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Relationships between Economic Growth and Population

Health in Low and Middle Income Countries^{*}

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Abstract:

From 1960 to the present, many low and middle income countries have experienced significant economic growth and unprecedented improvements in population health. We examine the complex relationship between economic growth and population health, including the economic and health impacts of malaria, tuberculosis, HIV/AIDS, malnutrition, reproductive health issues, and the associated intervention policies. We also examine the impact of several pertinent economic policies on population health, including microfinance, the TRIPS agreement, and UNITAID, an international organization for purchasing drugs for use against AIDS, malaria, and tuberculosis. In addition we examine the effects of globalization on population health and economic growth. The evidence indicates that investment in improved population health is a reasonable macroeconomic policy tool for economic growth in low and middle income countries because improved health status has a positive impact on economic performance, and diminished health status has a negative impact on economic performance. Furthermore, variations in the rates of diffusion of disease control technologies have been a major cause of the variations in population health and economic growth between countries. Since 1960, low and middle income countries have been much more successful in closing the life expectancy gap than the economic development gap with high income OECD countries. Finally, while some progress has been made, achieving the infant and childhood mortality Millennium Development Goals will require a substantial investment in the increased diffusion of existing disease control knowledge and technology. Increased income per capita alone will not be sufficient.

JEL classification codes: O15, O19, O20

Key words: Population health, economic growth, disease and nutrition, globalization, development policy

I. Introduction

Policy makers need to understand the significant interrelationships between economic growth and population health in low and middle income countries (Jamison, 2006; Jamison et al., 2005; Bloom and Canning, 2006; Bloom et al., 2004b; Franzini et al., 2005). Both economic and health-related

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policies have multiple impacts and can significantly affect the other policy target area. Policies designed to foster economic growth can by their success have a significant impact on population health. Similarly health-related policies can have a significant impact on economic growth. It is important for policy makers in both of these areas to understand and take these multiple impacts into account in the policy development process.

The rest of the paper is organized as follows. After reviewing historical trends in the interrelationships between economic growth and population health (Section II), we examine the empirical evidence on the impact of health status on improved economic performance and the impact of life expectancy on aggregate economic performance (Section III). Then we examine health-related policies and their impact on income and other measures of economic performance, emphasizing infectious disease policies related to malaria, tuberculosis and HIV/AIDS, as well as nutrition and reproductive health policies (Section IV). Next we consider the evidence on the impact of economic policies on population health (Section V). Then we review globalization's negative and positive impacts on population health (Section VI). Finally, based on the available evidence, we present our conclusions and a set of recommendations that we believe the evidence and conclusions support (Section VII).

II. The Aggregate Determinants of Population Health

There is a strong, positive association between economic growth and improved population health in very poor countries; however, the strength of the relationship diminishes as gross domestic product per capita (GDP/P) increases (Bloom et al., 2004b; Jamison, 2006). Recent research has established that while economic growth may be a necessary condition for widespread population health improvement in very poor countries, the magnitude of the gains in other low and middle income countries has been more dependent on the adoption and diffusion of new disease control technologies and the increased availability of education (Jamison, 2006; Bloom et al., 2004b; Deaton, 2003, 2004; Jamison et al., 2005).

Since 1960 low and middle income countries have experienced remarkable gains in life expectancy, from an overall average of 45 years in 1960 to 66 years in 2005 (Table 1), significantly closing the gap with industrialized countries. In addition, from 1960 to 2005, across all of these countries, GDP/P nearly tripled (in constant U.S. dollars), but there were substantial regional variations. East Asia and the Pacific had the largest gains, nearly a ten-fold GDP/P increase and a remarkable 32 year increase in life expectancy from 39 to 71 years. During this period, Sub-Saharan Africa had a relatively small 29% increase in GDP/P and an increase in life expectancy of only eight years (from 41 to 49 years). Countries in Latin America and the Caribbean and South Asia experienced intermediate growth: the GDP/P doubled in Latin America, with an associated improvement of 17 years in life expectancy, and GDP/P tripled in South Asia, with an increase of 20 years in life expectancy.

Table 2 illustrates that low and middle income countries have been much more successful in closing the life expectancy gap than the economic growth gap with high income OECD countries. Bangladesh,

Table 1
GDP Per Capita, Longevity and Poverty in Low and Middle Income Countries, by Region, 1960-2005

	1960	1975	1981	2005
South Asia				
Population, millions	565	804	924	1,476
GDP/P:				
-constant U.S. \$	186	224	248	564
- PPP, constant international \$	-	-	901	2,070
Life expectancy, years	44	-	-	64
Under age 5 mortality rate ¹	238	181	-	85
Living on <\$1/day, % ²	-	-	51.6	32.0 ³
East Asia and Pacific				
Population, millions	902	1,255	1,379	1,884
GDP/P:				
-constant U.S. \$	141	212	284	1,358
-PPP, constant international \$	-	-	831	3,895
Life expectancy, years	39	-	-	71
Under age 5 mortality rate ¹	205	98	-	31
Living on <\$1/day, % ²	-	-	57.7	9.0 ³
Sub-Saharan Africa				
Population, millions	226	332	398	763
GDP/P:				
-constant U.S. \$	434	587	585	561
-PPP, constant international \$	-	-	1,687	1,672
Life expectancy, years	41	-	-	49
Under age 5 mortality rate ¹	273	213	-	159
Living on <\$1/day, % ²	-	-	42.3	41.1 ³
Latin America & Caribbean				
Population, millions	215	318	365	549
GDP/P:				
-constant U.S. \$	2,065	3,157	3,585	4,155
-PPP, constant international \$	-	-	7,140	8,355
Life expectancy, years	56	-	-	73
Under age 5 mortality rate ¹	154	105	-	28
Living on <\$1/day, % ²	-	-	10.8	8.6 ³
Low income countries				
Population, millions	847	1,219	1,413	2,376
GDP/P:				
-constant U.S. \$	206	248	262	478
-PPP, constant international \$	-	-	918	1,720
Life expectancy, years	43	-	-	60
Under age 5 mortality rate ¹	242	189	-	114
Low & middle income countries				
Population, millions	2,327	3,241	3,643	5,438
GDP/P:				
-constant U.S. \$	484	753	869	1,437
-PPP, constant international \$	-	-	2,486	4,112
Life Expectancy, years	45	-	-	66
Under age 5 mortality rate ¹	-	148	-	80
Living on <\$1/day, % ²	-	-	40.6	18.4 ³
High income OECD countries				
Population	695	773	806	939
GDP/P:				
-constant U.S. \$	9,010	15,294	17,802	29,012
-PPP, constant international \$	-	-	20,471	33,585
Life Expectancy, years	69	73	74	79
Under age 5 mortality rate ¹	43	18	13	6
Living on <\$1/day, % ²	-	-	nil	nil

Notes: 1 Per 1,000 live births; 2 The World Bank threshold for extreme poverty; 3 Data are for 2004.
Source: World Bank, *World Development Indicators*, 2007

Table 2
Life Expectancy and GDP Per Capita in Selected South Asian Countries, 1960-2005

	<u>1960</u>	<u>2005</u>	<u>Δ Years</u>	<u>% Δ</u> <u>Life Exp.</u>	<u>%<1960</u> <u>OECD:</u> <u>In 1960</u>	<u>%<2005</u> <u>OECD</u> <u>In 2005</u>
Bangladesh:						
Life expectancy at birth	40	63	24	+58%	42% ¹ 9% ¹	20% ²
GDP/P (constant U.S. \$)	235	400	—	—	97% 96%	99%
India:						
Life expectancy	44	64	20	+45%	36% 7%	19%
GDP/P (constant U.S. \$)	181	588	—	—	98% 93%	98%
Indonesia:						
Life expectancy	41	68	27	+66%	41% 1.5%	14%
GDP/P (constant U.S. \$)	196	942	—	—	98% 89%	97%
Nepal:						
Life expectancy	39	63	24	+62%	43% 9%	20%
GDP/P (constant U.S. \$)	134	234	—	—	99% 97%	99%
Pakistan:						
Life expectancy	44	65	21	+48%	36% 6%	18%
GDP/P (constant U.S. \$)	188	606	—	—	98% 93%	98%

Notes: 1. For example, life expectancy for Bangladesh was 42% below the OECD's life expectancy in 1960, and by 2005 it was only 9% below the OECD's 1960 level; whereas in 1960 GDP/P (constant U.S. dollars) was 97% below the OECD's in 1960 and by 2005 it was 96% the OECD's in 1960.

2. 2005 country data compared to 2005 OECD data; in 2005 life expectancy in Bangladesh was 20% below that of the OECD in 2005, while GDP/P was 99% below that of the OECD in 2005.

Source: World Bank, *World Development Indicators*, 2007.

India, Indonesia, Nepal, and Pakistan experienced remarkable life expectancy gains of more than 23 years during 1960–2005 without significantly closing the GDP/P gap, even relative to 1960 OECD GDP/P levels. In 1960, life expectancies in these countries were 40% below the OECD average of 69 years, but by 2005 they were only 6.5% below the 1960 OECD average and 18% below the 2005 OECD average of 79 years. While not achieving parity with the OECD, it was nevertheless a phenomenal improvement. Indonesia's individual experience was even more striking as it experienced a 27 year, or 66%, increase in life expectancy and, in doing so, reduced the life expectancy gap relative to the 1960 OECD life expectancy level from 41% in 1960 to less than 2% by 2005. And India experienced a doubling of life expectancy during the middle of the 20th century, a degree of change that required two and half centuries in England and France (Fogel, 2004).

While these countries made tremendous gains in life expectancy, the 1960 GDP/P in constant U.S. dollars for these five countries was 98% below the mean 1960 OECD GDP/P, and by 2005 it had only improved to 94% below the mean 1960 OECD GDP/P. In 2005 it was 98% below for the mean 2005 OECD GDP/P. Continuing with the Indonesian example, it only experienced a reduction in the GDP/P gap, relative to the 1960 OECD level, from 98% in 1960 to 89% in 2005, in constant U.S. dollars. It is clear that factors in addition to economic growth have been major determinants of improved life expectancy.

Recent evidence indicates that the rate of adoption and diffusion of new technologies has been a

major determinant of success in economic growth and human longevity, and variations in the degree of adoption and diffusion of new technologies have been a major explanator of the differences in economic and life expectancy improvements between countries. While higher incomes and better education contribute to reduced mortality (Currie et al., 2003), Jamison (2006) maintains that health knowledge and technology are responsible for as much as two-thirds of the tremendous decline in childhood mortality rates. In other words, some new technologies have spurred economic growth while new technologies available for disease prevention and treatment, such as a better understanding of germ theory, the filtration and chlorination of water supplies, and the development and dissemination of antibiotics and vaccines, have allowed for significant gains in life expectancy. Mosk and Johannson (1986) discuss the interaction of income and mortality in Japan and point to the Japanese adoption of public health technologies as a significant factor in the reduction of mortality rates. Deaton (2004) notes that while there is a strong inverse relationship between poverty and life expectancy, beyond the lowest income countries life expectancy and growth of income per capita have not been strongly correlated. Rather, the continued diffusion of health knowledge and technology has been the best approach to improving population health.

Recent research, controlling for variations in the rate of technology adoption and diffusion across developing countries, has shown that income is a less important determinant of infant mortality than had been shown in previous econometric research; however, education was found to be just as strong a determinant as before (Jamison et al., 2006). Ranis et al. (2000) found that investments in health and female education were important to human development, while the investment rate and income distribution were important to economic growth. They also point out that while human development and economic growth affect one another, countries which initially invest relatively more in human development are more likely to achieve a mutually reinforcing virtuous cycle over the long run. Howitt (2005) notes that improved health positively affects both economic growth and the development of human capital by allowing improved creativity, coping skills, and innovation.

III. The Impact of Health Status and Life Expectancy on Economic Growth

Good health status is an important contributor to economic development. As Jamison (2006, p. 9) notes: “The dramatic mortality declines of the past 150 years—and their reversal in Africa by AIDS subsequent to 1990—have had major economic consequences.” Population health has a significant influence on GDP. Empirical evidence indicates that improved health status is associated with improved economic performance, and diminished health status is associated with diminished economic performance. The evidence relating increased life expectancy (as opposed to health status) to aggregate economic outcomes, however, is somewhat mixed. While the preponderance of empirical evidence indicates that the impact of increased life expectancy on economic development is both positive and substantial, some recent evidence suggests that the impact is positive, but small.

The impact of improved health status on economic performance

Evidence from numerous studies indicates that improved health status has a significant, positive impact on economic performance and that it improves aggregate economic performance in low and middle income countries (Bloom et al., 2006; Jamison, 2006). There are multiple pathways from health to economic performance. For example, improved health increases productivity through the improved ability to perform physical labor, facilitates brain development and hence increases productivity, and results in increased life expectancy and increased savings as people prepare for the retirement that comes with increased longevity (Jamison, 2006). Evidence supports the view that health has an important impact on labor productivity. Studies using both experimental and non-experimental empirical methods have been used to document the positive impact of improved health on workers' productivity and earnings in low-income settings (Strauss et al., 1998).

Reinforcing this idea, Mayer-Foulkes (2004) notes that health and nutrition are not only objectives of economic development but also significant inputs in the development process. Looking at the intergenerational effects of human development, he concludes that early childhood nutrition and improved health contribute to long-run economic growth, helping to avoid a poverty trap which prevents human capital formation.

The impact of diminished health status on economic performance

The economic impact of decreased health status resulting from widespread disease and malnutrition is also an important consideration. Reductions in labor productivity, human capital formation, savings rates, credit availability, and educational attainment and longevity can be devastating to an economy. Diminished health status and early childhood malnutrition can act as serious and long-term impediments to economic growth because they have a life-long influence on human capital accumulation (Mayer-Foulkes, 2004).

Bell et al. (2003) report that the AIDS epidemic has reduced annual rates of economic growth in heavily affected countries by 0.3 to 1.5 percentage points. The impact of poor health, and AIDS in particular, on small business economies can be ruinous (Chao et al., 2007). As Haacker (2004) notes: "HIV/AIDS, through its demographic effects and its social and economic consequences, has evolved into a major threat to economic development in many countries around the world." HIV/AIDS has caused numerous, quantifiable economic, social, and demographic effects on individuals, families, communities, and entire economies. Bell et al. (2004) conclude that HIV/AIDS is not only a threat to long-run economic growth but also a threat to current economic stability in countries, such as Sub-Saharan Africa, that are very seriously affected by the epidemic.

Poor population health can set off a downward spiral, causing poverty, further ill health, and an inability to afford treatment. High mortality rates among prime-aged workers deter the next generation from investing in education and increase the number of orphans. Savings rates and the availability of credit decline, and foreign investment is less likely due to the decline in human capital and in the quality of the workforce (Jamison, 2006).

The impact of increased life expectancy on aggregate economic performance

Empirical evidence indicates that increased life expectancy has a positive impact on economic growth. Bloom et al. (2004), estimating a production function for aggregate economic growth, found a positive, sizable, and statistically significant effect on aggregate output. They conclude that the life expectancy effect in the growth regressions appears to be a real labor productivity effect and that, in the long run, increased life expectancy increases GDP per capita. Jamison et al. (2005) found that reductions in adult mortality explained 10 to 15 percent of economic growth in developing countries during 1960–1990. Investigating the impact of adult survival rates on GDP growth rates, Bhargava et al. (2001), using 5-year interval data, found positive effects in low income countries for the 1965–1990 period. They conclude: “It is important to include investment in health as a tool of macroeconomic policy, due to the fact that differences in growth rates have been significantly explained by health differences.”

Using data from 53 countries, Jamison, Lau and Wang (2004) reported that improvements in health accounted for about 11% of economic growth during 1965–1990. Using data for 48 of the countries, they extended their analysis to the year 2000, and the results were similar.

Evidence from Aguayo–Rico (2005), Ranis et al. (2000), Strauss et al. (1998), and numerous others cited in the literature provides substantial support of the hypothesis that increased life expectancy has a positive impact on economic growth¹. Mayer–Foulkes (2004) notes that there is empirical evidence for Latin America that life expectancy changes impact income even after a lag of thirty years. Health improvements can also result in increased direct foreign investment. Foreign capital searches for a healthy, productive work force, improved quality of and economic returns on education, newly available resources from the diminished need for healthcare, and a demographic dividend with improved life expectancy (Jamison, 2006; Lopez–Casasnovas et al., 2005; Cutler et al., 2007).

A recent empirical study, however, reports contradictory results. Acemoglu and Johnson (2006) constructed an instrument for changes in life expectancy (predicted mortality) to estimate the impact on total GDP of 40 years of changes in life expectancy. According to their findings, the impact of improved life expectancy on the growth of GDP, while positive, is relatively small. While acknowledging the existence of a growing consensus that improving health can accelerate economic growth, they conclude that based on their study “there is no evidence that the large exogenous increase in life expectancy led to a significant increase in per capita economic growth.”

IV. Health–Related Policies and Their Relation to Economic Growth

Our concern in this section is with the impact of health–related policies on income, related indicators of economic growth, and on health. The impact of economic policies on health and economic growth will be addressed in the following section (Franzini et al., 2005).

¹ See Table 1, Bloom et al. (2004) for a summary of related studies.

Infectious diseases and economic growth

Prevention and control of diseases play an important role in achieving better population health. What distinguishes infectious from non-infectious diseases is that infectious diseases are exogenous. If you can avoid infection, you will avoid the disease. For most infectious diseases with known etiologies, there are preventive measures with varying levels of effectiveness. Preventive measures include vaccinations, protective equipment, environmental improvement, prophylactics, and pesticides. The likelihood of successful prevention and control of an infectious disease, therefore, may depend proportionally on the resources which are available to be used in the battle against it. This is one of the principle rationales for the inseparable relationship between economic growth and infectious disease.

Among infectious diseases, we have selected malaria, tuberculosis, and HIV/AIDS as areas of focus because these diseases have affected human health most substantially in low and middle income countries.

Malaria

Malaria is a protozoal infectious disease transmitted to human beings by infected *Anopheles* mosquitoes. Following infection, there is an incubation period ranging from 7 to 30 days before symptoms appear. Common symptoms include fever, chills, sweats, headaches, nausea and vomiting, muscle pains, diarrhea, and malaise. Severe forms may include organ failure, delirium, impaired consciousness, and generalized convulsions, causing coma and death (<http://www.who.int/malaria/faq.html#howtransmit>, <http://www.cdc.gov/malaria/disease.htm>). Each year half of the world's population is at risk from malaria, and more than 500 million fall ill from it. More than a million deaths are due to malaria every year; approximately 90% occur in Sub-Saharan Africa, mostly among children.

Malaria is curable with adequate and prompt treatment. Preventive and curative approaches to reduce infection, incidence, and death have been widely used. Nevertheless, malaria is still ranked as the ninth leading cause of death in low and middle income countries, accounting for 2.5% of total deaths (Lopez et al., 2006). Children and pregnant women are at the highest risk for death from the disease. In addition to being a direct cause of mortality, malaria contributes to other health issues such as anemia, adverse birth outcomes, and impaired learning (Malaria Fact Sheet No. 94, WHO, 2007). It also contributes to overall child mortality. Malaria is the eighth leading cause of lost disability adjusted life years (DALYs) in low and middle income countries, causing 39.96 Million lost DALYs in these regions (Lopez et al., 2006).

1. Relationship between malaria and economic development

Empirical studies have established the relationship between economic growth and malaria prevalence: economic growth rates are much lower in countries with endemic malaria, and poverty is likely to be predominant in areas where malaria is prevalent (Sachs and Milaney, 2002). Sachs et al. (2002) state: "Where malaria prospers most, human societies have prospered least." There is a strong correlation between malaria and poverty, and in countries with endemic malaria, the level and growth rate of GDP per capita are much lower than in countries without endemic malaria. The impact of

malaria is felt through increased morbidity, increased mortality, reduced fertility, and through all the additional consequences that these problems imply. Malaria traps occur when reduced health negatively impacts income, which makes treatment unaffordable, thereby perpetuating poor health and reduced income and making development impossible. In other words, malaria causes poverty. Gollin et al. (2007) report that in 1995, in 106 countries with serious malaria burdens, the disease accounted for a loss of over \$3,000 in income per capita. Gallup et al. (2001) compared GDP and malaria status among countries and found that GDP per capita was much higher in non-endemic countries than in endemic countries. Controlling for multiple economic, population health, and geographic factors, this study also showed that the economic growth rates in malaria-endemic countries were 1.3 percent lower for the 1965–1990 period.

While many developing countries have not been successful in controlling malaria, some have (Barat, 2006). For example, successful government efforts in the 1990s resulted in a substantial decline in malaria cases in Vietnam, resulting in improved population health and increased household income (Laxaminarayan, 2004). Success against malaria requires careful planning and the commitment of adequate resources. While economic improvement is not a sufficient condition for controlling malaria, it is certainly more feasible to make the necessary resources available in an environment of economic growth (Worrall et al., 2005).

With improved availability of medication and preventive equipment and with increased efforts both domestically and internationally, malaria incidence and deaths have declined substantially. There are areas, however, where malaria is still a significant burden. Additionally, global climate change has affected the mosquito habitation, and a geographical change in malaria-affected areas may occur. Increasing drug resistance poses another threat to malaria control because the new treatment necessary to fight the disease is more costly than conventional treatment. Finally, the interaction of malaria with HIV/AIDS is of increasing concern as the geographical areas affected by these diseases overlap. The resulting co-infections have increased the already heavy burden on these societies. Studies of malaria and HIV/AIDS interactions in Sub-Saharan Africa suggest that higher HIV/AIDS prevalence has resulted in increased malaria incidence (Abu-Raddad et al., 2006; Korenromp et al., 2005). Further research focusing on the interaction of these public health threats is needed. Despite the progress against malaria, there is still a need for continued prevention efforts and increased access to curative services.

2. International coalition against malaria

During the World Health Organization's malaria eradication campaign in the 1950s and 1960s, the incidence of malaria declined rapidly (UNICEF et al., 2003). The later efforts of the campaign, however, began to focus on control of the disease rather than eradication, and, after decades of indifference, malaria re-emerged as a very significant problem in the 1990s. In countries where malaria is transmitted intensely, as much as 40% of public health expenditures and many of the available hospital resources may be directed toward this disease.

In response to this crisis, The Roll Back Malaria (RBM) Partnership was launched by the WHO, the United Nations Children's Fund, the United Nations Development Program, and the World Bank in

1998 (RBM website). The RBM Partnership has significantly expanded its control efforts by involving governments of malaria-endemic and donor countries, international organizations, private foundations, private corporations, non-governmental organizations, and research and academic institutions (WHO, 2005). RBM's objective is to reduce malaria-associated mortality by 50% by 2010 and 75% by 2015. The cost of achieving this goal is estimated to be US \$3.8–4.5 billion per year (Kiszewski et al., 2007).

Tuberculosis

Tuberculosis is one of the primary causes of infectious disease mortality in the world. It is caused by *mycobacterium tuberculosis* and is transmitted through the air from one person to another (CDC). Even though a person may be infected with tuberculosis (latent tuberculosis infection, LTBI), he/she will have no symptoms and cannot spread the disease unless he/she develops active tuberculosis. Prophylactic intervention is available to prevent development of active tuberculosis from LTBI. Although most cases of active tuberculosis can be treated with anti-tuberculosis drugs, drug-resistant strains are becoming a greater public health issue.

According to the WHO, one third of the world's population is estimated to be infected with tuberculosis, with 8.8 million new cases and 1.6 million deaths in 2005 (WHO, 2007a). Although the aggregate incidence of tuberculosis has leveled off, it is not equally distributed among or within countries. The WHO has identified 22 countries as high-burden in which 80% of the world's new cases occur. The WHO's list includes six Asian countries which account for half of the world's new cases each year (WHO, 2007a). Most of these high-burden countries are also low and middle income countries. Among these low and middle income countries, tuberculosis was ranked the eighth leading cause of deaths in 2001 (Lopez et al., 2006). Among adults (aged 15–59) in those countries, it was the third leading killer next to HIV/AIDS and ischemic heart disease in 2001, accounting for 7% of total adult death (Lopez et al., 2006).

1. Relationship between tuberculosis and economic development

Although the relationship between economic development and infectious disease has been widely recognized, there are relatively few empirical studies which have focused only on tuberculosis, rather than on tuberculosis in combination with HIV/AIDS.

Examining the impact of tuberculosis in the Philippines during 1997–2001, Peabody et al. (2005) found that tuberculosis incidence increased among adults as household income fell. After controlling for demographic factors, they found that a 10% increase in income was associated with a 2% decrease in tuberculosis prevalence. Both males and females with tuberculosis had lower wages than those without it, and aggregate income loss due to tuberculosis was estimated to be US \$145 million in 1997. Kamolratanakul et al. (1999) interviewed tuberculosis patients to examine the economic impact at the household level and found that patients with incomes below the poverty line spent more than 15% of their annual income on the diagnosis and treatment of tuberculosis. In addition, more than 10% of patients in this income group had to sell their property or borrow from banks to finance the illness-related expenses.

Malnutrition negatively influences cell-mediated immunity, which plays a critical role in fighting tuberculosis, and the likelihood of developing tuberculosis increases among the malnourished (Chandra, 1996). Because malnutrition is closely related to economic status, poor nutritional status resulting from poverty may explain some of the relationship between tuberculosis and economic development. The economic burden of tuberculosis is substantial. Lopez et al. (2006) estimated that it resulted in 35.87 million disability adjusted life years (DALYs) lost in 2001, a magnitude clearly sufficient to have a negative impact on economic growth.

The relationship between tuberculosis control and economic growth raises several concerns. First, the co-morbidity of tuberculosis and HIV/AIDS can be devastating. The presence of HIV/AIDS increases the risk of tuberculosis infection, and, together, these diseases exacerbate existing population health and economic burdens. More rigorous interventions should be directed to these areas. Second, although tuberculosis is curable, some strains of tuberculosis have developed resistance to first-line drugs, making treatment more expensive and increasing its economic burden. Early detection and completion of adequate treatment is important to prevent drug-resistance. Third, more research is needed to examine the micro-level economic impact of tuberculosis to allow decision makers to make more fully informed funding decisions.

2. International coalition against tuberculosis

International organizations and governments have been making efforts to combat tuberculosis, and the incidence of this disease has decreased. Despite their efforts, however, tuberculosis still affects millions of people living in poverty. Tuberculosis has been a global concern for decades, but the level of concern was amplified in the 1990s when the WHO declared tuberculosis to be a global emergency and established tuberculosis intervention goals at the 1991 World Health Assembly (WHO, 2006a). Although some of the goals have not been met, the situation has improved as global efforts to fight the disease have continued (Dye et al., 2007).

In 2000, The Stop TB Partnership was established to promote political and community action to control tuberculosis. The Partnership includes international organizations, public and private donors, governments, NGOs, and individuals. To help achieve the Millennium Development Goals for tuberculosis control, the organization developed the Global Plan to Stop TB 2006–2015. The cost of implementation is estimated to be US \$56 billion over 10 years (Maher et al., 2007). The global cost-effectiveness per DALY averted is estimated to be US \$157 (Laxminarayan, 2004; Maher et al., 2007).

The Global Drug Facility was established in 2001 under the WHO administration and the Stop TB Partnership secretariat. Its aims are to ensure efficient distribution of anti-tuberculosis drugs and access by linking demand and supply, monitoring and evaluating competitive outsourcing and product standardization, and encouraging the private and public sectors to collaborate to improve efficiency. It is a unique, innovative model that has been replicated in other disease areas (Matiru et al., 2007; the Global Drug Facility website), and it has succeeded in distributing nine million courses of anti-tuberculosis drugs in 78 countries (Matiru et al., 2007). In close coalition with other global agencies, including the Global Fund, the World Bank, and UNITAID, The Global Drug Facility has established

the goals of providing both new and conventional treatments and diagnostic products and ensuring drug manufacturing capacity and the sustainability of drug supplies (Matiru et al., 2007).

The Global Fund to Fight AIDS, Tuberculosis and Malaria was established in 2002. Its objectives were to increase resources for the control of the three diseases and to distribute these resources to the areas in need. Building partnerships with governments, civil society organizations, private sectors, and communities, the Global Fund plays an innovative role as a financing mechanism rather than as a provider of interventions (Global Fund, 2007b). By the end of 2006 the Global Fund had signed 410 grant agreements for US \$5.3 billion in 132 countries and had disbursed US \$3.24 billion to grant recipients in the three years since its establishment. It is estimated that US \$8–10 billion per year are needed to achieve the Millennium Development Goals by 2015 (Global Fund, 2007a). Given the tremendous cost necessary to fight these diseases, success will not be feasible without significant donor country participation.

HIV/AIDS

In 2006, HIV/AIDS caused 2.9 million deaths and affected 39.5 million lives around the world (UNAIDS Report 2006). There are 11,780 new cases per day, or 4.3 million per year, and more than 95 percent of these cases are in low and middle income countries (WHO). In some African countries where HIV/AIDS is highly prevalent, life expectancy at birth has dropped to less than 40 years of age (World Bank).

In 2005 HIV/AIDS was the leading cause of death among adults aged 15–59, and it resulted in 70.80 million DALYs lost in low and middle income countries. In Sub-Saharan Africa it accounted for 16.5% of aggregate health-related DALYs lost (Lopez et al., 2006). The impact of the HIV/AIDS epidemic is enormous; with severely limited resources, strategies to alleviate the impact of the disease must involve multilateral relationships.

1. Relationship between HIV/AIDS and economic development

The World Bank and the WHO have made continuous efforts to quantify the socio-economic impact of the HIV/AIDS epidemic by considering the costs of the treatment and preventive programs initiated by each organization in cooperation with the governments of affected countries.

A study co-initiated by the World Bank and the International HIV/AIDS alliance in the Ukraine estimated the macroeconomic costs of HIV/AIDS and the impacts on both the labor force and government revenues (World Bank, 2006). Analysis of the labor force impact was based on a demographic projection that the labor force will shrink by 2.3 million between 2004 and 2014, thereby changing the pattern of employment. By applying three scenarios of the HIV/AIDS pandemic, projections were made for the working-age population, for the labor force, and for employment and unemployment. It was estimated that by 2014 the HIV/AIDS epidemic will cause an additional decline of 0.8–1.4 percent in the working-age population and a 1.0–1.7 percent decline in both the labor force and employment. And, before developing AIDS, those infected with HIV become progressively more ill, requiring leave from work and temporary disability benefits.

In another analysis the study applied a simple growth model based on a hypothetical “no-AIDS”

baseline to two scenarios of the epidemic. It found the following compared to the 2014 baseline:

- A reduction in the level of output in constant prices of 0.7 percent (optimistic scenario) or 1.3 percent (pessimistic);
- An unchanged per capita output;
- A reduction in average GDP growth rate of 0.06 –0.11 percent;
- A reduction in capital stock of 0.2–0.3 percent;
- A reduction in labor supply of 1–1.5 percent; and
- A reduction in investment of 0.7–1.3 percent.

In another analysis, a macro-econometric model was used to estimate the economic costs of Ukraine's epidemic. Total welfare and GDP decrease substantially under all scenarios. Increased expenditures on care and treatment cause a decrease in savings and investment. In the pessimistic scenario, an HIV/AIDS-induced loss of labor and labor productivity, a reduced marginal product of capital, and a 7 percent reduction in the real rate of return to capital, result in a decline in private investment of 9 percent. The reduction in labor productivity is the strongest determinant of the negative impact, followed by the reduction in labor supply. Increased public spending yields a smaller effect. The return to labor declines in all but the optimistic scenario. Separating the effects of reduced labor supply and lower productivity, skilled and highly skilled labor become scarcer, and their wages go up. Overall labor productivity, however, acts in the opposite direction, pushing wages down, and the combined effect is a drop in wages.

In an interesting study, Bell et al. (2006) examined the relationship between human capital formation as affected by HIV/AIDS and economic growth. High adult mortality due to the AIDS epidemic constrains human capital development and economic growth in Kenya. Bell tested this relationship by developing a model with three overlapping generations, calibrating it to demographic and economic conditions from 1950–1990. He then performed simulations under alternative demographic assumptions for the period ending in 2050. Based on his model, he has estimated that the AIDS epidemic will delay the attainment of given levels of human capital by about a decade.

2. International coalition against HIV/AIDS

The international community has made combating HIV/AIDS a priority. Of eight key areas covered by the Millennium Development Goals, six of these areas—reduced poverty and child mortality, increased access to education, gender equality, improved maternal health, and efforts to combat major infectious diseases—are severely undermined by high rates of HIV/AIDS in low and middle income countries. At the June 2006 General Assembly High-Level Meeting on AIDS, United Nations Member States reaffirmed their commitment to fight this disease (WHO).

In April 2007 the World Bank introduced a new health, nutrition, and population sector strategy which is dedicated to key challenges in the fight against the HIV/AIDS pandemic (World Bank, 2007). The strategy emphasizes that increasing and sustaining prevention and treatment will be supported by the World Bank's continuing and expanded financial assistance. In particular, the World Bank will focus on strengthening the health system to improve and expand HIV prevention, treatment, and care. Plans to strengthen the health system include:

- Integration of HIV/AIDS and health system programming;
- Financial interventions that are important for controlling the HIV epidemic or the health situation that might otherwise be neglected; and
- Systematic identification, monitoring, and evaluation of country-based World Bank assistance to HIV/AIDS programs and to the health sector.

Within the UN system, the WHO strongly endorses “scaling up HIV treatment, care, and prevention services through the health sector, including targeting appropriate technical and financial assistance, and monitoring progress” (WHO).

Several studies have provided evidence of efficient treatment alternatives for scaling up prevention and treatment of HIV/AIDS. Bollinger et al. (2007) found that the costs per case of averting HIV/AIDS was US \$1,000 and that such interventions should be a priority on the World Bank’s HIV/AIDS agenda. In another study, Ravenga (2006) investigated the cost effectiveness of antiretroviral therapy (ART) in Thailand and found that the most cost-effective policy option resulted in US \$736 per discounted life-year saved. Given the national HIV/AIDS policy to provide first-line therapy only, Thailand is seeking to provide ART as the standard of care to a large number of people with symptomatic HIV disease.

The impact of the TRIPS (Trade Related Aspects of Intellectual Property Rights) Agreement and the Doha Declaration on the availability of needed pharmaceuticals in low and middle income countries are addressed in the following section V. of the paper.

Malnutrition

Malnutrition is caused by insufficient nutritional intake, infection and disease, inappropriate feeding practices, poor health care provision, absence of proper sanitation, and the absence of safe water supplies (UNICEF website; Blossner et al., 2005). In 2004 more than 820 million people, or 16% of the population in low and middle income countries, were suffering from malnutrition caused by undernourishment—food consumption continuously below minimum dietary energy requirements (World Food Program, 2007; World Bank, 2007). While this represented an improvement compared to the 20% undernourishment rate for this population in 1992, malnutrition was still the leading health risk in low and middle income countries.

Although malnutrition affects all segments of the population, its impact on women and children is particularly dire. Malnutrition exacerbates immune system problems, making those affected more susceptible to infection, and it impedes the mental and physical development of children and fetuses (Walker et al., 2007; Engle et al., 2007; UNICEF website; Chandra, 1996). Malnourished mothers are more likely to have low birth-weight babies and are more vulnerable to infection, disease, and premature death (Blossner et al., 2005; Walker et al., 2007). Malnutrition accounts for more than half of child mortality (Pelletier et al., 2003), and nearly 9% of the aggregate disease burden in affected countries is caused by malnutrition-attributable disease among children (Lopez et al., 2006).

1. Relationship between malnutrition and economic development

Research indicates a positive relationship between economic development and improved nutritional

status. Based on household surveys and malnutrition rates in 12 countries, Haddad et al. (2003) estimated that a 10% increase in income decreased the rate of malnutrition by as much as 5%. Alderman et al. (2007) found that nutritional improvement also contributes to economic development by increasing productivity and saving resources.

Malnutrition can have a negative, long-term impact on development (Blossner et al. 2005; Walker et al. 2007; UNICEF website). In a study of twins, Behrman et al. (2004) found a negative association between the incidence of low birth-weight babies and GDP per worker. Behrman et al. also found that increased birth-weight increases educational attainment, adult height, and earnings, along with the associated long-term social benefits.

In their first 5 years, children are particularly vulnerable to developmental risk factors such as poverty, lack of adequate nutrition, health problems, and a lack of cognitive stimulation. Grantham-McGregor et al. (2007) show that stunted development and poverty in early childhood are closely related to poor developmental performance and educational attainment, causing poverty risk factors to be passed to the next generation. Walker et al. (2007) identify a lack of nutrients (such as iron and iodine), growth retardation, and an inadequate environment for cognitive stimulation as risk factors that inhibit children's developmental potential.

2. International coalition against malnutrition

The first goal of the Millennium Development Goals (MDGs) is to "halve, . . . by 2015, the proportion of people who suffer from hunger." Between 1990 and 2005, many developing areas saw a reduction in the incidence of underweight children, age five years and under (United Nations, 2007). The problem, however, is still widespread. Significant disparities remain, particularly in South Asia and Sub-Saharan Africa, which account for the majority of children living in hunger (United Nations, 2007).

UN agencies such as UNICEF, the WHO, and the Food and Agricultural Organization, international organizations such as the IMF and World Bank, and governments are working together to achieve the MDGs in collaboration with NGOs and private sector organizations. It is estimated that an additional US \$25–50 billion annually will be needed to achieve the MDGs by 2015 (Global Monitoring Report, World Bank, 2007). The MDG project recommends substantial financial support from donor and recipient countries, but while funding from donor countries is increasing, it is not clear whether sufficient support will be forthcoming (Atkinson, 2006; Sachs et al., 2005).

Fertility and Reproductive Health Issues

The UN Millennium Project has concluded that promoting reproductive health is necessary to achieve the MDG goals and that investment in reproductive health and gender equality will have long-term economic development benefits (UNFPA State of World Population 2005). Evidence indicates that simultaneous investments in country-level distribution of reproductive health information and services, provision of education for girls and women, and promotion of economic rights for women are effective in stimulating a country's development (Malhotra et al., 1999; United Nations Population Fund, 2005). Moreover, women's control over their reproductive rights gives them

the opportunity to pursue other productive activities and to secure both stable employment and higher wages. It is estimated that poor reproductive health reduces the overall productivity of women by 20% (Anonymous, 2004). In the Philippines, women with 1–3 pregnancies have twice the income growth of women with more than 7 pregnancies (United Nations Population Fund, 2005). The evidence affirms that access to family planning could prevent unintended pregnancies and reduce maternal deaths by 100,000 per year, or by 20–35%, and prevent 20 times as many serious maternal injuries and disabilities. Nevertheless, almost all (99%) of maternal deaths still occur in low and middle income countries (United Nations Population Fund, 2005).

In poor income countries, higher education for girls has a highly positive effect on economic development as it empowers girls to delay marriage and childbearing and thus allows them to acquire skills to improve economic conditions for themselves and their families. In the poorest regions of the world, however, more girls than boys are out of school. Evidence shows that South Korea, Taiwan, and Thailand have “successfully eradicated the harmful traditional practice of child marriage” and have thereby gained opportunity and economic growth. These countries have improved educational and employment options for girls and decreased birth and mortality rates. Countries with high rates of child marriage, on the other hand, including some countries in Africa, Asia, and the Middle East, have high birth, mortality, and poverty rates as well as lower levels of economic growth and other indicators of development, such as schooling, employment, and access to health care (United Nations Population Fund, 2005).

Fertility rates have decreased since 1960 when reliable contraceptive methods became available. Recent data indicate that family planning reduces fertility, improves women’s productivity and family well-being, and eventually promotes economic growth. Holloway (2002) notes that reduced micro-level fertility may result in aggregate economic growth within a generation. Evidence of reduced fertility rates and subsequent economic development is clear among the “Asian Tiger” economies (Maliksi, 2007; Holloway, 2002; United Nations Population Fund, 2005).

V. Economic Policies and Their Relation to Population Health and Economic Growth

Microfinance

The majority of the population in low-income countries lives in rural areas, does not participate in the formal economy, and historically has not had adequate access to credit or other financial services. It is very difficult, therefore, for these people to escape poverty. The spread of microfinance, first developed in Bangladesh in the 1970s, has made an important contribution in the fight against rural poverty and poor population health. The subsequent efforts of a variety of organizations (governmental agencies, private banks, and international organizations) have expanded the availability of microcredit, micro-savings, microinsurance, and other microfinancial services to millions of people in low income countries on five continents (Asian Development Bank, 2000).

By targeting production rather than consumption with very small, unsecured loans, microfinance has been successful in contributing to self-sustaining, or virtuous cycles, of family level economic

growth (Bloom et al., 2004a). By providing much needed capital, these loans help remove a major constraint to development. Over 95% of borrowers in these programs have been poor women in rural areas (Asian Development Bank, 2000), and the empirical evidence indicates that these efforts have contributed not only to reduced poverty but also to increased educational opportunities and the improved health status of women and children (Littlefield et al., 2003).

1. Poverty

Simonwitz (2002) reported that in India the majority of the microfinance clients studied improved their employment quality, increased their family's economic well-being, and decreased their overall level of poverty. In Bangladesh it was reported that longer-term microfinance clients significantly increased both household expenditures and household savings (Mustafa et al., 1996). There are numerous similar examples from other low and middle income countries (e.g., Chowdury et al., 2001; Barnes, 2001).

Interestingly, most micro-credit institutions that deal with customers living in extreme poverty (less than \$1 per day), and that make loans that average less than one half of GDP/P, have very respectable repayment rates, are financially sustainable, and earn a positive return on their lending activities (Littlefield et al., 2003)—an indication that the borrowed funds have been put to productive use.

2. Education

Similar progress has been made with respect to increased educational opportunities for children. One of the top priorities for women who receive loans has been to invest in the education of their children, and the evidence indicates that children of microfinance participants are more likely to attend school than other children and less likely to drop out (Littlefield et al., 2004). Studies from many countries reinforce these findings (Barnes, 2001; Chowdury et al., 2001).

3. Health of women and children

Evidence also indicates that microfinance participants have improved household nutrition, receive maternal and health instruction as part of the micro-finance program, have improved health practices, and experience improved family health (Chowdury et al., 2001; Barnes, 2001; Pitt et al., 2003). Littlefield et al. (2003) report that microfinance funds have contributed to the improved health status of women and children.

In summary, the spread of microfinancial services has made a significant contribution to the poor in both economic and human development terms. The majority of the rural poor in low income countries, however, still do not have access to these services. Microfinance has been a very effective initiative, and efforts to increase the availability of microfinancial services should be encouraged.

The TRIPS Agreement and Doha Declaration

When considering the relationship between population health and economic growth in low and middle income countries, it is imperative to consider that there are 350 million new cases of HIV/AIDS, TB, malaria, dengue, hookworm, and Chagas disease each year—diseases which are amenable to vaccination, drug prevention, or treatment (WHO, 2006b). The quality of health services heavily depends on the availability of effective and affordable pharmaceuticals. Factors impacting their

availability include development, patents and intellectual property rights, pricing and procurement of existing drugs, product diversion, and other pharmaceutical system inefficiencies. According to the WHO estimates, one-third of the world's population lacks access to essential drugs (WHO, 2001).

With respect to intellectual property rights, the basic tradeoff is between the need for patent protection to provide an incentive for research on new pharmaceuticals and the public health need for increased availability of medications. In 1995 the World Trade Organization completed the TRIPS Agreement covering the major intellectual property issues. Its implementation, however, was delayed until 2005 for developing countries and until 2016 for the least-developed countries (Otten, 2007; WHO, 2006b). Major changes have been undertaken in the area of intellectual property rights because of the TRIPS Agreement. According to the agreement, minimal patent protection on both product and process patents must be provided, through national legislation, for at least 20 years. The pharmaceutical industry was the primary lobbying group for incorporation of intellectual property issues into the new General Agreement on Tariffs and Trade framework.

The TRIPS Agreement has become one of the major determinants of the ability to obtain effective drugs for low income countries, and it is clear that TRIPS is having a significant effect on poor countries. Although the objective of the TRIPS Agreement was to protect the research incentive, there has been a movement toward differential high and low income country pricing. If the income generated from the higher prices of pharmaceuticals in high income countries is sufficient to provide a reasonable economic return on investment, then pharmaceuticals can be sold for near marginal cost in low income countries (WHO, 2006b). In 2001, the Doha Declaration on TRIPS and Public Health echoed this perspective, indicating that the TRIPS Agreement "should be interpreted and implemented in a manner supportive of WTO members' right to protect public health and, in particular, to promote access to medicines for all" (WHO, 2001). It affirmed the right of countries to take measures, such as compulsory licensing and parallel imports, necessary to promote public health (Martin et al., 2007; Kerry et al., 2007; Oliveira et al., 2004). In December 2005, an amendment to the TRIPS Agreement contained a provision to allow compulsory licenses to be issued for countries with local manufacturers and to export pharmaceuticals to countries unable to produce them domestically (Martin et al., 2007; Kerry et al., 2007).

Many developing countries have adopted the TRIPS Agreement flexibilities and have created legal tools and public policies to protect population health. Local firms in Malaysia, for example, have imported HIV/AIDS drugs from Indian manufactures, and Zimbabwe has declared a health emergency and has permitted local companies to import or produce antiretroviral drugs. Additionally, despite strong opposition from the U.S. Trade Representative, Brazil and Thailand have issued compulsory licensing of HIV/AIDS medications to meet their public health needs (Martin et al., 2007; Oliveira et al., 2004).

Given the impact of population health on economic growth, a pressing challenge for international policy makers concerned with promoting both objectives is to balance the need to protect intellectual property rights and the R&D incentive with the need to ensure that public health needs are met and that there is access to essential medicines (Martin et al., 2007). The TRIPS Agreement was a step

toward the former, and the Doha Declaration on the TRIPS Agreement, and its subsequent Amendment, affirmed a growing consensus of the importance of the latter.

UNITAID

The lack of needed pharmaceuticals for HIV/AIDS and other infectious diseases makes the impact of the diseases even greater. International efforts have been made to alleviate the economic burden of pharmaceutical costs and to increase the availability of needed medications. UNITAID is an international drug purchasing organization founded in 2006 by Brazil, Chile, France, Norway, and the United Kingdom. “Its goals are . . .”, (1) to improve access to treatments against HIV/AIDS, malaria, and tuberculosis for the populations of low income countries, and (2) to promote the market availability of new drugs that are adapted to conditions such as drug resistance, the need for pediatric dosages, and the desire for combination drugs (UNITAID).

Provision of UNITAID funds comes directly from member countries, primarily via a solidarity tax on airline tickets. While membership includes some African countries whose populations are suffering from these targeted diseases, the funds are not directly given to the countries in need. Rather, the funds are given to international partners such as UNICEF, the Global Fund, and the WHO for distribution. UNITAID strategies are based on a market impact approach which allows price reduction through the purchase of high volumes of pharmaceuticals and diagnostic equipment (UNITAID).

In its first year, in partnership with the Clinton Foundation, UNITAID’s ordering of a higher volume of pharmaceuticals resulted in a 25% price reduction for low income countries and a 50% price reduction for second-line antiretroviral pharmaceuticals for middle income countries. A reduction of nearly 40% was also achieved for pharmaceuticals used in pediatric treatments (UNITAID).

While international and domestic efforts to combat HIV/AIDS have made some progress, continued efforts will be needed to achieve the Millennium Goals. Where the prevalence of the disease is still severe and the population is trapped in a negative disease-poverty spiral, the risk of an economic collapse exists. There is a need for improved cooperation between donor and recipient countries and for further research to evaluate the effectiveness of existing coalitions dealing with the prevention and treatment of HIV/AIDS and co-morbid diseases. While international efforts such as TRIPS and UNITAIDS are improving pharmaceutical distribution, corruption and parallel import/transport difficulties hinder progress when public health emergencies arise. To ensure the delivery of pharmaceuticals to those in need, improved tracking of drug distributions is necessary.

VI. Globalization and Health

Definition of globalization

Globalization is an extremely complex phenomenon that is hard to define, and a variety of definitions have been proposed to capture its meaning. Feachem (2001) defines globalization broadly in terms of openness: “openness to trade, to ideas, to investment, to people, and to culture.” Huynen et

al. (2005) draw on Rennen et al.'s (2003) definition of globalization as "an intensification of cross-national cultural, economic, political, social, and technological interactions that lead to the establishment of transnational structures and the global integration of cultural, economic, environmental, political, and social processes on global, supernational, national, regional, and local levels."

Evaluating the impact of globalization on health

While research on the impact of globalization has mainly focused on economic factors, globalization has also had important health consequences. Martin (2005) argues that in order to understand globalization we need benchmarks and barometers to measure its successes and failures. Martin believes that health should be such a barometer and that change in the health status of the population, as a marker of social welfare, should be used to evaluate whether the interconnectedness hurts or helps the populations affected by globalization. The impact of globalization on health is not uniformly good or bad; rather, it is context-specific. Some groups will benefit and some will suffer as a result of expanded trade and cultural exchanges. We follow Martin's (2005) recommendation of evaluating the effects of globalization from the perspective of the poor. While globalization has an impact on health, health also affects globalization (Martin, 2005). The SARS virus, for example, certainly had an impact on global travel.

Conceptual framework to evaluate the health impact of globalization

Huynen et al. (2005) propose a conceptual framework with a model linking health determinants to features of the globalization process. The distal health determinants affected by globalization include health-related policies, economic development, trade, social interaction (migration, conflicts, social equity, and networks), knowledge, and ecosystem goods and services. International organizations such as the World Bank, the WHO, and the WTO are increasingly formulating health-related policies and policies that influence population health. The economic benefits of globalization and its effects on health are controversial; some see a positive impact (Ben-David, 2000; Dollar et al., 2001; Feachem, 2001; Frankel et al., 1999), while others see a negative impact (Oman, 1996; Reinicke, 1998).

By 2005 international trade had increased to about 20% of world output (Huynen et al., 2005). Human migration has also increased, causing both positive and negative effects on population health. Globalization may decrease the risk of conflicts by creating greater interconnectedness across countries, but it may also increase the risk of tensions by igniting religious fundamentalism and intolerance in response to changes caused by globalization. Cultural globalization has the potential to encourage transnational networks beneficial to health such as the women's movement, the peace movement, and the environmental movement. On the other hand, cultural globalization, with its focus on self-interested individualism, may undermine local norms of solidarity and equity, causing a negative impact on health. The globalization of education and knowledge is likely to have a direct, positive effect on health and thus improve health education with likely positive consequences for health. Finally, environmental changes due to globalization, including climate changes, can have

significant effects on the provision of goods and services such as food, water, and natural resources that influence population health.

The proximal health determinants affected by globalization include health services, social environments and lifestyle, physical environments, and food and water. Globalization has negatively impacted health care by encouraging the privatization of health care delivery in China and other transitional economies. Globalization has also reduced the availability of local health care providers because of the international ‘brain-drain’ in the health sector. On the other hand, globalization has improved the health care sector through economic growth and increased diffusion of health knowledge. Globalization may affect the social environment both positively and negatively through its effects on social cohesion and on violence (WHO, 2002).

Interconnection due to globalization facilitates the spread of information and can impact health-related behavior. This can have negative influences on health such as the marketing of tobacco worldwide or positive influences such as health education. The globalization-induced movement of goods and people increases the risk of spreading disease, but enhanced surveillance helps control infectious diseases at the global level.

Food and water have the potential to significantly affect population health. Presently, food trade is closely linked to food security. Some argue that trade in food has created access to cheaper and better food supplies and to more efficient use of resources because food production moves to countries with a comparative advantage. Others believe, however, that the food trade endangers food security by leaving countries dependent on imports and open to global market shocks (FAO, 1996; FAO, 2003).

There has been concern that globalization affects water security in poor countries. International institutions have promoted water source privatization in order to achieve market competition and efficiency, but privatization may instead increase inequalities in access. On the other hand, globalization increases water security by favoring the development of global water use guidelines and facilitating the implementation of better water-related technologies.

Economic benefits of globalization and health

Compelling evidence supports the notion that the liberalization of trade and the increased foreign investments that accompany globalization promote economic growth (Dollar, 1992; Dollar et al., 2001; Frankel et al., 1999; Sachs et al., 1995). Low and middle income countries that globalized increased their GDPs by 104% from the 1970s to the 1990s (Dollar, 2001). These countries included Argentina, China, Hungary, India, Malaysia, Mexico, the Philippines, and Thailand. The GDP growth in these countries surpassed the growth of even high income countries, which experienced GDP growth of only 71%. During the same period, developing countries that did not globalize had an 18% decline in GDP.

While one has to be careful in drawing conclusions from cross-country comparisons (Rodríguez et al., 2000; Srinivasan et al., 1999), the evidence supports the notion that integration with the global economy accelerates economic growth in low and middle income countries. The recent experiences of countries such as China, India, and Vietnam further support this view.

Because GDP is a determinant of health, it follows that if globalization raises GDP, globalization should have a positive impact on population health. Specifically, if globalization raises the incomes of the poor, it will lead to better nutrition, lower child mortality, better maternal health, and better female education that will further improve health outcomes.

The equity of the distribution of globalization gains, however, must also be addressed in order to understand the impact of globalization on all population groups, particularly on the poor. The evidence of the impact of globalization on equity between and within nations is hotly debated. Some, including Feachem (2001) and Dollar (2001), argue that globalization has narrowed the wealth gap between rich and poor countries because globalizing low and middle income countries have grown faster than high income countries.

Some evidence also supports a positive impact of globalization on intra-country equity. Dollar (2001) and Dollar et al. (2001) analyzed 137 countries and showed that the incomes of the poorest 20% of people rise and fall with national per-capita income so that “percentage changes in income of the poor, on average, are equal to percentage changes in average incomes” (Dollar 2001, p. 829). Thus globalizing developing countries that increased their GDP should have also increased the incomes of their poor. There is, however, considerable variation by country. China, for example, experienced significant increases in inequality. Some countries, such as Uganda and Vietnam, saw no change in inequality, and others, such as the Philippines, actually experienced a decline in inequality. While relative income is important for health, absolute income and absolute poverty are significant determinants of health in poor countries. Over the last two decades, China and Vietnam dramatically reduced absolute poverty: China from 250 million people in 1978 to 34 million in 1999 and Vietnam from 75% of the population in 1988 to 37% in 1998. While the evidence seems to indicate that in many countries there are short-run winners and losers from globalization, on average, “the losers do not come disproportionately from among the poor” (Dollar, 2001). This evidence led Feachem (2001) to conclude that, overall, economic growth due to globalization is good for the health of the poor.

Others, including Cornia (2001) and Cornia et al. (2000), have argued that only the developing countries with good human resources and physical infrastructures have benefited from opening their economies to international markets. Through managed globalization and judicious domestic policies, countries such as China, India, Vietnam, and others have been able to attain economic growth, increase living standards, and improve health. Many more developing countries did not meet the domestic conditions for opening their economies, however, and globalization has hindered both their growth and their improvements in population health.

Evidence has been presented for an association between increased income inequality and globalization. Overall, income inequality has increased from the 1950s to the 1990s in 48 out of 73 countries (Cornia et al., 2001). Taylor (2000) associates globalization reforms in the last 20 years with increases in inequality in 13 cases, with no changes in inequality in 6 cases, and with reductions in inequality in 2 cases. If income inequality increases, the link between economic growth and poverty reduction is broken: the average per capita income can be growing while poverty still increases. Income inequality can also depress growth with a further negative impact on poverty (Addison et al.,

2001; Banerjee et al., 2001). Cornia (2001) claims that financial globalization is partly responsible for recurrent recessions caused by financial crises. These financial crises increase the volatility of growth with negative effects on economic growth, poverty, and health (Stiglitz, 1998). Cornia (2001) concludes that during the 1990s health improvements decelerated due to deregulation and globalization in many parts of Africa and countries of the former Soviet Union. In 15 countries, infant mortality was higher in 1994 than in 1990, and, in Sub-Saharan Africa, under-five mortality was higher in 1999 than in 1990.

Social political benefits of globalization and health

Globalization influences population health not only through economic growth and GDP but also through a country's social and political factors. Feachem (2001) identifies four areas where social and political consequences of globalization are beneficial to population health: quality of the government, rights of women, technology diffusion, and the internet. Interconnection and exchange with the rest of the world makes it more difficult for corrupt and oppressive governments to operate. With the eyes of the world on them, such governments cannot behave as unscrupulously for fear of condemnation and possible economic or military intervention. Globalization may lead, therefore, to less genocide, corruption, and oppression with positive health consequences for the population. Globalization and the accompanying openness to other cultures have encouraged a nascent set of universal moral standards, in particular the rights of women and the protection of children. Practices that were traditionally accepted in some countries, such as genital mutilation of women or child labor, have been questioned with positive consequences for women and children's health. The diffusion of technology brought about by globalization has made it possible for new beneficial technologies to reach even remote areas in low income countries. The internet in particular may have a positive impact on health by directly improving the administrative capacity of the delivery of healthcare services and by indirectly promoting economic growth.

The role of globalization on the provision of life-saving pharmaceuticals to low income countries has previously been discussed. Although globalization makes medical innovations and life-saving pharmaceuticals more widely available, low income countries cannot pay the high prices charged in high income countries. While some progress has been made, a system that provides developing countries with needed pharmaceuticals at affordable prices, while keeping the economic incentive for innovation in developed countries, has not been perfected (Dollar, 2001).

Negative effects of globalization on health

Globalization has some direct, negative effects on health. The spread of disease increases with both travel and personal interactions across countries (Feachem, 2001; Dollar, 2001; Cornia, 2001). Infectious diseases now have the potential to spread rapidly to all corners of the world. The AIDS epidemic is an example of a disease spread through travel and migration (Dollar, 2001). There is evidence that HIV prevalence rates are higher in populations with more immigrants (Steward et al., 2001). Sexually transmitted diseases that were almost eliminated from China in the 1960s spread

rapidly after the opening of the Chinese economy and the internal migration that followed (Sainz et al., 2000).

The impact of globalization on the global environment is still not completely understood. Changes in the global environment have the potential to significantly impact health. Global warming and pollution, for example, already affect large population groups in high and low income countries.

Globalization may lead to political instability in countries with latent regional, ethnic, class, or religious tensions (Cornia, 2001). The unequal distribution of gains and losses from globalization may disrupt a delicate balance of power and increase social instability. The resulting conflicts often have negative consequences for the health of the more disadvantaged groups.

Other possible negative effects of globalization on health include the possible decline in tax revenues available to support social services. By eliminating import tariffs, export taxes, and the downward bidding to attract foreign investment, tax revenues may decline, thereby reducing resources to pay for education and health programs. The evidence, however, is unclear regarding the effect of globalization on social spending for education and health (Cornia, 2001).

Conclusions on globalization and health

It is not possible to generalize the effects of globalization on population health across countries. Some countries have greatly benefited, while others have not. Even within countries, the benefits of globalization have not been distributed equally—some groups have gained while others have lost. The evidence suggests that the impact of globalization on health is country-specific. Overall, some countries, mostly in Asia, a few in Africa such as Uganda, and a few in Latin America such as Costa Rica and Mexico, have derived health benefits from the interconnections created by opening their economies to global markets. For other countries predominantly in Africa and South America, however, the promise of globalization thus far has failed to materialize.

VII. Conclusions and Recommendations

Conclusions

Economic growth's impact on population health. Economic growth has a positive, significant impact on population health in very low income countries; however, while it still remains positive, the strength of that relationship diminishes as GDP/P increases.

Health policy is economic policy. Improved health status has a significant, positive impact on economic performance, and diminished health status has a significant, negative impact on economic performance. Investment in improved health status is a reasonable macroeconomic policy tool for economic growth, and it has an important impact on labor productivity in low income settings. Increased life expectancy has a positive impact on economic growth, but the magnitude of the life expectancy effect is the subject of debate and requires more research.

The adoption and diffusion of technological advances has improved population health. While there is a strong, positive association between economic growth and population health in low

and middle income countries, and while economic growth may be a necessary condition for widespread population health improvement in very low income countries, the tremendous gains in population health during the 20th century in low and middle income countries have been even more dependent on the adoption and diffusion of new disease control technologies. Variations in the degree of adoption and diffusion of new technologies have been a major determinant of the differences in economic growth and life expectancy improvements between countries.

The life expectancy gap is closing faster than the economic gap. During 1960– 2005, low and middle income countries were much more successful in closing the life expectancy gap than the economic growth gap with high income OECD countries. Countries which initially invest more heavily in human development are more likely to achieve long-term virtuous cycles in which improved health positively affects economic growth (as well as the development of human capital, by allowing improved creativity, coping skills, and innovation) and economic development positively affects health.

Child health and mortality. Health knowledge and technology are responsible for as much as two-thirds of the tremendous decline in childhood mortality rates in recent decades. Research has shown that income is a less important determinant of infant mortality than had been shown in previous econometric research. Progress has been made in reducing childhood mortality rates. Compared to OECD countries, however, these rates are still higher in middle income countries and much higher in low income countries. Achieving the Millennium Development Goals will require a substantial increase in the diffusion of *existing* disease control knowledge and technology. Increases in income per capita alone will not be sufficient. Early childhood nutrition and improved health have a life-long influence on human capital accumulation and contribute to long-term economic growth, thereby helping to avoid an intergenerational poverty trap.

Specific conditions. The economic impact of diminished health status due to malnutrition is substantial and devastating, causing reductions in labor productivity, human capital formation, savings rates, credit availability, educational attainment, and longevity. The AIDS epidemic has significantly reduced annual rates of economic growth in high prevalence countries. It is a threat to long-term economic growth and may contribute to an economic collapse in affected countries.

Recommendations

The findings of the paper immediately yield a number of recommendations national and international policymakers can follow to improve population health and hence the prospects for economic growth. Among the many such recommendations, we suggest the following six:

Improve population health to improve economic growth. Improved health status positively impacts economic growth. Investments to improve population health status and human development should be viewed as another macroeconomic policy option to pursue economic growth. While more research is still needed, policy makers should at least consider investments to increase life expectancy as intermediate policy variables that affect economic growth.

Increase funding for programs aimed at women. We recommend increased funding for and

encouragement of female education. We also recommend increasing women's reproductive rights. Empowering women through education and reproductive freedom will have a positive impact on the health of women and the health and development of children.

Increase the availability of microfinance. Evidence indicates that increasing the availability of micro-financial services to the rural poor in low income countries will result in self-sustaining economic development and greater overall human development. We recommend the expansion of microfinance to reach the vast majority of the poor who still do not have access to needed credit.

Make trade policies more equitable to low and middle income countries. We recommend an improvement in the equity of trade policies and in the participation in trade negotiations between high and low to middle income countries. Countries should be treated as equal partners in trade negotiations.

Increase funding for disease prevention and control. US \$8–10 billion per year will be needed to significantly reduce the incidence of malaria, TB, and HIV/AIDS by 2015. We strongly recommend that donor countries and international organizations increase their current funding levels to reach the Millennium Development Goals. Interventions focused on HIV/AIDS co-morbidities are also needed. We recommend increased funding for research focusing on the interaction of HIV/AIDS and malaria as well as HIV/AIDS and TB. Because early detection and completion of adequate treatment is important in the effort to prevent drug resistance, we recommend increased funding for research and interventions focused on drug-resistant TB strains. Finally, there is a need for improved cooperation between donor and recipient countries. We recommend further research to evaluate the effectiveness of existing international coalitions dealing with the prevention and treatment of HIV/AIDS and co-morbid diseases.

Increase drug availability in low and middle income countries. While international efforts such as TRIPS/Doha and UNITAIDS are improving pharmaceutical distribution, corruption and import/transport difficulties hinder progress when public health emergencies arise. To ensure the delivery of pharmaceuticals to those in need, we recommend increased funding to better track drug distributions. A system that provides developing countries with needed pharmaceuticals at affordable prices, while retaining an economic incentive for innovation by producers, has not been perfected. The development of such a system should be a priority. In the interim, we recommend a further extension of TRIPS' provisions to allow poor countries increased access to necessary pharmaceuticals.

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