to young children.

**Figure 5: Returns to Different Levels of Education based on Family Background**



Source: Adapted from Cunha and others (2006).

**Figure 6: Returns to Different Levels of Education and Family Background**



Source: Wößmann and Schütz (2006).

To sum up, interventions affecting early childhood development produce long-term benefits for human capital and productivity. The microeconomic studies reviewed above suggest that prenatal care, food supplements for malnourished children, and preschool for disadvantaged children, among other such investments, help to raise the potential for academic and workplace success and lifelong well-being. These results are among the most robust in terms of the direct impacts on individuals and long-term implications for their enhanced health status, productivity, and income. Perhaps even more important is the potential impact on the next generation. These findings suggest that the cycle of poverty, morbidity, and early mortality can be broken by interventions in early childhood.

Unfortunately, early-childhood investments have not received enough attention or resources. Developed and developing countries alike now have a major opportunity to enhance human capital by turning their attention to such investments.

### ***Impact of illness on income***

Investments in young children and better nutrition for malnourished children are likely to make people healthier and less likely to fall ill. But what happens to productivity when people do fall ill? A broad literature addresses this issue, using the so-called cost of illness approach to measuring the impact of health on incomes. Some studies focus on the immediate impacts of illness, including reduced labor supply and the lower productivity of sick people while on the job, and others include possibly long-term effects due to protracted separations from the labor force and disengagement from economic activities.

Two studies by Bleakley (2006, 2007) examine the effects of disease-eradication campaigns on health and economic outcomes; his results suggest that improving health could be important for growth on the margin but is unlikely to be a panacea. In his 2007 study of the impact of hookworm eradication efforts under the Rockefeller Sanitary Commission in the American South in the early 20<sup>th</sup> century, he measures the infection rates that prevailed before the intervention; on average, 40 percent of school-aged children were infected. Like Acemoglu and Johnson (2006), he uses data on infection rates by location, which reflect the geographical variation in potential benefits from hookworm eradication, to identify the impact of changes in the health environment on economic outcomes. He finds that areas with higher pre-existing infection rates saw greater increases in school enrollment, attendance, and literacy after the intervention. For example, he finds that school attendance before 1910 was negatively correlated 1913 infection rates, but that by 1920 the 1913 infection rates did not predict attendance. That is, those areas that had more to gain from hookworm eradication saw their school enrollment rates increase more. Bleakley finds similar results for literacy. Other changes in the economic environment could have led to similar trends over this period, but he argues that if so, these

influences would have affected adults in different areas in similar ways. However, he found no similar pattern among adults across the affected areas, who, by the nature of the disease, had virtually no pre-existing infection.

Bleakley (2006) undertakes a similar exercise focusing on the malaria eradication campaigns in the United States circa 1920 and in Brazil, Colombia, and Mexico circa 1955. Pre-existing prevalence rates across regions, combined with a paced eradication campaign across the US South, which provide exogenous variation, permit him to identify the impact of childhood exposure to malaria on future adult literacy and incomes. He finds that among individuals born well before the relevant eradication campaign, those born in more malarial regions had lower wages and lower literacy rates later in life, but that among individuals born well after the campaigns, pre-eradication malaria prevalence had little effect on future wages and literacy. He concludes that “persistent childhood malaria infection reduces adult income by 40 to 60 percent.”

Interestingly, Bleakley is able to differentiate the impact of morbidity from that of mortality on future income. He finds that eradication of *vivax* malaria (which causes high morbidity, but relatively few deaths) leads to significant increases in human capital formation and future income, but that eradication of *falciparum* malaria (which is relatively fatal) produces no such gains. To explain this result, he argues that though reductions in mortality rates increase the marginal benefit of human capital acquisition (because people who survive have more years in which to earn a return on human capital investments), this might have little impact on the level of investment if marginal costs are increasing steeply. By contrast, a reduction in morbidity makes it easier to attend school and to learn while there, thereby flattening the marginal cost curve, and leading to significant increases in human capital acquisition.

Bleakley (2006) uses his results to extrapolate across countries, and estimates that malaria may account for about 10-16 percent of the income gap between the US and Latin America. This suggests that eradicating malaria could modestly narrow the income gap by inducing higher growth in Latin America. He concludes that “...while reducing malaria could bring substantial income gains to some countries, the estimated effect is approximately an order of magnitude too small to be useful in explaining the global income distribution” (page 26).

The recent expansion in the availability of antiretroviral drugs in sub-Saharan Africa has enabled researchers to examine the impact of HIV/AIDS treatment on labor market outcomes. The effects on labor supply and income seem to be considerable. In a study in Western Kenya, Thirumurthy and others (2005) find that within six months of initiating treatment, a patient is 20 percent more likely to participate in the labor force, and has a 35 percent increase in weekly hours worked. Larson and others (2007) study a similar expansion of antiretroviral treatment (ART) in Kericho, a tea-growing region of western Kenya. They find that in the nine months before starting ART, HIV-positive individuals worked significantly fewer days plucking tea each month than their

comparators without HIV—but that after starting ART, the individuals undergoing treatment quickly increased the number of days they spent on this work (to 6.8, 11.8, and 14.3 days per month at one, six, and twelve full months on ART respectively), while the labor supply of their comparators remained constant at 17-18 days per month. Also, during the first six months on ART, the individuals on treatment earned on average 25 percent less than their comparators, but during the next six months of therapy they raised their earnings to 89 percent of those of their comparators.

Some studies suggest that reduced access to health care services tends to reduce the labor supply. A randomized experiment in which the prices of health services were increased in some districts in Indonesia found that health service utilization *and* labor supply fell in the districts where prices were increased. The decreases were particularly marked among people with low education levels, whose labor productivity might be expected to be more vulnerable to health shocks (Gertler Indonesia). Similar conclusions are drawn from an analysis of labor market outcomes in Canada following the phased introduction of national health insurance (Gruber and Hanratty, 1995).

Health care can work to improve children's school attendance as well as adults' labor supply. Kremer and Miguel (2004) provide something of a benchmark analysis of the link between health care and schooling by examining the impact of randomly assigned de-worming treatment across schools in western Kenya. They find that the intervention reduced student absenteeism by a quarter, with the larger gains among the youngest students, and among girls compared with boys. Despite the impressive gains in school attendance, however, the study found no effect on educational outcomes as measured by test scores. This is probably because school attendance was not enough to ensure good academic performance: complementary inputs such as teachers and facilities may have been sufficiently poor, and/or sufficiently overstretched, that children's additional days at school had little impact on learning.<sup>7</sup>

Another route by which health affects schooling is orphanhood. This has received a great deal of attention in the literature on the economic effects of AIDS. If orphans receive less education then the inter-generational transmission of human capital can be interrupted, with important, and potentially disastrous, long-term effects (Bell and others, 2003). Case, Paxson, and Ableidinger (2002) use demographic and health surveys across ten sub-Saharan countries to examine the impact of orphanhood, and find that orphans are significantly less likely than other children to be enrolled in school. In this study, however, the repeated cross-sectional nature of the data means that the interpretation of the results is not without ambiguity. Gertler, Levine, and Ames (2004) use panel data from Indonesia and find that a parental death doubles the probability that a child will drop out of school the same year. Neither of these two studies finds a gender

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<sup>7</sup> Kremer and Miguel (2004) suggest that the classroom overcrowding that resulted from reduced infection rates could have offset any positive effect from lower absenteeism.

effect, either at the parent or child level. Other studies find little impact of parental death on schooling, possibly because members of extended families take on the parenting function (Ainsworth, Beegle, and Koda 2002; Kamali and others 1996; Lloyd and Blanc 1996).<sup>8</sup>

Consistent with this view, Fortson (2006: 26) reports that children in areas in southern Africa with high HIV prevalence are “less likely to attend school, less likely to complete primary school, and [they] progress more slowly through school.” Fortson shows that more than half of this impact on schooling can be attributed to the expectation of a shorter life of the parent, and not to orphanhood itself; orphans and non-orphans both do badly when adults expect to die sooner. Reductions in adult mortality might lead to greater investment in children’s education, because of higher demand either by parents or by children themselves, who expect to reap the future returns for longer.

Another important dimension of poor health is the economic impact it has on other people. Thirumurthy and others (2005), studying the impact of HIV/AIDS treatment in Kenya, find that the labor supply of other household members changes: young boys and women in the household work considerably less after the patient in their family starts treatment, though girls and men in the household do not change their labor supply. The authors highlight the important potential implications for schooling outcomes. Beegle and others (2006) study the impact of mortality from AIDS on the economic well-being of surviving household members, in both the short and long term, in a 13-year cohort of individuals in Tanzania. The authors find that households who had experienced an adult death due to AIDS saw a reduction in their consumption of 7 percent after five years, while households not so affected saw an increase in their consumption of 12 percent over the same period. Thus, *vis-à-vis* the average household, households who experienced an adult death due to AIDS suffered a 19 percent fall in consumption after five years. There is some evidence that such losses are persistent, although they are estimated imprecisely, and the possibility that they are reversed in the long term cannot be rejected. Interestingly, the authors found that losing a *female* adult to AIDS leads to a particularly severe fall in consumption.

### **Using macro-accounting to assess economic returns**

A third group of studies attempt to overcome the shortcomings of macroeconomic and microeconomic studies by combining the two approaches. Their use of more refined techniques and reliance on measures that better capture the economic effects of health and nutrition investments provide an

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<sup>8</sup> Evans and Miguel (2003) (as discussed in Miguel 2007) use data from the randomized deworming project in western Kenya to address some of the identification issues that trouble cross-section and panel data studies. Their results on the impact of parental death on schooling mirror those of Case and others (2002) and Gertler and others (2004): parental death seems to reduce schooling, and there is little difference by gender.

arguably firmer foundation than do the macro studies for drawing conclusions about the link between health and growth.

Weil (2005) and Shastry and Weil (2003) use a different methodology to estimate the share of cross-country variation in income that can be associated with differences in health status. Combining microeconomic estimates of the impact of health on productivity with a macroeconomic accounting model, they decompose aggregate country output into a (residual) productivity term plus the return to factors, including physical capital, educational human capital, and health human capital. Measures of output, physical capital, and educational capital (proxied by years of schooling), are readily available for some countries; the challenge is to construct a measure of health that is relevant to productivity.

Weil's (2005) approach to accounting for the effect of health on economic performance is to estimate the returns (in terms of higher wages) to a number of health indicators, including adult height, the adult survival rate, and the age of menarche, using instruments for differences in health inputs, birth weight differences between twins (see e.g., Behrman and Rosenzweig, 2004), and historical data on caloric intake (see Fogel, 1997). He finds that a 10 percent increase in the adult survival rate would lead to an increase in labor input per worker of 6.7 percent and in GDP per worker of about 4.4 percent. Notably, this estimate of the increase in GDP per worker is much smaller than other such estimates in the literature.<sup>9</sup> Weil calculates that about 9.9 percent of the variance of log GDP per worker is attributable to health and nutrition gaps between countries. He concludes that "My estimates do not match the characterization of ill health as a major stumbling block to economic development, as described in the WHO report on macroeconomics and health....."

When general equilibrium effects associated with fertility and population changes are incorporated into Weil's analysis - which, as Acemoglu and Robinson (2006) point out, implicitly assumes a fixed population size - the estimated impact of health on per capita income may be somewhat smaller. On the other hand, the aggregation methodology does not allow for certain behavioral responses to improved health, such as changes in savings rates or educational choices, which could possibly increase incomes in the long term. In a more recent paper, Ashraf, Lester, and Weil (2007) incorporate these additional channels by which health changes might affect growth, but they still find only modest income gains.

The conclusions from these combined micro-macro studies are in the same vein as those of Bleakley's (2006) analysis: health improvements can improve economic performance, but are unlikely to explain why some countries lag far behind others in material well-being. Moreover, because the most significant

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<sup>9</sup> Indeed it lies *below* the lower bound of the 95 percent confidence interval for the same measure as estimated by Bloom and Canning (2005), using a cross-country regression with lagged variables as instruments.

health improvements occur early in life, the associated income effects take a long time to come to fruition.

## **Health-Related Interventions and Health: Evidence and Policy Implications**

The above review of the literature suggests that the link from health to growth is still not beyond dispute, although our interpretation is that the link, if it exists, is relatively small.

What this means for policy choices is not immediately clear. Improving life expectancy by a year might increase a country's income by some amount, but *how* such a health improvement is to be achieved is the subject of a whole separate literature. It is a question that needs to be addressed, however, whether we care about health only for its own sake or also for its potential role in improving incomes.

Experience shows it will not be that easy to spend our way to better health, and thence, if there is a causal link, to higher growth: just as growth-inducing policy interventions are elusive, so too health-improving strategies can be difficult to identify and politically unpopular.<sup>10</sup> All too often the link from spending on health care to health outcomes is weak (Filmer, Hammer, and Pritchett, 2000).

This section thus examines the literature on the determinants of a population's health with a view to drawing broad lessons for policy. We first provide a historical overview of the main causes of improvements in health, many of which—such as improvements in food supply, sanitation, and control of disease vectors—lie outside the health care field. We then look at aspects of the current relationship between health care spending and a population's health status, focusing particularly on institutional issues within the health care sector in developing countries that affect the efficiency of public spending on health.

### **Causes of historical improvements in health**

The dramatic improvements in health status of the past 50 years—most obvious from the declines in mortality and increases in life expectancy—stem mainly from improvements in nutrition, advances in public health, and education; for

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<sup>10</sup> Indeed, while the technical and scientific knowledge exists to solve many health problems, the fact that these solutions are often not widely adopted suggests they are not simple to implement (World Bank 2008). For example, oral rehydration therapy (ORT) is a simple and cheap way to reduce diarrhea, which kills more than four million children a year. But ORT fails to reach needy families in some developing and transition countries for the same reasons most redistributive policies are not fully effective: political trade-offs, vested interests, corruption, and a general lack of resources.

populations at large, higher spending on health care has had minimal impacts on mortality.

Historically, inadequate food production and the resulting malnutrition compromised adult productivity. For example, data from the UK show that until the late 18<sup>th</sup> century UK agricultural production could only feed 80 percent of the population. Greater output raised nutritional status, leading to longer working hours, while parallel public health investments improved the use of the calories (Fogel 2002). Fogel (1986) concludes that nutritional improvements have contributed about 40 percent to the decline in mortality since 1700, with sharp rises in nutritional status occurring in periods of abundant food—mostly in the 20<sup>th</sup> century.

Along with better nutrition, advances in hygiene and education have played a more important role in reducing mortality than advances in medicine. McKeown and others (1962, 1975) examine the reasons for mortality declines in England and Wales during the 19<sup>th</sup> and 20<sup>th</sup> centuries. Mortality was affected by medical measures such as immunizations, but reduced exposure to infection, expanded access to piped water and sanitation, and better nutrition were the major factors explaining the rising survival rate. Reduction in death from airborne infections occurred before the introduction of effective medical treatment, and better nutrition had a large effect on both the ability to ward off infection and the probability of death. Mortality declines from water- and food-borne diseases could be traced to improved hygiene and better nutrition, with treatment emerging as largely irrelevant. Similarly, Fuchs (1974), in his study of infant mortality reductions in New York City between 1900 and 1930, attributed these shifts mainly to rising standards of living, education, and lower fertility, rather than to medical advances. Fogel (2002) compares morbidity levels in the post-Civil War period in the US with those in the latter part of the 20<sup>th</sup> century, and finds that morbidity levels have fallen significantly, partly because of changes in lifestyle and partly because of other factors including medical interventions. Lleras-Muney (2002) examines the determinants of life expectancy in the US using a synthetic cohort beginning in 1900. Her estimates indicate that each year of education increases life expectancy at age 35 by as much as 1.7 years—a very significant increase that suggests the central importance of education. Similar findings are reported in multiple studies in developing countries (Schultz 2001).

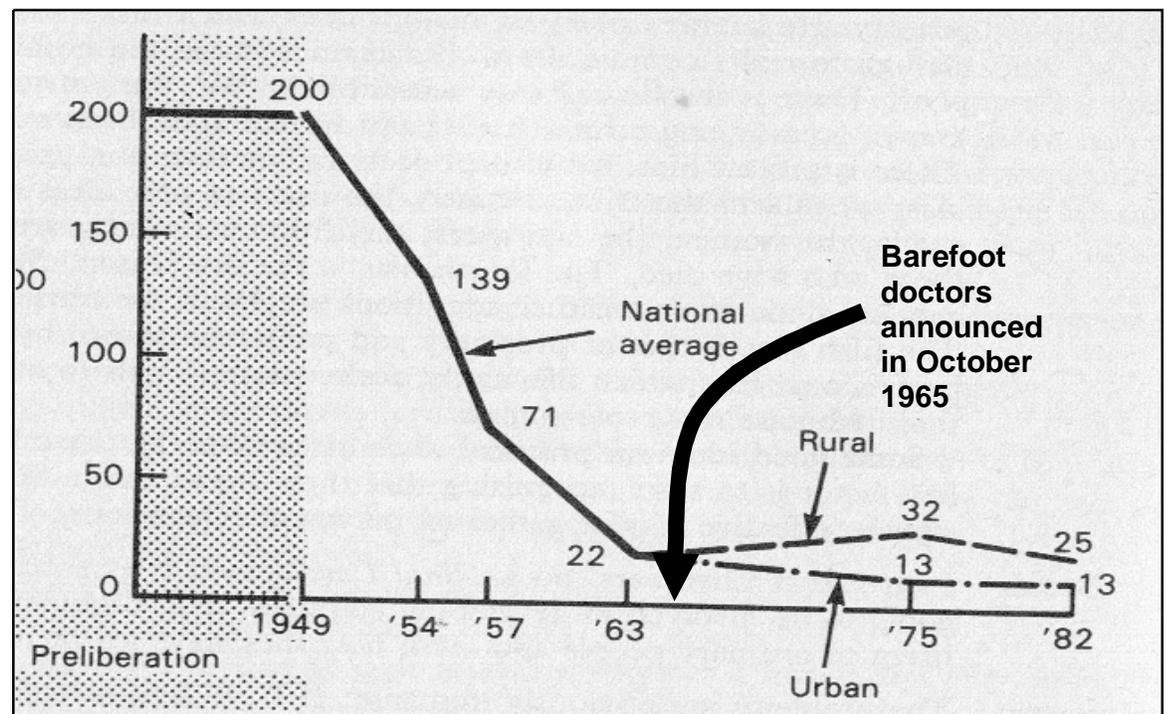
Later evidence from OECD countries suggests that changes in lifestyle and nonmedical advances have had a bigger impact than medical advances and health care on longevity and well-being. Lifestyle characteristics such as reduced cigarette smoking and more moderate alcohol consumption have made the US population healthier (Wolfe 1986).

Both in OECD countries and China, many of the most effective therapies for infectious diseases only emerged after the improvements in public health were well established. McKinley and McKinley (1977) examined declines in infectious

diseases in the US over the period 1900-73 and, like other researchers, found that effective treatments emerged only after the incidence of these diseases had fallen; non-medical factors had played important roles in reducing morbidity and mortality from those diseases. China has historically shown much better health indicators than its income might predict. Though much of this achievement was popularly attributed to the country's barefoot doctors—minimally trained medical personnel who were tasked with providing primary health services—most of the improvements in infant and child mortality occurred *before* the barefoot doctors began to be deployed in 1965, and when the barefoot doctor system was abandoned, China's health status did not decline. The early health improvements can be credited to, among other things, Chairman Mao's "five pests" campaign, his exhortation to drink tea instead of (unboiled) water, and generally safe latrines. Figure 7 illustrates the lack of evidence linking barefoot doctors to health improvements.

Underlying the health improvements that countries achieved were investments that were informed by advances in public health science. Periodic epidemics of cholera, malaria, and other infectious diseases plagued Europe and the Americas during the 19<sup>th</sup> century until the science of disease transmission developed and viable interventions were discovered.

**Figure 7: China's Health Improvements and the Advent of Barefoot Doctors**



Source: Hsiao (1984).

Note: The vertical axis measures the infant mortality rate, per 1,000. The curved arrow and associated text have been added.

Major investments in public health in the 19<sup>th</sup> century—in response to the work of Snow (1848) linking contaminated water with cholera— resulted in dramatic declines in mortality. Simply eliminating people’s contact with sewage-contaminated water contained the cholera epidemic in London in 1854 (Crosier 2007).

Similarly, the Thames embankment, which helped the river move effluent out of London, and the draining of swamps elsewhere led to the disappearance of malaria in the United Kingdom (Kuhn and others 2003). More recently, Cutler and Miller (2005) studied the impact of clean water on health, looking at the results of the adoption of filtration and chlorination by United States cities in the first quarter of the twentieth century. They attribute nearly half of the total mortality reduction in major cities, three quarters of the reduction in infant mortality, and two-thirds of the reduction in child mortality to improved water supply.

An important factor that facilitated the introduction of public health measures was centralized decision making with little involvement of citizens. Eminent domain effectively ensured that public health measures in Europe and parts of the Americas were implemented before the 20<sup>th</sup> century. For example, beginning in the mid-19<sup>th</sup> century in the Americas, concerns to protect trade from the costs of tropical illness such as yellow fever and malaria were addressed through intense surveillance, control of disease vectors, sanitary improvements, and significant investments in parasitological research centers (PAHO 2007?). A recent example of collective action to enhance human and economic well-being is the multi-country and multi-donor funded Onchocerciasis (river blindness) Control Program in the Niger Delta in West Africa. The program of spraying infected areas with pesticide has effectively controlled the black flies responsible for this debilitating and lethal human infection. It has enabled the recultivation of 25 million hectares of fertile agricultural land, which had been abandoned because of the prevalence of the disease (Benton 2006).

Other such public health interventions are needed across the developing world to deal with some of the same challenges that confronted European cities in earlier times. The World Bank estimates that a billion people lack access to clean water and 2.6 billion (or roughly 40 percent of the world’s population) lack access to basic sanitation. Some 94 percent of diarrheal cases worldwide can be attributed to unsafe drinking water, poor sanitation, and inadequate hygiene, with 1.5 million cases resulting in death, mostly among children (World Bank 2008).

### **Market failures and the financing and delivery of health care**

As well as investing in public goods that improve health and hygiene, all governments take an active role in the financing and provision of health care, which has the attributes of a private good, due to significant failures in private markets for both health care and insurance. Economists have long understood

the limitations of unfettered private markets in delivering health care. First, an agency problem can exist between the provider and the patient: the patient, being at an informational disadvantage, might not know the cause of illness or what health intervention, if any, is appropriate, and is at the mercy of the provider. Of course, similar problems exist in many service markets, from auto repair to accounting services, many of which appear to operate reasonably well.

The second feature of medical care markets that can restrict their efficiency is individuals' need for insurance against the possibility of random catastrophic events. Such events can expose individuals to significant risks, but adverse selection might limit the extent to which private markets can spread those risks. Governments sometimes respond by financing and/or delivering medical care themselves (as in the UK National Health Service), in order to maintain coverage of a broad pool of individuals. This desire to provide a safety net explains the significant presence of public spending on health in most developing countries and, especially, in countries in transition from communism, where governments continue to dominate health care delivery.

Some countries couple more or less universal public insurance with private provision of medical care. Examples include the US insurance programs for the elderly (Medicare) and the poor (Medicaid), the French, German and Australian health care systems. In much of the developing world, universal health care translates into government financing and provision with parallel out-of-pocket and insurance purchases from the private health sector, mandatory wage taxes, or general revenue underwriting health care costs. Transition countries, with their history of generous government financing and provision, now combine public provision and finance with some private sector activity and informal, under-the-table payments to public providers.

Relatively open-ended public insurance coverage, in conjunction with strong profit motives in the private sector, can often lead to inefficient levels of care, such as over-prescription and unnecessary procedures. Not facing the (marginal) cost of their decisions regarding use of services, people opt for excess testing, treatment, and other benefits. Even if there is no agency problem between provider and patient, insurance leads to over-consumption. These moral hazard effects have led to the introduction of provider payment systems based on performance, quantity controls, and other cost control efforts. An OECD-wide study of health care (Docteur and Oxley 2002) identified spiraling costs and the need for cost-containment measures as the single most important issue in health policy. Developing and transition countries can avoid the mistakes of OECD countries by putting in place approaches that offer incentives to mitigate the problems that the richest countries now confront.

Physician agency, adverse selection, and moral hazard together suggest that health care services will be provided in excess to people with insurance, and deficiently to people without. In practice, however, the failures of the medical care market are more nuanced. While spending might be excessive in some

countries, the actual delivery of useful services does not always follow suit: far from spending and getting too much, society spends too much and gets too little. Similarly, the theory of adverse selection implies that the bad (risks) will drive out the good (risks): but policymakers usually express exactly the opposite concern, that people with high risks will not be able to afford insurance. Publicly financed insurance is then likely to appear expensive, precisely because it covers relatively expensive, high risk, individuals.

### **Cross-country evidence on health care spending and health in developing and transition countries**

Cross country evidence on the link between health care spending and health status is not encouraging. Both market *and* government failures combine to complicate the design of health policy in general, and the financing and delivery of health care in particular. Indeed, considerable debate continues over what effect, if any, public spending on health care has on health in developing and transition countries. At first, this ambiguity seems surprising—surely spending on widgets should produce widgets?

However, the reasons that public spending on health care might not improve health, as set out by Filmer, Hammer, and Pritchett (2000), are economically straightforward. First, if there is a functioning private market for health care, public spending may simply replace private activities, rather than adding to the aggregate supply of health care. Second, public purchase of health care services does not necessarily assure their delivery to patients: doctors who are paid but don't show up to work, drugs that are procured but are siphoned off, and diagnostic equipment that lies idle for lack of maintenance or complementary inputs such as electricity or skilled labor, all contribute to health spending but not to health. Third, the technical efficacy of some health care spending (on garlic as a cure for AIDS, for example) is very low or even zero, so that even if some publicly financed services are delivered to patients, they might have little effect.

One way to examine the impact of public spending on health is to employ cross-country regression techniques as in the health-income literature reviewed in Section 2 above. In this case, though, we can be somewhat more confident about the use of cross-country comparisons, because problems of endogeneity seem to be less severe: it is unlikely that better population health would, in itself, lead to greater public spending on health.

Filmer and Pritchett (1999) regress under-five mortality on a variety of variables, including public health spending, and find that virtually all the cross-country variation is due to average per capita income, its distribution, female education, ethno-linguistic diversity, and religious and regional dummy variables. That is, health spending is more or less uncorrelated with health outcomes: independent variation in public health spending explains a paltry one-seventh of one percent of the variation in child mortality.

Wagstaff and Claeson (2005) examine how these results are affected by good governance. They find that health spending does reduce under-five mortality as long as the quality of governance, as measured by the CPIA index, is high.<sup>11</sup> Flawed institutions would be expected to produce limited and poor-quality health services. But Lewis (2006) finds no association between the effectiveness of health spending and proxy measures for the effectiveness of institutions in the health sector—either the government effectiveness or the corruption measures of Kaufmann, Kraay, and Mastruzzi (2005).

One channel through which public spending may affect health—and one that, implicitly or otherwise, motivates some calls for greater spending—is its impact on the poor. Bidani and Ravallion (1997) find that public health spending significantly affects the health of the poor, but (consistent with Filmer and Pritchett 1999) not aggregate health.

In more recent work, Boone and Zhan (2006) investigate the determinants of child mortality using survey data on 278,000 children in 45 low-income countries. Their results provide some nuances to those of Filmer and others (2000). Somewhat controversially, they find that the prevalence of common diseases, and the supply of infrastructure such as water and sanitation, are *not* good predictors of child mortality, but that parents' education and a mother's propensity to seek out modern medical care are. Here the simulated effects they report appear large: for example, they find that if all mothers and fathers in the 45 countries had years of schooling equal to those of parents in Egypt, child mortality in these countries would fall by 19 percent. On the other hand, they report that halving the prevalence of diarrhea, fever, and cough would reduce child mortality by only 3 percent.<sup>12</sup>

In keeping with the results of country-level studies, Boone and Zhan (2006) conclude that educated parents demand health services, and that these services will be forthcoming from the private market. Educated parents may well be better able to induce a supply of quality medical care from the private market. They might even be better able, or better motivated, to ensure good governance procedures within the public sector, thereby improving both the quality of publicly delivered medical care and the reliability and adequacy of public infrastructure.

In the OECD countries the evidence on the impact of health spending on health status is tenuous. Bunder, Frazier, and Mosteller (1994) suggest that the main effect of health care is on the quality of life and well-being, as measured by

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<sup>11</sup> This is as much good news for health spending as it is for the CPIA (Country Program and Institutional Analysis) as a measure of governance. "Good" public spending should lead to improved health outcomes (unless it simply crowds out private spending), so the fact that countries with high CPIA scores show a positive link from spending to health is consistent with the CPIA measuring something relevant.

<sup>12</sup> These numbers are, however, difficult to apply to decision making, as the costs of the two hypothetical interventions are not reported.

increases in activity and mobility. This indirect evidence suggests that health care plays a key role by providing information (about lifestyle and prevention) and reducing morbidity.

### **Country-level evidence on the effectiveness of health care spending: the importance of institutions**

Examining why the link between health spending and health status is so tenuous is easiest to do at the country and health-facility level where institutional issues can be fully explored. Limited data and research on the subject complicate the design of effective policies, but evidence is beginning to emerge on the nature of health institutions in developing and transition countries and the kinds of services that they support. Our reading of the literature suggests that the more severe constraints on improving health through the delivery of health care in developing countries are institutional, and include the provision and enforcement of basic performance incentives and cost containment. This section discusses some recent evidence on these topics and their relevance for institutional strengthening to improve health status.

Access to health care has improved markedly in the last two decades but the quality of public health care services has only recently been examined. For the most part it has been found wanting. Recent evidence suggests that ineffective incentives and lack of accountability undermine the public provision of health services, leading to underperformance and substandard care (Lewis 2006). This may help to explain why public spending shows minimal effects on health status. Jack and Lewis (2004) attribute the shortcomings to government failure, effectively “government interventions that have gone wrong.”

Institutions in health care are important but under-studied. The lack of sound institutions undermines health investments and leads to ambiguous evidence on the relationship between health care services and health status. Accepted indicators of health care performance such as hospital infection rates, utilization statistics, or surgery survival rates are rarely collected even where required due to lack of some combination of oversight, regulation and enforcement. And this applies to middle-income countries as well. Indirect indicators of poor performance that have emerged in response to the lack of more direct measures include: provider absenteeism, lack of basic medical supplies and drugs, poor management of purchases, corruption in selling public positions, leakage of funds and under-the-table payments by patients, all of which highlight the nature of the performance lapses (Lewis 2006).

An extraordinarily important factor in public health care is simply whether workers show up. Chaudhury and Hammer (2004) report shockingly high rates of absenteeism among doctors in rural Bangladesh: 40 percent of doctors in large clinics were absent, and fully 74 percent of doctors in small (single-doctor) clinics were not at work. Chaudhury and others (2005) report figures on the absenteeism of health workers and teachers across six developing countries

(Bangladesh, Ecuador, India, Indonesia, Peru, and Uganda). They find average absenteeism rates of 39 percent for doctors, and 31 percent for other health workers across their sample. Results from a range of countries—India, Tanzania, and Brazil—are instructive. A study in India finds that the public sector provides medical practitioners with attenuated incentives for good performance: Das and Hammer (2007) report the results of observing more than 4,000 doctor-patient interactions in Delhi and comparing clinical practices with what the doctor knew to be appropriate behavior (as appraised in previous vignettes). They find (p. 8) that “[p]ublic doctors exert much less effort than their private counterparts.” In addition, better trained doctors do not necessarily provide better service: Das and Hammer find that although providers without a medical degree are less competent (i.e., know less about what *should* be done in clinical situations), those with medical degrees exert significantly less effort. Indeed, “[c]learly incentives are strong for MBBS [i.e., degree holding] doctors to do less than they know, and stronger still in the public sector.”

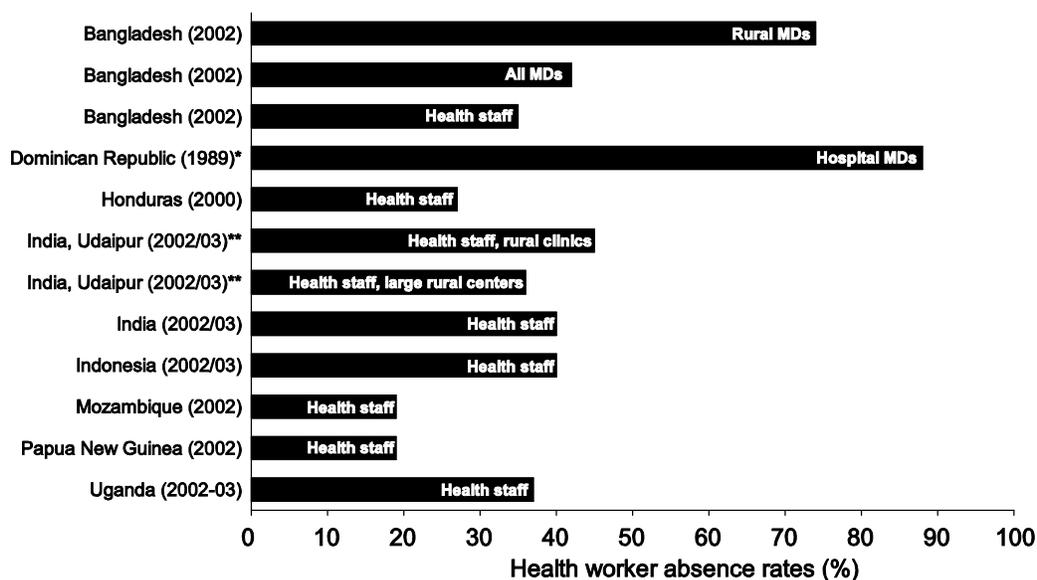
Figure 8 summarizes evidence from these studies and others that show similarly high rates of absence using different methods including surprise visits, time-in-motion studies, and clinical observations. Absenteeism has been captured in qualitative work as well (DiTella and Savedoff 2001).

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<sup>13</sup> Vignettes are case studies that assess adherence to clinical protocols.

**Figure 8: Absence Rates among Health Workers in Selected Countries, 1989–2003**



Sources: Chaudhury and Hammer (2004); Chaudhury et al. (2006); Banerjee, Deaton and Duflo (2004); Lewis, La Forgia and Sulvetta (1996); Lindelow, Kushnaroova and Kaiser (2006); Lewis (2007).

Notes: \*Santo Domingo Hospital, Dominican Republic. \*\*Udaipur district, Rajasthan, India.

In Tanzania, using vignettes and direct clinical observation, Leonard and Masatu (2006) show that NGO physicians consistently provide more accurate diagnoses and better treatment than their public sector colleagues. The main differences are that NGOs charge more, and exhibit better management, incentives, and accountability. These authors' results suggest that performance is better where facility directors have greater authority, and particularly the ability to hire and fire staff and adjust compensation. Leonard and Masatu (2007) indicate that in rural Tanzania a physician's training has little effect on performance once the ownership of the provider is taken into account: what counts is not what you know but what you do, and the two are unrelated where incentives are not in place to encourage the application of medical knowledge.

In Brazil, a recent experiment in hospital autonomy in twelve general public hospitals in Sao Paulo state led to significantly higher productivity of staff, more care, lower infection rates, reduced mortality, and lower costs when compared to a set of twelve traditionally managed general public hospitals of the same size in other similar locations. The ability to contract and terminate staff, and initiate efficiency measures, provided powerful incentives for better hospital performance. Hospital directors who did not improve under the pilot project had their appointments terminated. Monthly tracking of performance led to impressive improvements in both quality and efficiency in hospitals where the ability to terminate both staff and management appointments provided accountability to the state funding agency (La Forgia and Couttelenc 2008).

The evidence from India, Tanzania, and Brazil highlights the critical roles of incentives, supervision, and accountability in raising performance and ensuring

that expenditures will have positive returns in enhancing the health status of patients. Lewis (2006) summarizes a wealth of complementary evidence on issues of financing and delivery of care, identifying shortcomings and their measurement, and emphasizing the importance of incentives and accountability if health institutions are to contribute effectively to improving health status and individual well-being.

One response to poor performance in public facilities is to shift the focus to private actors, but as Hammer and Das (2007) have illustrated, this is by no means a panacea in service delivery for the reasons discussed above. At the same time, adverse selection problems in the insurance market can lead to a breakdown in private insurance coverage as the unhealthy and the poor are excluded. In this case, some form of mandatory insurance coverage, even if privately provided and financed, may be necessary to avert an adverse selection spiral. This is the approach taken in Chile, Colombia, and Switzerland, and more recently in the US state of Massachusetts. In all of these cases, and others, the government regulates the private purchase of insurance by people earning middle and upper incomes, while subsidizing coverage for the poor, who would otherwise be unable to comply with the insurance mandate.

To sum up, if health care spending is to improve health status, institutions matter. The systemic problems are increasingly well understood, but without shifts in the institutions and the incentives for performance embedded in them, the link between spending and outcomes is likely to remain weak.

## Conclusions

The impacts of a population's health on national income are hotly debated, and they probably vary depending on the health indicator used and the countries included in the analysis. Some cross-country regressions using instrumental variables find quite large impacts of health on income, but few other analytical approaches yield similar results. Part of the problem in resolving the debate lies in the fact that comparisons of health and non-health interventions in non-experimental environments are besieged by identification problems, while (quasi-) experimental settings that would allow such comparisons are especially rare. It is difficult enough to estimate the impact of a health *or* growth intervention compared with the status quo, but comparing health *and* growth interventions has proven especially intractable, particularly in light of the vast array of interventions that are feasible in both areas.

The two empirical approaches to this dilemma have been, first, to estimate the effects of arguably exogenous innovations in population health status on incomes at the macro level, and second, to focus at the micro level on the impact of specific health interventions on economic outcomes.

At the macro level, our tentative conclusion is that the effect of health on income is small if it exists at all. At the micro level, some clear causal relationships have been documented from health to earning potential and income.

Though the macro and micro analyses seek to provide information on the impacts of improved health on incomes, neither of them can really tell us whether an extra dollar of public funding should be allocated to the health sector or to an alternative, or about which interventions provide the biggest bang to health *and* income for the buck. Our reading of the literature suggests that some health policies and investments—particularly those with pure public-good attributes—can plausibly have important impacts on incomes, but that at the macro level health and incomes are at least as likely to be jointly determined by such intangible features as institutional quality, corruption, and public sector accountability.

The lack of clarity about the link from health to economic growth is not a reason to refocus public investment away from the health sector. The link from growth to health itself takes many forms, and it would seem to be a mistake to put all our eggs in the growth basket if we care about health for its own sake. The more pressing problem is to improve the link from health spending to health outcomes: scarce resources allocated to the health sector that have little impact on health are very unlikely to have the knock-on effect on incomes that some scholars and advocates seek. Strengthening the first link in that chain, from health spending to health, through improvements in accountability and incentives, should be a priority for health policy. Even if it turns out there is little effect on growth, the improvements in health status will be worth the effort.

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