

1 **Wealth, health and the cycle of progress**

Indur Goklany

“If present trends continue, the world in 2000 will be more crowded, more polluted, less stable ecologically, and more vulnerable to disruption than the world we live in now. Serious stresses involving population, resources, and environment are clearly visible ahead. Despite greater material output, the world’s people will be poorer in many ways than they are today.”

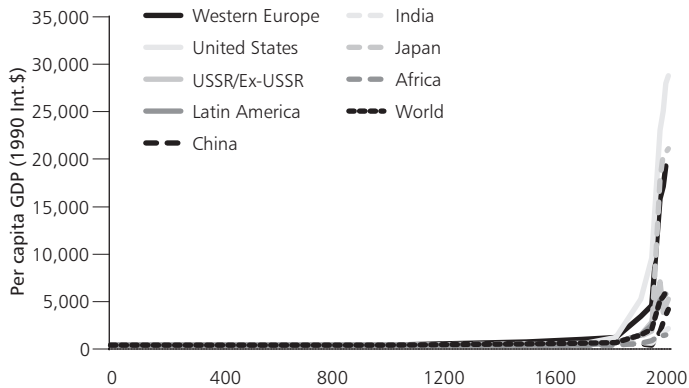
Global 2000 Report to the President

Introduction

With this Neo-Malthusian vision of the future, the *Global 2000 Report to the President* (Wrigley & Schofield, 1981) began a chilling description of the problems that lay ahead for the world unless radical changes were made. Fifteen years later, Julian Simon (Simon, 1995) quoted these words in his introduction to the monumental collection of essays, *The State of Humanity*. The point of that book, which Simon also edited, was to determine whether trends in human well-being and environmental quality were in accord with a Neo-Malthusian world view.

The State of Humanity, in fifty-eight chapters by more than fifty scholars, documented the tremendous strides in human well-being over the centuries, as well as trends in natural resource use and environmental quality. Based on these discussions, Simon wrote: “Our species is better off in just about every measurable material way” (Simon, 1995).

Figure 1 **Global economic development, AD 1–2003**



Source: Maddison (2005a); GGDC&CB (2005)

Yet today anxiety about the future continues. Calls to restructure our economy to avoid the pending insurmountable problems are typical. “The challenge facing the entire world is to design an economy that can satisfy the basic needs of people everywhere without self-destructing,” said Lester Brown, president of World Watch Institute, in 1998 (Brown, 1998).

This chapter is a conscious effort to emulate, build upon, and update the work of Julian Simon and to provide empirical data to help evaluate the heated rhetoric of Lester Brown and other Neo-Malthusian alarmists. While no one can confidently predict the future, it is possible to scrutinize the past and present to determine the current state of humanity and identify which factors have helped, and which hindered progress.

Thus, the goal of this much smaller chapter is to collect in a convenient and portable volume the historical trends for indicators that are widely used to illustrate human welfare. These trends are presented not only across time, but, where data are available, across

countries with different levels of economic development. In some cases, the data go back to when modern economic growth began – around 1800 or even earlier (see Figure 1) (Maddison, 1999a; 2005a; GGDG 1981).¹

This chapter will address whether and to what extent modern economic growth has improved humanity's lot, using the following indicators.

- ◆ *Available food supplies per capita.* Having sufficient food is the first step to a healthy society. It enables the average person to live a productive life, while hunger and undernourishment retard education and the development of human capital, slowing down technological change and economic growth.
- ◆ *Life expectancy.* To most people, this is the single most valuable indicator of human well-being. Longer life expectancy is also generally accompanied by an increase in disability-free years.
- ◆ *Infant mortality.* Throughout history, high levels of death in early childhood have produced enormous sorrow, reduced population growth, and lengthened the time spent by women in child-bearing.
- ◆ *Economic development.* Gross domestic product (GDP) per capita is a measure of people's income. Thus, it measures the wealth or level of economic development of a country. While wealth is not an end in itself, it indicates how well a nation can achieve the ends its people desire, from greater availability of food, safe water, and sanitation to higher levels of education and health care.
- ◆ *Education.* While education is an end in itself, it also adds to human capital and can accelerate the creation and diffusion of technology. Education (particularly of women) helps to spread knowledge about nutrition and public health practices.
- ◆ *Political rights and economic freedom.* The ability to conduct one's life creatively and productively usually depends on having political rights and economic freedom. They are critical

to maintaining liberty and the pursuit of happiness, which are among the inalienable rights of human beings.

- ◆ *A composite human development index.* Using an approach similar to that employed in the United Nations Development Program (UNDP), this index combines indicators for life expectancy, education, and per capita income (UNDP, 2000).²

After examining trends in the above indicators, this chapter will address whether differences in human well-being have widened between developed and developing countries and whether urban residents fare worse than rural residents. Finally, it will discuss the factors that appear to be responsible for the remarkable cycle of progress that has accompanied modern economic growth.

Hunger and undernourishment

Concerns about the world's ability to feed its burgeoning population have been around at least since Thomas Malthus's "Essay on the Principle of Population" two hundred years ago. Several Neo-Malthusians of the twentieth century confidently predicted apocalyptic famines in the latter part of the century in the developing countries (Ehrlich, 1968; Paddock & Paddock, 1967). But even though the world's population is the largest it has ever been, the average person has never been better fed.

Since 1950, the global population has increased by 150 per cent (FAO, 2005), increasing the demand for food, but at the same time the real price of food commodities has declined 75 per cent (Mitchell & Ingco, 1995; World Resource Institute, 1998; World Bank, 2005). Greater agricultural productivity and international trade have made this possible (Goklany, 1998). As a result, average daily food supplies per person increased 24 per cent globally from 1961 to 2002, as indicated by Table 1. The increase for developing countries was even larger, 38 per cent. The decline in real prices, moreover, increased the availability of food for people in the lower rungs of the economic ladder.

Table 1 **Daily food supplies (Kcal/capita/day), c. 1800-2002**

Year(s)	<i>Pre- or early- industrial phase^{ab}</i>	1961	1975	1989	2002
France	1,753 (1790)	3,194	3,247	3,563	3,654
Developed countries		1,928	3,147	3,308	3,314
Eastern Europe		3,118	3,412	3,436	3,194
India	1,635 (1950–51)	2,072	1,942	2,417	2,459
China	2,115 (1947–48) ^c	1,641	2,090	2,642	2,951
Developing countries		1,930	2,144	2,519	2,666
Sub-Saharan Africa		2,055	2,065	2,093	2,207
World		2,254	2,422	2,710	2,804

a Data are for the year(s) shown in brackets.

b Many developing countries, e.g., India and China, barely embarked upon industrialization until after World War II.

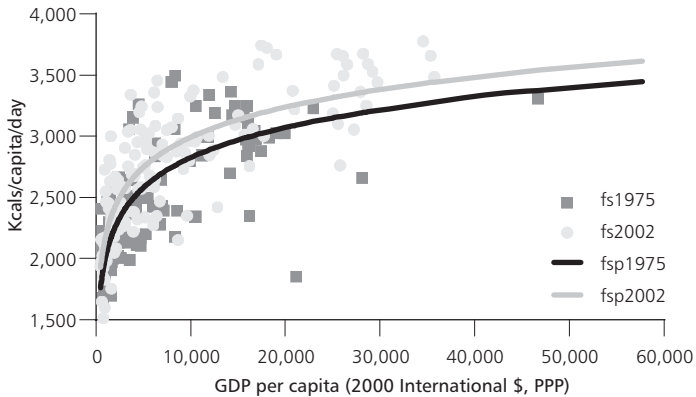
c Based upon data for 22 provinces.

Sources: Burnette and Mokyr (1995); Fogel (1995); Goklany (1999a); WRI (2005)

The Food and Agriculture Organization estimates the minimum daily energy requirement for maintaining health and body weight and engaging in light physical activity to be between 1,720 and 1,960 Calories (properly, kilocalories) per person per day (FAO, 1996). Adding to this threshold an allowance for moderate activity results in an estimate of the national average requirement from 2,000 to 2,310 Calories per person per day. (This assumes equal food provisions are likely to be equally available to the population.)

The improvements in the food situation in India and China since the middle of the twentieth century are especially remarkable. By 2002, China's food supplies had gone up 80 per cent from a barely subsistence level of 1,636 Calories per person per day in 1961. India's food supplies went up 50 per cent from 1,635 Calories per person per day in 1950–51. Between 1969–71 and 2000–02 such increases in food supplies helped reduce the number of chronically undernourished people in developing countries from 956 million to 815 million (or from 37 per cent to 17 per cent of their population) despite an 83 per cent growth in population (FAO, 2002; 2004; 2005).

Figure 2, based on cross-country data for 1975 and 2002 from the

Figure 2 **Food supplies per capita vs. income, 1975–2002**

Source: Based on data from World Resources Institute (2005), World Bank (2005b)

World Resources Institute and the World Bank³ shows that available daily food supplies per capita (FS) increase with both GDP per capita – a surrogate for per capita income (or “income” or “affluence”) – and the passage of time.⁴ The upward slope for each year probably reflects the fact that the wealthier the country, the greater its ability to afford more productive technologies to increase crop yields or purchase food in the global market through trade. The upward shift of the available food supply curve from 1975 to 2002 is consistent with the fact that for any given level of resources (represented by GDP per capita), over time food production increased largely due to technological change.⁵

According to Figure 2, if a hypothetical country’s per capita income were frozen at \$1 per day (in 2000 International dollars), available daily food supplies would have increased from 1,652 to 1,818 calories per capita per day from 1975 to 2002, an increase of 10.0 per cent, due to technological change alone. And if income were increased to from \$1 to \$2 per day in 2002, available daily food

supplies would rise a further 13.5 per cent to 2,064 calories per capita. Thus, if a country had doubled its per capita income between 1975 and 2002 (equivalent to an annual economic growth rate of 2.6 per cent), available food supplies per capita would have increased by 25 per cent.

Life expectancy

Life expectancy at birth is probably the single most important indicator of human well-being. For much of human history, life expectancy was between 20 to 30 years (Preston, 1995). By 2000–2005 it had increased to 66.8 years worldwide, as Table 2 indicates (World Bank, 2007). For the wealthiest group of nations, the Organization for Economic and Cooperative Development (OECD), life expectancy at birth was 78.5 years in 2003 (World Bank, 2005b). Life expectancy in the countries that are developed today fluctuated in the early nineteenth century, followed by small declines in the middle two quarters of the nineteenth century. Then, with a few notable exceptions and some minor fluctuations, it began a sustained improvement that continues to this day.

In England and Wales, life expectancy was 35.9 years in 1801. After some ups and downs, it increased to 40.8 years in 1831 but then declined to 39.5 in 1851. After further fluctuations in the range of 40.2 to 41.2 years, it has been climbing since 1871 (Floud & Harris, 1997). The same broad pattern seems to fit the United States from the 1850s to the present, with steady improvements from 1880 onwards (Haines, 1994). The nineteenth century fluctuations were probably due to a combination of factors. Urbanization, ignorance of germs, and poor sanitation helped spread infectious and parasitic diseases such as cholera, smallpox, malaria, tuberculosis and typhoid.

Once solutions to these diseases were identified – in some cases before understanding their causes – nations cleaned up their water supplies and instituted basic public health measures, such as sanitation, pasteurization, and vaccination. Mortality rates dropped rapidly in the late nineteenth and early twentieth century.

Year(s)	Middle ages	Pre- or early-industrial phase ^{ab}	1900 ^d	1950–55 ^e	1975–80 ^e	1985–90 ^e	2003 ^f
France		~30 (1800)	47	66.5	73.7	76.0	79.4
UK	20–30	35.9 (1799–1803) ^c	50	69.2	72.8	75.0	78.3
Developed countries	20–30			66.1	72.3	74.1	75.6 ^d
Eastern Europe				64.2	69.5	70.3	67.9 ^d
India		24–25 (1901–11)	24	38.7	53.3	57.2	63.1
China		25–35 (1929–31)		40.8	65.3	67.1	71.5
Sub-Saharan Africa				37.4	47.2	49.4	45.9
Developing countries				41.1	56.9	60.4	63.4 ^d
World	20–30	30		46.6	59.9	62.9	65.4

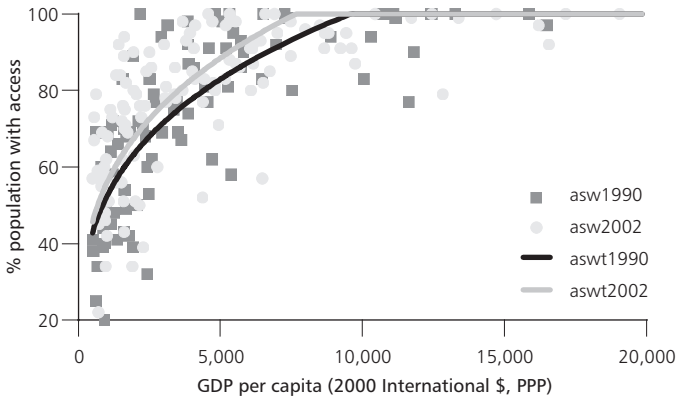
a Data are for the year(s) shown in brackets.

b Many developing countries, e.g., India and China, had barely embarked upon industrialization until after World War II.

c 1799–1803 data are for England and Wales, only. d Maddison (1999b). e UNPD (2004). f World Bank (2005b).

Sources: Wrigley and Schofield (1981); Preston (1995); Lee and Feng (1999); Maddison (1999b); UNPD (2004); World Bank (2005b)

Figure 3 Access to safe water vs. income, 1990–2002

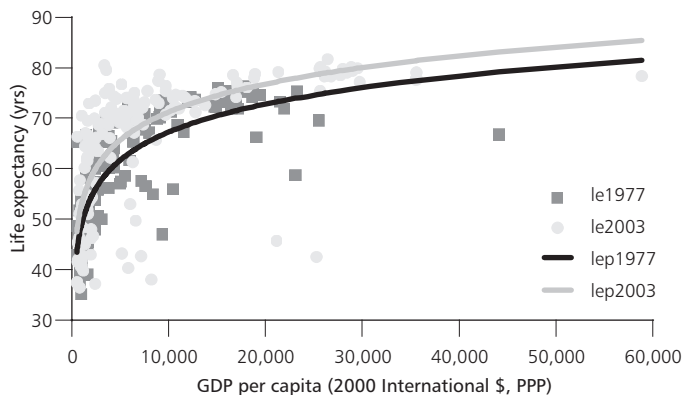


Source: Based on data from World Bank (2005b)

Then, in the first half of the twentieth century, antibiotics, pesticides such as DDT and an array of vaccines were added to the arsenal of weapons against disease. Once the traditional infectious and parasitic diseases were essentially conquered, the developed countries turned to dealing with so-called diseases of affluence: cancer, heart diseases and strokes (plus HIV/AIDS, a nontraditional infectious disease).

During the second half of the twentieth century, the diffusion of technology from the developed to developing countries, as well as greater wealth in the developing countries, increased access to safe water and sanitation services in developing countries. Figure 3 shows the increase in access to safe water (ASW) between 1990 and 2002.⁶ It indicates that if a country were to go from a per capita income of \$1 a day to \$2 a day that would have increased access to safe water from 39.1 per cent of the population to 47.7 per cent in 1990, and from 41.7 to 50.9 per cent in 2002.

Such access, coupled with increases in per capita food supplies,⁷

Figure 4 Life expectancy vs. income, 1977–2003

Source: Based on data from World Bank (2005b)

basic public health services, greater knowledge of basic hygiene, and newer weapons (such as antibiotics and tests for early diagnosis) reduced mortality rates.⁸ As a result of such advances, life expectancies lengthened worldwide, not just in the richest nations. Average global life expectancy increased from 46.6 in 1950–1955 to 66.8 years between 1950–1955 and 2003, as technology, including knowledge, was diffused around the world (World Bank, 2005b).

Figure 4 shows, using data for 1977 and 2003, that life expectancy increases as GDP per capita increases.⁹ Like the previous figures, it also shows the gains from technological change with the passage of time. A hypothetical doubling of GDP per capita from a dollar to two dollars a day would increase life expectancy from 40.7 to 46.2 years in 1977, and from 44.6 to 50.2 years in 2003. Thus, at these levels of affluence the gain from technological change between 1975 and 2003 is 3.9–4.0 years.

Figure 4 also suggests that because of technological change today's developing countries may have higher life expectancies than

did the developed countries at equivalent levels of income. This, indeed, is the case for China and India, countries once synonymous with poverty and wretchedness. In 1913 when the United States had a GDP per capita of \$5,301 (in 1990 International, PPP-adjusted dollars) (Maddison, 2005a), its life expectancy at birth was 52.5 years (Bureau of the Census, 1975). In 1977, when China and India had GDP per capita of a mere \$895 and \$937 respectively (also in 1990 International dollars) (Maddison, 2005a), they had life expectancies of approximately 65.4 and 52.9 years (World Bank, 2005b).

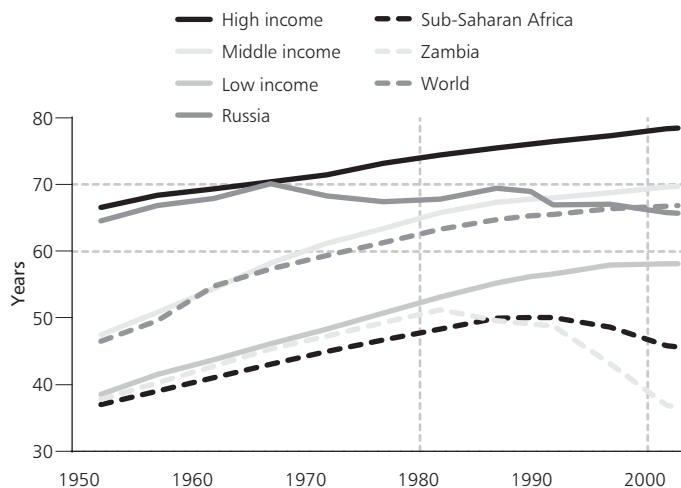
Not only are we living longer; we are also healthier (OECD, 1998; Shalala, 1998). Disability in the older populations of such developed nations as the United States, Canada, and France has been declining (U.S. Department of Health and Human Service, 1997). In the United States, for instance, the disability rate dropped 1.3 per cent per year between 1982 and 1994 for persons aged 65 and over.

Robert W. Fogel, the Nobel Prize-winning economic historian, notes that age-specific prevalence rates of specific chronic diseases and disabilities were much higher in the century preceding World War II than they are today. White males aged 60–64 are two-and-a-half times more likely to be free of chronic diseases today than their counterparts of a century ago. During the course of the twentieth century, the onset of chronic diseases has been significantly delayed – by 9 years for heart diseases, about 11 years for respiratory diseases (despite higher smoking rates), and nearly 8 years for cancers (Fogel, 2003).¹⁰

According to the World Health Organization, health-adjusted life expectancy (HALE) for the U.S., China and India, were 69.3, 64.1 and 53.5 years, respectively, in 2002 (WHO, 2004).¹¹ This is substantially more than these countries' corresponding *total* life expectancies before industrialization (see Table 2).

Figure 5 shows trends in life expectancies from the years 1950–55 to 2003 for various income groups and other entities.¹² Although life expectancy has on average increased worldwide since the 1950s, more recently there have been dramatic declines in many

Figure 5 Life expectancy 1950–2003



Source: World Bank (2005b), WRI (2005)

areas of Sub-Saharan Africa as well as less pronounced declines in Russia (Becker & Bloom, 1998) (which is somewhat representative of the former Soviet Union).

Russia's decline since the late 1980s in large part reflects economic deterioration concurrent with, and following, the fall of the communist government. Between 1989 and 1998, GDP per capita (in 1990 International dollars) declined 44 per cent before it rebounded (GGDC&CB, 2005). However, in 2003 it was still 21 per cent below its 1989 level. Yields of cereal, which represent 50 per cent of all crops, fell, and food supplies per capita, nutritional levels, and public health services all declined (Goklany, 1998). Alcoholism increased, as did accidental deaths, homicides, hypertension and suicides (Becker & Bloom, 1998). Life expectancies similarly declined in other countries in Eastern Europe and the former Soviet Union.

Table 3 **Infant mortality (<1 year of age, per 1,000 live births) from the Middle Ages to 2003**

Year(s)	Middle Ages	Pre- or early-industrial phase ^{ab}	1950 –55 ^c	1970 –75 ^c	1985 –90 ^c	2003 ^d
Sweden		240 (1800)	19.7	10.2	6.0	2.8
France		182 (1830)	45	15.9	7.8	4.4 ^e
Developed countries	>200		59.1	21.4	12.7	7.1 ^c
Russia			97.5	27.7	23.7	16.0
China			195.0	61.1	50.0	33.0
India			190.0	132	94.5	63.0
Developing countries			179.8	104.7	77.9	62.4 ^c
Sub-Saharan Africa			177.0	134.2	112.4	101.0
World	>200		156.9	93.2	70.4	56.8

a Data are for the year(s) shown in brackets.

b Many developing countries, e.g., India and China, had barely embarked upon industrialization until after World War II.

c Based on UNPD (2004).

d Based on World Bank (2005b).

Sources: Mitchell (1992); Hill (1995); UNPD (2004); World Bank (2005b)

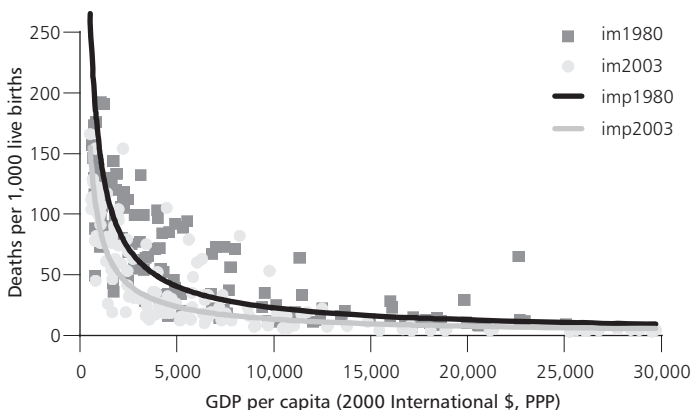
However, they have rebounded in the former region, as well as in many countries in the former Soviet Union (World Bank, 2005b).

Life expectancies have dropped much more dramatically since the late 1980s in a number of Sub-Saharan countries, due to a vicious cycle involving new and resurgent diseases, particularly, malaria, HIV/AIDS and tuberculosis, and a drop in economic output (UNDP, 2000). No country for which data are readily available has had a steeper decline than Zambia.

Infant mortality

Before industrialization, at least one out of every five children died before reaching his or her first birthday. As Table 3 shows, infant mortality, measured as the number of children dying before reaching

Figure 6 Infant mortality vs. income, 1980–2003



Source: Based on data from World Bank (2005b)

one year, typically exceeded 200 per 1,000 live births (Hill, 1995). The rate fell to 57 worldwide in 2003 (World Bank, 2005b). This is roughly the same level that more developed countries had reached in the 1950–55 period (World Research Institute, 1998; UN 2000). In the United States, as late as 1900, infant mortality was about 160; in 2004, it was about 6.6 (Bureau of the Census, 1975; NCHS, 2005a).

In the developing countries, the declines started later but may be occurring more rapidly in some areas. For instance, between 1950–55 and 2003, India's infant mortality fell from 190 to 63, and China's from 195 to 30 (UNPD, 2004a; World Bank, 2005b).

These declines were most likely due to a combination of greater economic development and technological factors, including wider knowledge about the factors that contribute to infant mortality and how to reduce them.¹³ Figure 6, which uses data for 1980 and 2003 from World Bank (2005b), shows that infant mortality drops with greater affluence and with time.¹⁴ According to this figure, if a hypothetical country doubled its GDP per capita from a dollar to two

dollars a day it would have decreased infant mortality from 355 deaths per 1,000 live births to 199 in 1980, and from 207 to 116 in 2003.

The declines in infant mortality were accompanied by declines in maternal mortality that were equally, if not more, spectacular. In the United States, for instance, while infant mortality rates declined from around 100 per 1,000 live births in 1915 to 6.8 in 2001, maternal mortality rates declined from 220 per 100,000 live births to 9.9 (Bureau of the Census, 1975; 2004).

Economic development

Long term trends in economic growth, based on data from Maddison, are shown in Table 4 for various countries and regions including the United States, India, China, Japan, Europe, Latin America, Africa, the former Soviet Union and the world (Maddison, 2005; GGDCECB, 2007). While these estimates are less than precise, they do indicate that for most of this millennium, GDP per capita worldwide was below \$600, measured in 1990 international dollars. Acceleration of economic growth began around 1800 and has been dramatic in recent years (see Figure 1). Today, it is more than ten times that (see Figure 5).

At the same time, the cost of basic necessities such as food has declined substantially in the last few decades in real (constant dollar) terms. More importantly, they have declined relative to income levels. For instance, between the years 1897 to 1901 and 2001 to 2003, U.S. retail prices of flour, bacon, and potatoes relative to per capita income dropped by 92 per cent, 85 per cent, and 82 per cent, respectively (Bureau of the Census, 1975; 2004).

Not only are basic necessities cheaper and the average person's annual income higher, but workers spend fewer hours on the job. Between 1820 and 2001, average hours worked per person employed declined 39, 20, and 45 per cent for the U.K., U.S., and Japan, respectively (Maddison, 2005). Ausubel and Grübler estimate that for the average British worker, total life hours worked declined

Table 4 **Gross domestic product per capita (in 1990 International \$, PPP-adjusted), A.D. 0–2003**

Year	1	1000	1500	1700	1820	1913	1950	1989	1996	2001	2003 ^c
Western Europe	450	400	771	998	1,204	3,458	4,579	15,856	17,097	19,256	
United States	400A	400 ^a	400	527	1,257	5,301	9,561	23,059	25,066	27,948	28,797
USSR/Ex-USSR	400	400	499	610	688	1,488	2,841	7,098	3,854	4,626	5,267
Latin America	400	400	413B	441 ^b	692	1,481	2,506	5,123	5,556	5,811	
China	450	450	600	600	600	552	439	1,827	2,820	3,583	4,185
India	450	450	550	550	533	673	619	1,270	1,630	1,957	2,194
Japan	400	425	500	570	669	1,387	1,921	17,942	20,494	20,683	21,104
Africa	430	425	414	421	420	637	894	1,463	1,403	1,489	
World	445	436	566	615	667	1,525	2,111	5,140	5,517	6,049	

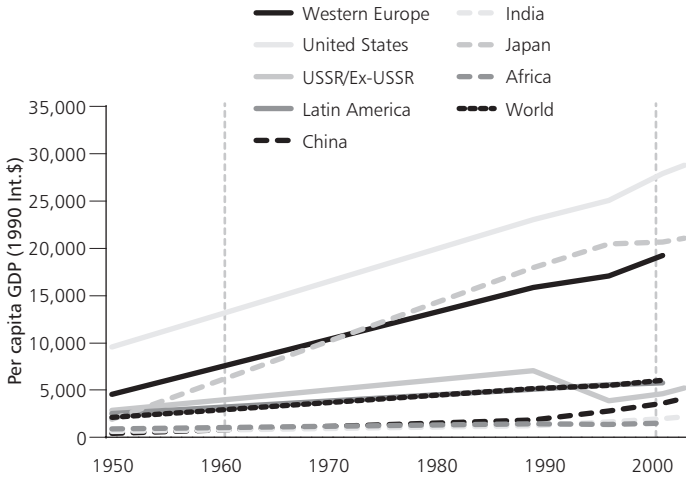
a Based on Maddison (1999a) estimate for "North America."

b Based on the arithmetical average for Brazil and Mexico.

c Based on GGDC (2005), adjusted per Maddison (2005a).

Source: Maddison (2005a); GGDC (2005)

Figure 7 Global economic development, AD 1950–2003

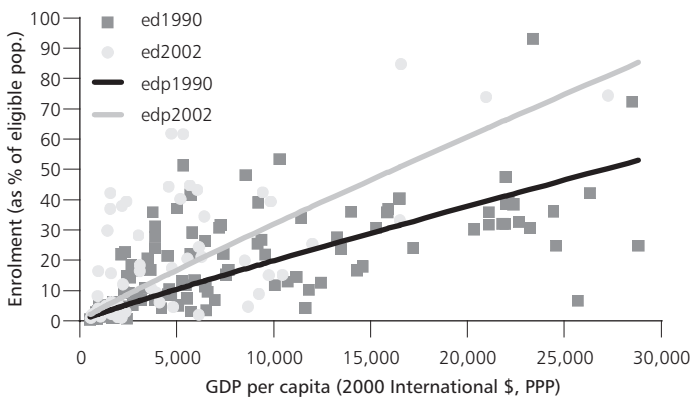


Source: Maddison (2005a); GGDC&CB (2005)

from 124,000 in 1856 to 69,000 in 1981 (Ausubel & Grübler, 1995). Because the average Briton lives longer and works fewer hours each year, the life hours worked by the average British worker has declined from 50 per cent to 20 per cent of his or her disposable life hours. In other words, the average person has more disposable time for leisure, hobbies, and personal development.

Thus, trends in real wages measured in dollars per hour would show an even more dramatic improvement than the income growth shown in Figure 7. Between 1820 and 2001 GDP per man-hour for the U.K., U.S., and Japan increased 19-, 28- and 56-fold, respectively (Maddison, 2005b). However, even these trends substantially underestimate the true improvements in economic well-being because methods to convert current dollars in one year to real dollars in another year are not robust when there has been a

Figure 8 Post-secondary schooling vs. income, 1990–2002



Source: Based on data from World Bank (2005b)

vast technological change between the two years. Goods and services available in the year 1950, for instance, were vastly different from those available in 1995. Personal computers, cell phones, VCRs, and instant access to the Library of Congress's electronic catalogue, to mention a few, simply were not available in 1950. Today, for a few hundred dollars people can buy goods and services they could not imagine, let alone buy for all the money in the world even a generation or two ago.

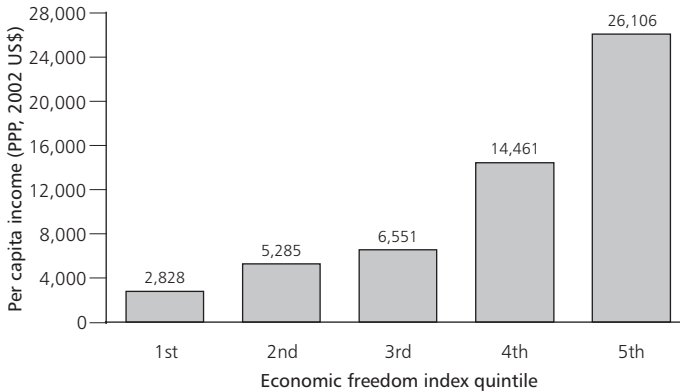
Education and child labor

Figure 8 shows that the per cent of the eligible population enrolled in postsecondary education increased with time and with affluence across a range of countries (World Bank 1999).¹⁵ Table 5 shows long-term improvements in the levels of education for the United States, France, China, and India based on data from Maddison (Maddison, 1995; 1998). Globally, postsecondary enrolment increased from 6.8

Table 5 Education (average number of years per person aged 15–64), c. 1820–2001

	1820	1870	1913	1950	1973	1992	2001
France			6.99	9.58	11.69	15.96	
UK	2.00	4.44	8.82	10.60	11.66	14.09	15.45
USA	1.75	3.92	7.86	11.27	14.58	18.04	20.21
Japan	1.50	1.50	5.36	9.11	12.09	14.87	16.61
India				1.35	2.60	5.55	
China				1.60	4.09	8.93	

Sources: Maddison (1995, 1998, 2005b).

Figure 9 Average income vs. economic freedom index, 2002

Source: Gwartney & Lawson (2004)

per cent in 1965 (World Bank 1999) to 25.6 per cent in 2001 (World Bank 2005a).

Literacy has increased worldwide as well. Between 1970 and the early 2000s, global illiteracy rates dropped from 46 per cent to 18 per cent (World Bank, 2005b; UNESCO, 2005). Complementing these increases are declines in the portion of the population aged 10 to 14 years who are working. Worldwide child labor measured this way has declined from 24.9 per cent in 1960 to 10.5 per cent in 2003 (World Bank, 2005b).

Political and economic freedom

In 1900, no country had universal adult suffrage; and only 12.4 per cent of the world's population enjoyed even limited democracy (Freedom House, 2002). Today 44.1 per cent of the world's population is deemed free by Freedom House, while another 18.6 per cent is considered partly free (Freedom House, 2005). Multiparty electoral

systems were introduced in 113 countries in the quarter century following 1974 (UNDP, 2000).

Economic freedom is also ascendant around the world. Gwartney and his coworkers have constructed an index of economic freedom that takes into consideration personal choice, protection of private property, and freedom to use, exchange, or give property to another. According to this index, economic freedom increased from 1990 to 2002 in 102 of the 113 countries for which they had data for both years (Gwartney & Lawson, 2004; Gwartney, 1998). Their analysis indicates that the more economically free a country's population, the higher its economic growth (see Figure 9).

Human development index

While the above indicators make a strong case for a steady increase in many aspects of human well-being, it is possible to create a single indicator that incorporates a number of key measurements of well-being. The United Nations Development Program (UNDP) has popularized this approach with its Human Development Index. This index is based on life expectancy, education, and GDP per capita.¹⁶

According to the UNDP's latest *Human Development Report*, the Human Development Index (HDI) has been going up for most countries (UNDP, 2004). This index is somewhat arbitrary. It probably understates improvements for the majority of the world's population because it omits measurements of hunger and infant mortality, both of which have improved for the majority of the world's population. Nevertheless, the data show that:

- ◆ All but three of the 102 countries for which data are available showed improvement in the human development index between 1975 and 2002. The exceptions – Zambia, Zimbabwe, the Democratic Republic of Congo – were all in Sub-Saharan Africa. Each had increased its HDI between 1975 and 1985 (due to longer life expectancy and higher literacy rates despite a

decline in GDP per capita).¹⁷ However, these gains have been more than erased since then due to continuing economic declines in affluence, lower life expectancy due to HIV/AIDS and the resurgence of malaria, and the conflict in the Democratic Republic of Congo (which Zimbabwe chose to involve itself in, and which created refugee problems in neighboring countries, including Zambia) (*Daily Mail and Guardian*, 1998; UN High Commission on Refugees, 1998; 1999a; 1999b). Intermittent droughts and their effects, exacerbated by poor governance, also contributed to declines in Zambia and, to a greater extent, in Zimbabwe.

- ◆ Twenty of the 138 countries with available data showed a decline in HDI between 1990 and 2002. The majority of these countries (thirteen) were in Sub-Saharan Africa. For this set of countries too, the declines could be attributed to HIV/AIDS, resurgent malaria, and, in some areas, declining affluence as well as the direct or indirect effects of conflict within – or in nearby – countries.
- ◆ Of the 20 countries that had lower HDIs in 2002 than in 1990 (based on UNDP data), five were in the former Soviet Union; none were in Eastern Europe. Following the collapse of the communist regimes in Eastern Europe and the former Soviet Union, the drop in affluence in those areas accompanied by the deterioration in health status led to a decline in their HDIs. However, by the mid- to late-1990s, the economic situation in these countries had bottomed out. As a result, despite drops in the early-1990s, a number of these countries had higher HDIs in 2002 than in 1990.
- ◆ The remaining two countries with HDIs known to be lower in 2002 than 1990 were the Bahamas and Belize. Their declines, which were relatively minor, had nevertheless been reversed by the mid- to late-1990s.

In summary, the data indicate that human well-being has improved and continues to improve for the majority of the world's

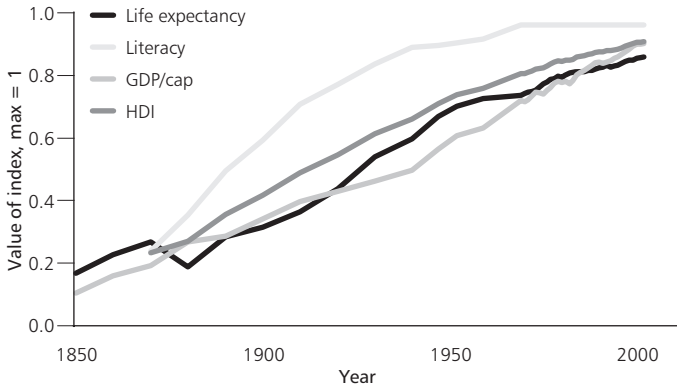
population. Over the past 15 to 20 years, however, well-being has been reduced in many Sub-Saharan, and continues to deteriorate. On the other hand, while matters had also regressed in Eastern European and the former Soviet Union nations, they now seem to be rebounding. These broad regional trends can be grasped when one considers that between the mid-1970s and the early-2000s:

- ◆ Affluence broadly advanced around the world for most income and regional groups with some exceptions – major oil exporting countries,¹⁸ Sub-Saharan Africa, the former Soviet Union and a handful of Latin American countries (e.g., Nicaragua, Honduras, Peru, Bolivia and Argentina) (GGDC&CB 2005; World Bank 2005b; see also Figure 7). A common thread for the last three groups was that they all suffered from internal conflicts and/or failed economic policies.
- ◆ Life expectancy also increased generally around the world except in Sub-Saharan Africa and some areas in the former Soviet Union (see Figure 5).

The critical factor underlying declines in HDI is the lethal combination of deteriorating wealth exacerbated by serious public health problems (e.g., deadly new diseases such as HIV/AIDS or resurgent diseases such as malaria and tuberculosis), and vice versa. This is most painfully illustrated by the experience of Sub-Saharan countries.

When AIDS first appeared, it resulted in almost certain death. Developed countries, particularly the United States, launched a massive assault on the disease. U.S. deaths due to HIV/AIDS dropped from a high of approximately 52,000 in 1995 to 19,000 in 1998 (Centers for Disease Control and Prevention, 2002; 2003, 2005; Martin et al., 1999). Since then fatalities have leveled off at around 18,000 per year. In 1996, HIV/AIDS was the eighth leading cause of death in the U.S.; by 1998 it had dropped off the worst-fifteen list. But similar improvement is unlikely to occur soon in Sub-Saharan countries because they cannot afford the cost of treatment unless

Figure 10 Human development index, US, 1850–2002



Source: see text

it's subsidized by the governments, charities, or industry from the richer nations.

For the United States, I have constructed an index similar to the HDI. Instead of education per se, I use literacy data, which are more readily available.¹⁹ The minimum value for each of the three components corresponds roughly to what it was around 1820, approximately the start of industrialization. These are: 30 years for life expectancy, 73.7 per cent for literacy, and \$1,257 (in 1990 International dollars) for GDP per capita (Costa & Stecker, 1997; Maddison, 2005a). For the maximum values, I assume 85 years, 100 per cent, and \$40,000, respectively, similar to what UNDP assumes in its Human Development Reports (UNDP, 2000). My index assumes that literacy stays at 99 per cent after 1970. This actually understates the level of improvement since it does not account for long-term increases in the educational level of the average American. Based on these assumptions, Figure 10 shows trends in the composite HDI and its individual components for the United States from

1870–2002. Despite minor fluctuations in the components, there has been a general improvement in overall human well-being in the United States during the twentieth century. Each component improved throughout the century except for literacy, which reached saturation around 1970.

Have gaps in human well-being widened?

While human well-being has improved continually over the past two centuries, it is often claimed that inequalities continue to widen between the developed and developing nations. A typical observation is the following from the United Nations Development Program's 1999 Human Development Report:

Nearly 30 years ago the Pearson Commission began its report with the recognition that, "the widening gap between the developed and developing countries has become the central problem of our times.' But over the past three decades the income gap between the richest fifth and the poorest fifth has more than doubled. Narrowing the gaps between rich and poor ... should become explicit global goals ..." (UNDP, 1999).

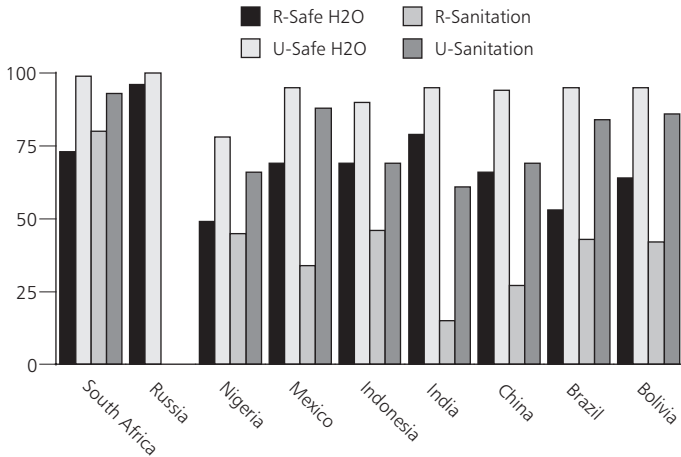
As Figure 7 showed, there are wide – and, in many cases, growing – disparities in income between the richer and poorer countries. The gaps in per capita income between Western Europe and the United States and other regions have ballooned since the start of modern economic growth about two centuries ago, and many people remain terribly poor (Maddison, 1998; 1999a). However, the increasing gap in incomes between the richer and poorer countries does not mean that income gaps between all human beings in the world, regardless of where they live, is necessarily widening (Economist, 2004). More importantly, it does not follow that the well-being of the relatively poor groups is declining.

In 2001, according to the World Bank, 1.1 billion people, mainly in the developing world, lived in "absolute poverty" (defined as subsisting on less than one U.S. dollar per day based on 1993 purchasing power parity) (Ravallion, 2004). Nevertheless, contrary to

conventional wisdom (Goklany, 2002), this was an improvement over matters in 1981 when 1.5 billion people fell into that category. In the intervening twenty years the world poverty rate declined from 33 to 18 per cent mainly because of robust economic growth in Asia, especially China and, to a lesser extent, India (Ravallion, 2004). On the other hand, the numbers and proportion of the population living in absolute poverty has increased in Africa, because of its generally dismal economic performance and its inability to cope not only with new diseases such as AIDS/HIV but also the more familiar diseases of malaria and TB. Other analyses also affirm that the number and proportion of people living in absolute poverty has declined worldwide, but not in Sub-Saharan Africa (Sala-i-Martin, 2002; Bhalla, 2002). However, they estimate fewer people live in absolute poverty worldwide than does the World Bank (Economist, 2004; Sala-i-Martin, 2002; Bhalla, 2002).

Measurements that describe human well-being more directly than income show the same general pattern. Yes, gaps in life expectancy and infant mortality between the more and less developed countries are substantial. But, these gaps have narrowed by 50 per cent since the 1950s. The gap in life expectancy was 25.0 years in the 1950–1955 but fell to 12.3 years in the 1995–2000, while the gap in infant mortality fell from 121 to 59 deaths per 1,000 live births (UNPD, 2004a). For these indicators, the gaps between Sub-Saharan Africa and the developed countries also shrank from the 1950s through the late 1980s, but since then, for reasons already articulated, the life expectancy gap has grown substantially (see Table 2 and Figure 5) while the infant mortality gap continued to shrink, but at a much reduced rate. Similarly, hunger is less prevalent worldwide than it was thirty years ago, and except for Sub-Saharan Africa the number of people suffering from chronic under-nourishment has declined in both absolute and relative terms (FAO, 2002; 2004). And with respect to child labor, another critical indicator of human well-being, the gap between richer and poorer nations has shrunk since at least 1960. Here, too, the shrinkage has been least for the gap between Sub-Saharan Africa and other income groups (Goklany, 2002).

Figure 11 Rural (R) vs. Urban (U) divide access to safe water and sanitation, 2000



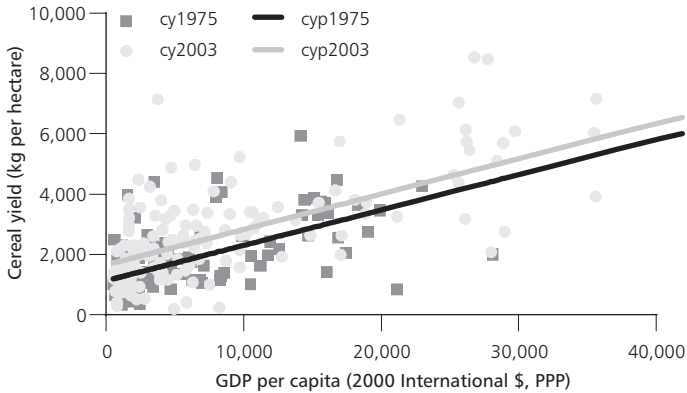
Source: World Resources Institute (2005)

Thus, while income inequalities might have widened between countries, they seem to have shrunk between people. More importantly, in the aspects of human well-being that are truly critical – life expectancy, infant mortality, hunger – the world is far more equal today than it was a half century ago, notwithstanding relapses in Sub-Saharan Africa and, to a lesser extent, some countries in the former Soviet Union.

Are rural residents better off?

Historically, as the currently developed countries embarked on modern economic growth, the welfare of urban dwellers generally lagged behind that of their rural compatriots (Easterlin, 1996; Fogel, 2000; Lerner & Anderson, 1965). Fogel notes that U.S. cities with

Figure 12 Cereal yield vs. income, 1975–2003



Source: Based on data from World Bank (2005b)

populations above 50,000 had twice the death rates of rural areas in the 1830s (Fogel, 2000). Evidently, overcrowding, lack of knowledge about hygiene, and the lack of safe water and sanitation made urban populations more susceptible to contagious diseases such as cholera, typhoid and tuberculosis. The image of urban suffering compared to a healthier rural life is reinforced in the mind of anyone who visits the over-crowded and polluted urban areas of the developing world, which give the impression that life in developing countries is worsening as cities grow.

In fact, however, urban residents are better off in most developing countries. When measured by the United Nations' Human Development Index and its related Human Poverty Index, there is more progress and less deprivation in urban areas (UNDP, 2000). For instance, in Swaziland, the rural HDI was 35 per cent below the urban level in 1999, reflecting less access to safe water, sanitation and public health services; lower rates of literacy; and higher rates of undernourishment. Figure 11 shows the urban–rural divide for

access to safe water and access to sanitation for 2000 in some of today's more populous developing nations. In each case, rural residents have lower access.

The cycle of progress

We have seen that human welfare advanced more in the past century than it did in all the rest of mankind's tenure on earth. I contend that this progress in human well-being was sustained, and perhaps even initiated, by a cycle composed of the mutually reinforcing, co-evolving forces of economic growth, technological change and free trade.

Technology increases food production through various mechanisms. It boosts yields through special seeds, mechanization, judicious application of inputs such as fertilizers and lime, and reductions of losses to pests, spoilage and wastage. Use of this technology is closely linked to economic development because not everyone can afford it. One reason why poorer countries have lower cereal yields is that farmers cannot afford sufficient fertilizer and other yield-enhancing technologies (Goklany, 1998; 2000). Thus we see in Figure 12 that yields increase over time and with wealth.²⁰ Higher crop yields translate into more food. And if food deficits exist despite increases in domestic production, with greater wealth they can augment food supplies by purchasing food and agricultural products through trade on the open market (see Figure 2). Thus, global trade in conjunction with improved technology increases food security (Goklany, 1995; 1998). The infrastructure – ships, refrigerated trucks, roads, and rails – that trade depends on, as well as financial mechanisms that transfer money and hedge risks, are products of technology, capital, and human resources.

More food also means more healthy people who are less likely to succumb to infectious and parasitic diseases. That – along with capital and human resources targeted on improvements in medicine and public health (see Figure 2) – has reduced mortality and increased life expectancy worldwide (Fogel, 1995; World Health

Organisation, 1999). Hence, as populations become more affluent, mortality decreases, as shown in Figure 6 for infant mortality, and life expectancy increases, as shown in Figure 4 (Goklany, 1999b; Pritchett & Summers, 1996; World Bank 1993). Thus, a wealthier population is healthier.

A healthier population is also wealthier because it is more productive (Barro, 1997; Bloom, 1999; Fogel, 1995; World Bank, 1993; World Health Organisation, 1999). Fogel estimates that the level of food supplies in eighteenth century France were so low that the bottom 10 per cent of the labor force could not generate the energy needed for regular work, and the next 10 per cent had enough energy for about half an hour of heavy work (or less than 3 hours of light work) (Fogel, 1995).

Citing a United Nations study, Easterlin notes that when malaria was eradicated in Mymensingh (now in Bangladesh), crop yields increased 15 per cent because farmers could spend more time and effort on cultivation (Easterlin, 1996). In other areas elimination of seasonal malaria enabled farmers to plant a second crop. According to the World Bank, the near-eradication of malaria in Sri Lanka between 1947 and 1977 raised its national income by an estimated 9 per cent (World Bank, 1997). A joint study by the Harvard University Center for International Development and the London School of Hygiene and Tropical Medicine estimated that if malaria had been eradicated in 1965, Africa's GDP would have been 32 per cent higher by 2000 (Malaria Foundation International, 2000; *Guardian*, 2000).

A healthier and longer-lived population is also likely to invest more time and effort in developing its human capital which contributes to the creation and diffusion of technology. It is not surprising that levels of education have gone up with life expectancy or that researchers today spend what at one period was literally a lifetime to acquire skills and expertise necessary for careers in research.

In addition, several measures undertaken to improve public health provided a bonus in economic productivity. Draining swamps not only reduced malaria but also added to the agricultural land

base (Easterlin, 1996). The World Bank reported that an international program to curtail river blindness, the Onchocerciasis Control Program, a mixture of drug therapy and insecticide spraying, had protected 30 million people (including 9 million children) from the disease (World Bank, 1993), and would free up 25 million hectares (60 million acres) of land for cultivation and settlement. Similarly, improved food supplies and nutrition by themselves may aid learning. This is one of the premises behind school meals programs (Watkins, 1997).

Improvements specific to health, food, and agriculture also benefit from a larger, more general cycle in which broad technological change, economic growth and global trade reinforce each other. Other technologies – invented for other reasons – have led to medical advances and improved productivity or reduced the environmental impacts of the food and agricultural sector. For example, computers, lasers, and global positioning systems permit precision agriculture to optimize the timing and quantities of fertilizers, water, and pesticides, increasing productivity while reducing environmental impacts. Plastics – essential for food packaging and preservation – also increase productivity of the food and agricultural sector. Transportation of every kind increases the ability to move inputs and outputs from farms to markets, and vice versa. Broad advances in physics and engineering have led to new or improved medical technologies, including electricity (without which virtually no present day hospital or operating room could function), x-rays, nuclear magnetic resonance, lasers and refrigeration.

These specific impacts do not exhaust the benefits of broad economic growth, technological change and global trade. Technological change in general reinforces economic growth (Barro, 1997; Goklany, 1998), giving countries more resources to research and develop technological improvements and to increase education (Goklany, 1995).

As Figure 8 showed, the proportion of the eligible population enrolled in postsecondary schools increases with wealth. Anecdotal evidence reinforces the importance of wealth in developing human

capital. Wealthy countries have the best education. An informal survey of fellow immigrants suggests that many of the most talented people from poorer countries end up in the universities and research establishments of the richer nations not only because they expect a higher quality of education but because they anticipate job opportunities that will better use their education and talents. In 1993, for instance, ten of the richest (and most well-educated) countries accounted for 84 per cent of global research and development and controlled more than 80 per cent of the patents acquired in the United States and in developing countries (UNDP, 1999).

Freer trade contributes directly to greater economic growth, helps disseminate new technologies, and creates competitive pressures to invent and innovate (Goklany, 1995). As an example, trade accelerated the cleanup of automobile emissions in the United States because the threat of cleaner cars from imports advanced the introduction of catalytic converters in the 1970s (Barbour, 1980; Seskin, 1978).

By expanding competition, trade helps contain the costs of basic infrastructure, including water supply and sanitation systems. A vivid example of the importance of trade in improving human well-being comes from Iraq. Because of trade sanctions, it was unable to properly operate and maintain its water, sanitation, and electricity systems, resulting in significant public health problems (United Nations, 2007).

Trade also helps augment food supplies. In fact, between 2000 and 2002, international trade allowed developing countries to enhance their grain supplies by 11.6 per cent (FAO, 2005).²¹ The corresponding figure for Sub-Saharan Africa was 23.5 per cent. Thus, in the absence of trade, food prices would have been higher (which would have priced more poor people out of the market), and hunger and malnutrition would have been more prevalent in developing countries. Also, cultivation of marginal lands would probably have increased to narrow the shortfall between food supply and demand.

In terms of income alone, trade raises incomes for both the poor and the rich (Dollar & Kraay, 2000; Frankel & Romer, 1999). Dollar

and Kraay (Dollar & Kraay, 2000) also find that economic growth favors rich and poor equally, confirming analyses by Ravallion and Chen (Ravallion & Chen, 1997) and Easterly and Rebelo (Easterly & Rebelo, 1993). Similarly, increased protection of property rights and fiscal discipline (defined as low government consumption) raise overall incomes without increasing inequality.¹¹²

Thus, each link in the cycle – higher yields, increased food supplies, lower mortalities and higher life expectancies – is strengthened by the general forces of economic growth, technological change and trade. Qualitatively, at least, this explains why all the figures for cereal yields (Figure 12), food supplies per capita (Figure 2), safe water (Figure 3), life expectancy (Figure 4) and post-secondary education (Figure 8) when plotted against per capita income look similar, and all look like mirror images of Figure 6 for infant mortality rates.

However, the experience of Sub-Saharan Africa warns us that a cycle that moves forward can also go into reverse if a deteriorating public health and a declining economy undermine each other.

Conclusion

Since 1800, global population has increased over six-fold (FAO, 2003; McEvedy & Jones, 1978). Manufacturing industries have increased over seventy-five times in value (Bairoch, 1982) and carbon dioxide emissions from fossil fuel combustion has increased 600 times (Marland et al., 2005). Overall, global economic product has multiplied more than sixty-fold.²² Despite the environmental disruption which might have been caused by all this activity, the state of humanity has never been better. Specifically:

- ◆ In the last two centuries, the average person's life expectancy at birth has doubled, infant mortality is less than a third of what it used to be, and real income has grown sevenfold. Food is more affordable. A child is less likely to go to bed hungry and a woman is far less likely to die in child birth.

- ◆ Children are more likely to be in school than at work. People are more educated and freer to choose their rulers and express their views. They are more likely to live under the rule of law and are less fearful of being arbitrarily deprived of life or limb, freedom, property, wealth and other basic human rights. Not only is work less physically demanding, but people work fewer hours and have more leisure time and money to devote to optional pursuits.
- ◆ Although gaps between richer and poorer nations may be expanding in terms of per capita income, gaps in the critical aspects of human well-being (particularly life expectancy, infant mortality, hunger and malnourishment and literacy) have for the most part shrunk over the past half-century, despite regression in Sub-Saharan Africa and in the countries of the former Soviet Union.
- ◆ Developing nations on the whole have benefited from knowledge and technology generated in developed countries. With respect to the most critical indicators of human well-being – life expectancy, infant mortality and hunger – developing countries are better off than were developed countries at equivalent levels of income. These improvements have come from reducing death and disease due to inadequate food supplies and infectious and parasitic diseases such as cholera, malaria, typhoid, diarrhea, dysentery and other water-related illnesses.
- ◆ The reductions in water-related diseases and diseases caused or aggravated by inadequate food and nutrition have not yet run their full course. Thus, improvements in infant mortality and life expectancy in developing countries may continue, shrinking the gap between developing and developed countries for these indicators.

However, once the easy and relatively cheap improvements in health and life expectancy have been captured, the gap may widen again. Further improvements will come only through dealing with

nontraditional diseases such as AIDs and the diseases of affluence. While the United States has reduced deaths from HIV/AIDS by almost 65 per cent between 1995 and 2003, treatment is expensive and unaffordable to most in the developing world. This illustrates not only the need for improved technology but also the importance of economic growth as well as trade in ideas and products.

It must be noted, however, that like other cycles, the Cycle of Progress can also go in reverse. Whatever gains the last half-century brought to Sub-Saharan Africa, they could be more than erased unless countries in that region undertake the policy and institutional reforms necessary to break the vicious cycle of falling incomes and poorer health that currently grips many parts of that area.

Economic growth, technological change and trade become even more crucial for the continued improvement in the state of humanity when one considers that global population may grow anywhere between 15 and 120 per cent during this century, according to the United Nations' latest projections (United Nations Population Division, 2004a; 2004b).