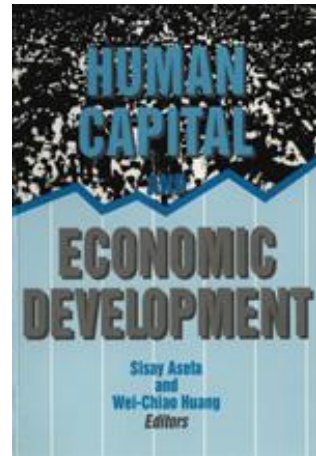




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Can There Be Too Much Human Capital?

Is There a World Population Problem?

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Most of the emphasis in the study of human capital is on investment in people and the consequences of that investment—social and private returns, social and private costs, the effects of human capital upon productivity and national output growth, on-the-job training versus formal education, and the substitution between quality and numbers of children. I plan to discuss a rather different aspect of human capital, namely, the value of a person—a human being—with little or no formal investment other than that common in the majority of the developing countries of the world.

My interest in the value of a person whose primary human capital consists of a combination of physical capability, native intelligence, and a limited education investment is in exploring whether population growth has a measurable negative effect upon real per capita income in developing countries. As I use the term, a negative effect exists if the total marginal product of an additional individual is less than the average product of the existing population. This definition of a negative effect does not require that the marginal product be negative, only that it be less than the average product or per capita income level. This is a very stringent test, much stronger than what is generally considered.

I believe if the majority of people were asked what was the relationship between population growth and per capita real incomes in developing countries they would answer that there was a negative relationship—that population growth reduces real per capita incomes below what they would otherwise be. This was the common viewpoint expressed in the popular press prior to and during the 1992 world conference on the environment in Rio de Janeiro. It is the intent of the

Population Crisis Committee, certain agencies of the United Nations, and the authors of *The Population Bomb* to create such an impression. It is certainly the answer given by officials in the People's Republic of China responsible for the country's population programs.

There have been relatively few voices putting forward a contrary view; Julian Simon has been the most prominent. A few years ago (1986) a Working Group was organized by the National Research Council of the National Academy of Sciences, and after many meetings and several studies commissioned, it issued a report (NRC 1986), *Population Growth and Economic Development: Policy Questions*, which has been ignored except for reviews in a few scholarly journals. I hope I will be forgiven if a significant part of this paper is devoted to presenting the major findings of that report which, I believe have stood the test of time very well. But I may be biased—I was the co-chairman of the Working Group.

Why is Population Growth Bad?

It is useful to start with the arguments that support the view that population growth has adverse effects upon economic growth in developing countries. The case is quite simple and straightforward. The earth is considered to be finite in terms of physical space and resources. The exploitation or use of its resources is subject to diminishing returns—additional inputs (including labor) applied to the land, water, minerals, and forests will yield a diminished return. Therefore, other things equal, more people will mean a reduction in the marginal productivity of labor and, eventually, lower per capita incomes. These relationships seem so obvious that they are seldom spelled out so explicitly. The basic argument hasn't changed from that given by Malthus nearly two centuries ago.

The fact that only a small minority of the world's population eats less well today than did the majority of Europeans at the time Malthus wrote seems not to have dimmed the attractiveness of his model of human behavior (Fogel 1992). It is estimated that in the period 1781–1790, daily per capita calorie consumption in France was 1,753. As of 1965, how many countries in the world had a smaller caloric supply?

The answer is: exactly two—Mozambique and Somalia (World Bank 1992). It was not until the second quarter of the nineteenth century that France's calorie consumption equaled that of India today. At the end of the eighteenth century England's daily per capita production of calories was 10 percent below the Indian daily consumption in 1989. It is sad to note that in 1989 there were three countries, all torn by war and revolution, that had less than 1,753 calories per day—Mozambique, Ethiopia, and Chad—and as of 1992 they have probably been joined by Somalia and Sudan. Yet the view that increased food supplies would soon be followed by increased mouths to feed should not be too surprising, since this view was expressed more than two millennia ago in Ecclesiastes 5.11: "When goods are increased, they are increased that eat them."

The World Bank's *World Development Report 1984* dealt with the issue of population change and development. The discussion, which is both competent and balanced, gave rather little weight to the importance of diminishing returns to or scarcity of resources except for the possible adverse effects of population growth on the environment. Nor was the claim made that rapid population growth stopped development or caused a fall in real per capita income. Instead, the consequences were that rapid population growth, such as that occurring in most developing countries, slowed economic development (p. 105). It attributes the negative effects of rapid population growth to two factors. The first was internal to the family; a large family reduces the investment in each child in terms of time and other resources. Since poor families have the most children, this makes it more difficult to reduce poverty. The second factor was that "rapid population growth weakens macroeconomic performance by making it more difficult to finance the investments in education and infrastructure that ensure sustained economic growth" (p. 105). This work represented an important shift in the scholarly discussion of population growth, but seems not to have penetrated the popular discussion.

What Are the Facts?

What are the facts concerning the relationship between population growth and development as measured by the growth in real per capita incomes? This may seem like a simple question and, at one level, it is. But as will become clear, it is far from a simple question. Or it may be a simple question with a complex answer or answers.

I shall present some empirical information concerning the relationships between population growth and economic development. Let me note in advance that the empirical relationships presented do not prove causality; they do not prove that population growth has either a positive or negative effect upon development and growth. For this reason the Working Group (NRC 1986) did not present any regressions relating population growth to various variables, such as per capita income growth. Spurious correlations abound. Why do I present such data then? I do so because those who believe that population growth is the source of most human ills either implicitly or explicitly claim that a negative relationship holds between population growth and economic and social development. A recent pamphlet of the Population Crisis Committee, *The International Human Suffering Index*, presents, in color no less, a comparison between an index which it calls the Human Suffering Index and the annual rate of population increase. Two statements are made: "Most countries with high human suffering scores have very high rates of population growth," and "Virtually all the countries with low human suffering scores have low rates of population growth." But there appears to be a very weak statistical relationship between the two variables except between the 57 countries classified as having Minimal and Moderate Human Suffering versus the 83 others. Within the 83 other countries, whose fates include those classified as subject to Extreme Human Suffering, there was almost no relationship between population growth and the index; the square of the correlation coefficient is 0.06. This means that 94 percent of the variation in the suffering index was due to something other than differences in population growth rates. If one's only source of information on the status of the life of people in developing countries were the discussion of the Human Suffering Index, one would hardly guess that life expectancy at birth has increased from no more than 35 years in 1950

to 62 years in 1990 in the low-income countries (less than \$600 GNP per capita in 1990).

Why It Is So Hard To Know

Why is it so hard to determine how population growth affects economic development? As noted, the interrelationships between population and economic growth are very complex. First, if economic development is measured by changes in per capita real income, at certain income levels increases in per capita income will result in an increase in population growth through influences that reduce mortality, especially infant mortality. For the developing economies, there is a strong negative relationship between income levels and infant mortality. Thus, if income and population growth are compared for the same time period, it is likely that there will be a positive relationship between the two. Introducing lags as I have may not entirely eliminate the problems associated with the direction of causality. Second, the effects of population growth can differ in the short and long run, with the short run being perhaps as long as half a century. Other things equal, in the short run an increase in population growth would be expected to lower the rate of growth in real per capita incomes. An increase in population growth rates will be accompanied by an increase in the number of children and in the dependency ratio. The labor force declines as a percentage of the population. In the long run the effects of investment in human capital can be realized. Positive effects through invention and innovation and increasing returns to scale can result from population growth when there is time for adjustment and response to changing conditions. Slow or nil long-run increases in population also increase dependency as the population ages. Thus, in the long run (after one or two generations), slow population growth can have similar effects upon per capita productivity as rapid population growth may have in the short run.

A possible reason for the belief that an increase in population in the developing countries will either lower the actual average income or the rate of growth of income is the implicit assumption that individuals in these countries consume everything they produce. This assumption is

incorrect. The people of the developing countries do not consume everything they produce. According to World Bank data (1992, pp. 234–235), the domestic savings rates of the low-income countries are equal to or greater than the rates for either middle- or high-income countries. Thus if resources are productively invested, over a lifetime an additional person would make possible an increase in the productive potential of a country. This conclusion assumes that savings rates are independent of population growth rates, and that point is addressed below. It may be noted that the savings estimate excludes savings that result in human capital investment. If the succeeding generation has more education and more adequate health care than the current generation has, this increases the probability that a significant positive rate of population growth either will have a positive or nil effect on per capita real incomes in the long run. Consequently, in considering the effect of population growth on income growth we must consider the total effect and not solely the marginal product of labor. This is why I earlier used the term “total marginal product” of an additional person which includes not only the marginal product of labor but the increase in investment and any effects through increasing returns to scale.

Some Empirical Relationships

There are a number of empirical relationships or propositions that merit our attention. The first two are of a very general nature, and the third involves regressions between population growth rates and real per capita incomes with the inclusion of other relevant variables. These empirical propositions raise some questions concerning the validity of the commonly held view that higher rates of population growth have adverse effects upon economic well-being. I do not claim that these empirical relationships imply causality, but only that each is worth pondering and exploring.

The first of the empirical relationships is that the significant increases in the real incomes in the industrial countries of Europe and North America occurred in the eighteenth, nineteenth, and early twentieth centuries during a period of historically rapid population growth that followed a long period of slow population growth. From 1650 to

1750 population growth rates were very low in both the industrial and developing regions at 0.33 and 0.34 percent annually (see table 1). At these rates population doubling would require two centuries. From 1750 to 1900 population growth rates were higher in the industrial than in the developing regions and this difference continued through the first two decades of this century.

Table 1. Population Growth Rates and Distribution of World Population Between Industrialized and Developing Regions, 1650–1986

Interval	Average annual rate			% of world pop. in developing regions	% of growth in pop. in developing regions
	Industrialized regions (B)	Developing regions (A)	Difference (B–A)		
1980–1986	0.66	1.98	-1.32	76.9	91.6
1970–1980	0.78	2.23	-1.45	74.4	89.6
1960–1970	1.04	2.41	-1.37	71.7	86.2
1950–1960	1.26	2.07	-0.81	69.9	79.8
1940–1950	0.35	1.44	-1.09	67.5	90.0
1930–1940	0.85	1.28	-0.43	66.4	77.3
1920–1930	0.91	1.11	-0.20	66.1	68.6
1900–1920	0.92	0.52	0.40	67.9	53.8
1850–1900	1.05	0.53	0.52	73.3	54.5
1800–1850	0.83	0.31	0.52	78.1	53.4
1750–1800	0.62	0.47	0.15	79.3	73.6
1650–1750	0.33	0.34	-0.01	79.3	79.4

SOURCES Bogue (1969, p. 49), United Nations (1988)

As late as 1840 life expectancy at birth in six European countries and Massachusetts was 41 years (table 2). It reached 50.5 years by 1900 and then increased rapidly reaching 71 years by 1955. While we have little knowledge of life expectancy at birth in the developing regions prior to 1950, it is unlikely that there was any significant improvement in the prior century. However, since 1950 the increase in life expectancy can only be described as spectacular, increasing from 35 years in 1950 to 62 years in 1990 (World Bank 1984 and 1992). Life expectancy at birth in the United States was approximately 42 years in 1880; it did not reach 60 years until 1930. Thus, the lowest income

countries in the world achieved a greater increase in life expectancy in 25 years than was achieved in the United States in twice that long. This improvement in the developing regions was achieved during a period of rapid population growth.

Table 2. Expectation of Life at Birth for Six European Countries and Massachusetts in the United States: 1840 to 1955

Year	Expectation of life at birth	Average annual increase in life expectancy
1840	41.0	--
1850	41.5	0.05
1860	42.2	0.07
1870	43.5	0.13
1880	45.2	0.17
1890	47.1	0.20
1900	50.5	0.34
1910	54.3	0.38
1920	58.3	0.40
1930	61.7	0.34
1940	64.6	0.29
1955	71.0	0.43

SOURCE United Nations (1962, table IV 1).

Similar rapid progress has been made in the developing world in reducing infant mortality and child death rates since 1950 (table 3). The infant mortality rate declined from 165 in 1950 to 72 in 1985, while the child death rate fell from 27 to 11; both are rates per 1,000. The infant mortality rate in the United States in 1900 was 160, and it declined to approximately 80 over the next quarter century (U.S. Bureau of the Census 1971, p. 55).

The second of the empirical propositions is that the developing countries had rapid economic growth in the three decades from 1950 to 1980 with population growth rates exceeding those ever realized in the industrial countries. Population growth rates were 2 percent or more while the per capita GDP grew at an annual rate of 2.6 percent during the three decades (National Research Council 1986, p. 5). Prior to 1950 population growth rates had been much lower, generally 1 per-

Table 3. Life Expectancy at Birth, Infant Mortality Rate, and Child Death Rate

Country or income groups ^a	Life expectancy at birth		Infant mortality rate ^b (under age 1)		Child death rate ^b (ages 1–4)		GNP per capita (in \$U.S.)
	1960	1985 ^c	1960	1985 ^c	1960	1985 ^c	1985 ^c
Low-income economies							
China	42	69	165	35	26	7	310
India	43	56	165	89	26	11	270
Other	43	52	163	112	31	19	200
Average	42	60	165	72	27	11	270
Africa							
Low-income							
Semi-arid	37	44	203	151	57	34	218
Other	39	49	158	112	37	22	254
Average	38	48	164	117	40	24	249
Middle-income							
Oil importers	41	50	159	111	37	21	670
Oil exporters	39	50	191	113	51	21	889
Sub-Saharan	--	49	170	115	42	23	491
Middle-income economies	51	62	126	68	23	10	1,290
Lower-middle income	46	58	144	82	29	13	820
Upper-middle income	56	66	101	52	15	6	1,850
Industrial market economies	70	76	29	9	2	--	11,810

SOURCE: World Bank (1987).

a Income designations are based on per capita income (in 1985 U.S. dollars). low income, \$390 or less, lower-middle income, \$400–\$1,600; upper-middle income, \$1,600–\$7,420

b Rates are per 1,000

c Data for Africa are for 1982.

cent or less, and there had been slow or nil increases in real per capita incomes.

Economic growth was relatively slow during the 1950s in the low-income countries. If we look at a somewhat later period, 1965 to 1985, the rate of income growth was quite spectacular. The per capita gross national product for the low-income countries grew 2.9 percent annually for 1965–85 and exceeded the 2.4 percent of the industrial economies (World Bank 1987). Since low-income countries were defined as those with less than \$400 per capita GNP in 1985, some rapidly growing countries that were poor in 1965 were excluded from the calculation because they grew out of the low-income category by 1985; had these countries been included, the growth of income would have been even higher.

The third of the empirical propositions is that the evidence does not support the view that for developing countries the rate of population growth has a negative effect upon per capita income growth for the period since 1950. Some results are given in table 4 for three decades. In the simple model it was assumed that per capita income growth in a decade was a function of population growth and per capita income growth in the prior decade. Enrollment ratios for primary schools and per capita gross domestic products were included. School enrollment is included to provide a rough indication of society's investment in human capital. Per capita GDP is included to determine if there is a convergence effect among the developing countries. Per capita GDP growth in the prior decade was included because of the possible causality between income growth and population growth and the possibility of continuity in per capita income growth from one decade to the next. The coefficient for population growth was positive but not significantly different from zero for each of the three decades for low-income countries. For middle-income countries the coefficient was negative and significantly different from zero at the 10 percent level for the 1960s, but was not significant for either of the other two decades. Thus, of the six coefficients for the developing countries, only one indicated that there was a (weak) negative relationship between past population growth and current growth of GDP per capita. The variables included had surprisingly little relationship to the real per capita growth rates. The correlation coefficients were very small and none of the coefficients were statistically significant at the conven-

tional 5 percent level. Obviously other variables, including policy variables, are much more important in influencing income growth rates than population growth or the human capital measures that I have included.

Table 4. Cross-Country Regressions of Per Capita GDP Growth Rates

Low income	1960–1970	1970–1980	1980–1988
Lagged population growth	0.053	0.115	0.319
Enrollment primary school	-0.015	0.025	-0.015
Lagged GDP growth	0.226	-0.221	-0.286
Lagged GDP level	-0.001	-0.003*	0.000
Dummy: Africa	-0.931	-0.742	-3.371*
\bar{R}^2	-0.004	0.163	0.059
n	12	32	33
Middle income			
Lagged population growth	-0.524**	0.319	-0.551
Enrollment primary school	0.017	0.029	0.024
Lagged GDP growth	0.236	0.163	0.320*
Lagged GDP level	-0.005	0.000	0.000**
Dummy: Africa	-0.711	-0.241	-0.792
Latin America	-0.859	-0.608	-2.115**
\bar{R}^2	0.163	-0.043	0.055
n	32	61	58

NOTES GDP data are from Summers and Heston (1991); and World Bank (various years) Lagged population and lagged GDP growth rates are for the prior decade, lagged GDP level is beginning year of the decade Africa and Latin America dummies are 1 for country in region, 0 otherwise Constant terms not presented

*Statistically significant at 5 percent level

**Statistically significant at 10 percent level

Table 5 is from Levine and Renelt (1992), who included population growth as one of the variables in their analysis of the influence of policy factors on economic growth in 119 countries. In none of the regressions was there a statistically significant effect of population growth on the rate of economic growth. Several of the policy or policy-related variables had a statistically significant coefficient, especially investment and government share. A study by Singh (1992) for twenty-nine developing economies obtained negative but insignificant coefficients

Table 5. Cross-Country Growth Regressions (Dependent Variable: Growth Rate of Real Per Capita GDP)

Independent variable	Regression period data set				
	1960–1989	1960–1985	1960–1989	1960–1985	1960–1985
	WB/IMF (1)	SH (2)	WB/IMF (3)	WB/IMF (4)	SH (5)
Constant	-0.83 (0.85)	2.01 (0.83)	0.86 (0.89)	0.47 (1.18)	2.05 (1.12)
Initial GDP per capita (RGDP60)	-0.35* (0.14)	-0.69* (0.12)	-0.30* (0.11)	-0.40* (0.13)	-0.57* (0.12)
Investment share (INV)	17.49* (2.68)	9.31* (2.08)	16.77* (2.62)	13.44* (3.13)	10.15* (2.43)
Population growth (GPO)	-0.38 (0.22)	0.08 (0.18)	-0.53 (0.18)	-0.15 (0.19)	-0.02 (0.19)
Secondary-school enrollment (SEC)	3.17* (1.29)	1.21 (1.17)		0.63 (1.26)	0.99 (1.23)
Primary-school enrollment (PRI)		1.79* (0.58)		0.91 (0.73)	1.07 (0.70)
Government share (GOV)		-6.37* (2.03)		-0.59 (3.73)	-6.80* (2.30)
Growth of government share (GSG)			-0.08 (0.06)		
Socialist economy (SOC)		-0.25 (0.38)		-0.21 (0.45)	-0.17 (0.43)

Revolution/coups (REVC)			-1.76*	-0.86	-1.75*
			(0.52)	(0.62)	(0.59)
Africa dummy (AFRICA)			-1.24*	-1.36*	-1.78*
			(0.37)	(0.48)	(0.44)
Latin America dummy (LAAM)			-1.18*	-1.34*	-1.27*
			(0.33)	(0.38)	(0.36)
Growth of domestic credit (GDC)				0.019*	0.013
				(0.009)	(0.008)
Standard deviation of domestic credit (STDD)				-0.009*	-0.006*
				(0.003)	(0.003)
Civil liberties (CIVL)				-0.22	0.01
				(0.11)	(0.13)
Export-share growth (XSG)				0.090	0.023
				(0.052)	(0.047)
Number of observations	101	103	83	84	86
\bar{R}^2	0.46	0.68	0.61	0.67	0.73

SOURCE: Levine and Renelt (1992)

NOTES Regressions (1), (3), and (4) use primarily World Bank and IMF data, while regressions (2) and (5) use Summers and Heston data Coverage includes all countries with data given by the sources except major oil exporters

*Statistically significant at the P=0.05 level

for the population growth variable. In each of these studies the periods for income and population growth were contemporaneous.

Population Growth Only One Factor

Before summarizing the results of the NRC study on population growth and economic development, I want to make a point that is all too often ignored in the popular discussions of the subject. Population growth is only one factor in determining the economic well-being of the citizens of a country. And, looking around the world today at the observed differences in real per capita incomes, it seems to be a rather minor factor in explaining such differences. Governmental policies are of far greater importance. Much of the human suffering witnessed in recent years has not been caused by excessive population growth or too large populations; most of the real causes are to be found in civil war and strife and governmental mismanagement and failures. Bangladesh is a probable exception to this conclusion, but I am not sure that there are any others.

China is a clear example of the dominance of factors other than population growth in explaining real income growth over the past four decades. While there has been a reduction in population growth rates over the past three decades, the small decline in the population growth rate after the early 1970s can't account for any significant part of the sharp changes in the growth of income per capita. Using the Summers and Heston (1991) estimates, per capita GDP grew at an annual rate of 2.3 percent from 1960–1973, by 3.7 percent from 1973–1980 and, during major policy reforms, 7.8 percent from 1980 to 1988. Population growth rates in Taiwan closely parallel those of the mainland, but from 1960 to 1980 the real income growth rate was double that of the mainland. This difference can only be explained by policy factors. From 1980–1988 the per capita income growth rate on the mainland exceeded that of Taiwan.

Most African countries, unfortunately, provide further evidence of how the national policy framework dominates changes in economic welfare. From 1973–1980, thirty out of forty-six African countries had negative real per capita income growth rates (Summers and Heston

1991). The same number had negative per capita growth rates during 1980–1988. During these two periods the African countries generally followed import substitution policies with heavy taxation of agriculture, especially of export commodities. The beginning of the shift to market-oriented policies did not begin generally until the mid-1980s and is just now beginning to influence the pattern of growth.

Propositions: Population and Growth

In the report, *Population Growth and Economic Development: Policy Questions* (NRC 1986), nine questions were posed and the available evidence was used to answer them. I shall now paraphrase the nine questions and provide a brief summary of the report's conclusions.

1. Would slower population growth increase the per capita supply of exhaustible resources?

In reflecting upon this question, it should be remembered that over the past century the real prices of exhaustible natural resources have declined, not increased (Simon 1981). The decline in the prices of such resources relative to wages or earnings has been striking; for oil and coal the time cost today is about a fifth of what it was a century ago. The same pattern of decline in relative scarcity has prevailed for non-fuel resources such as copper.

An important point is that no exhaustible resource is essential or irreplaceable. As the easily available supplies of such a resource are extracted, the real cost of extraction and the price increase, which encourages economy in the use of that resource and stimulate the search for substitutes. One reason that real copper prices have declined is that aluminum, which is derived from a plentiful resource (bauxite), has been substituted for it in many uses, especially wire.

A little reflection will convince you that the number of people who will enjoy the use of an exhaustible resource will be the same whether population growth is slow or fast. Exhaustion will occur sooner with rapid population growth than with slow population growth, but the number of people who will have used the resource will be the same. If you contend that with more time provided by slower population

growth it would be possible to learn how to economize on the use of the resource, you have already lost most of your argument that rapid population growth results in undue resource exhaustion. The application of more resources to find ways to economize on use of the exhaustible resource is an effective substitute for more time. With a larger population there are more human resources to devote to the problem at an earlier time.

2. Would slower population growth increase the per capita availability of renewable resources and thus increase per capita income?

Up to the present, the decline in the per capita availability of renewable resources, such as land, has not resulted in a reduction in per capita income. Instead, the long-run trend in the prices of farm products that depend upon land, especially the food crops, has been a declining one over the past century (Simon 1981).

We need to bear in mind that the use of renewable resources is influenced by existing institutional arrangements. Some institutional arrangements, such as common property or property rights, that are limited and uncertain may have disastrous effects upon the conservation of renewable resources. Consider the near extinction of certain kinds of whales or the depletion of certain fishing areas. These occurred where common property existed and, until recently, no effective mechanism existed for avoiding the "tragedy of the commons." The tragedy of the commons occurs because it is in the interest of the individual to use or harvest the commons as long as what is harvested has a value greater than the costs, even though this activity reduces the total output. Consequently, if serious problems do occur due to the diminution of the productivity of renewable resources, it will probably be because appropriate institutional arrangements do not exist.

3. Will slower population growth alleviate pollution and environmental degradation?

Environmental resources, such as air and water, are almost always common property; unless appropriate institutional arrangements exist, these resources will be overused whether population is growing rapidly, slowly, or not at all. There is an optimum level of pollution, namely, the level at which the marginal cost of reducing the pollution equals the value of the marginal harm done by the pollutant. But where air or water are common property, no enterprise or person has to bear more than a small part of the cost of pollution created. Public policy

has the responsibility of internalizing the cost of pollution by adopting measures, such as regulations, fees, or incentives for pollution abatement, that force or induce producers to limit the amount of pollution to the socially optimum level. Please note that enterprise is used here in a very broad sense and includes enterprises owned publicly, such as the Tennessee Valley Authority or the local school district, as well as those owned privately; no form of ownership has a monopoly on pollution.

Major sources of pollution in the world today, however, are not associated with rapidly growing populations but with either populations with high incomes or in countries that had socialist economic systems. Feshback and Friendly (1992) chronicle the story of how having the means of production "owned by all the people" led to environmental disaster in the Soviet Union. People with high incomes consume more than people with low incomes, and their demands upon production resources and the potential for environmental disruption are greater. It follows that if population growth has little or no effect on income growth, more people increase the potential for environmental disruption; but the actual amount of environmental disruption is a function of many variables other than either per capita incomes or population.

Based on research done since 1986, it is now possible to say more about the effects of developing country economic growth on the state of the environment. A major factor in economic growth is the openness of the economy to the world economy—the degree of trade liberalization. Because of the comments about the North American Free Trade Agreement by groups that the press calls environmentalists, I start by noting the probable effects of world trade liberalization upon the environment. This is a topic ably addressed in a recent paper by Kym Anderson (1992).

The probable direct effect of world trade liberalization would be to reduce pollution overall. Two effects are worthy of note. Agriculture is an important source of ground water pollution, especially in the industrial countries. This is due to the relatively heavy use of chemicals in crop production and the concentration of livestock production in large units. Trade liberalization for farm products would shift crop production from countries with high farm output prices and heavy chemical use to countries that have and would continue to have lower levels of fertilizer and pesticide use. If there were worldwide trade liberalization

in agricultural products, grain production would shift from Western Europe to Argentina, Australia, Thailand, and the United States. With the lower crop prices in Western Europe, chemical use would be significantly reduced. While use of chemicals would increase some in the countries expanding crop production, the use level would be relatively low due to the price relationships between crops and fertilizer. The expansion in U.S. crop production would result from the return of idled land to cultivation; chemical use would fall.

The second direct effect of trade liberalization relates to the use of energy. Most developing countries hold energy prices below world market prices, resulting in excessive use of energy per unit of output. In China and India coal prices have been kept at hardly more than half the world market prices. Not only is an excessive amount of coal and other energy used, but energy is used inefficiently because it has not paid to invest in new and less polluting combustion technology. Inefficiency in combustion leads to a high level of pollution per btu consumed.

If the developing countries liberalize trade, including trade in energy, energy prices will rise to world market levels and there will be an incentive to conserve in the use of energy and thus reduce pollution.

One of the sources of environmental disruption in the low-income developing countries is the harvesting of forests for firewood and the consequent erosion and silting of rivers. As labor becomes more valuable, wood becomes less competitive as fuel. Its main cost under the conditions in the low-income developing countries is time, since the institutional arrangements permit harvesting without paying for the trees. Deforestation occurs not only because labor is so cheap, but because the rights to utilize the forest are not well defined.

The available evidence indicates that pollution abatement is a normal good. This means that the income elasticity of demand for pollution abatement is positive and that as real per capita incomes increase, people demand more pollution abatement. It is not only that more effort and resources are devoted to pollution abatement, but the acceptable standards for pollution become more stringent. Consequently, it can be expected that as per capita incomes increase in the developing countries, less and less pollution will be acceptable and permitted. Restraints on pollution are a function of per capita incomes, population density, and urbanization.

Those who opposed NAFTA because of presumed environmental effects apparently failed to consider such rational responses. Theirs is a highly condescending and even insulting view of the people of developing countries. The progress that developing countries have made in environmental improvement where it really counts, namely, in saving lives, has been enormous over the past four decades. Earlier I referred to the sharp reduction in infant mortality. A large share of this decline resulted from environmental improvements—better handling of sewage and the provision of safer and cleaner water. These changes occurred because the people of the developing countries had more income and allocated increased resources to improving their environment. And the evidence is clear: they have been highly successful at improving the environment where it really counts in saving lives and reducing illness.

4. Will slower population growth lead to more capital per worker and higher per capita worker output and income?

Does slower population growth increase the rate of saving? The NRC (1986) Working Group, after reviewing various ways in which population growth could influence the savings rate, concluded: “We have found little evidence that the aggregate savings rate depends on growth rates or the age structure of the population” (p. 87). Subsequently, A.C. Kelley (1988) presented the results of his research on the effect of population growth on savings and investments in developing countries. He considered three possible reasons for negative effects upon economic growth: age dependency, capital shallowing, and investment diversion. The age dependency effect is due to the large proportion of children who do not work; the children may also be responsible for investment diversion to consumption. Capital shallowing is nothing more than a reduction in the amount of capital per worker if savings decline on a per capita basis. Kelley concluded that the empirical research had not substantiated any of these effects (p. 459). He also noted that where the economic analysis was rather more sophisticated and included second order effects such as economizing on resources and supply effects, the “puzzle of reconciling the apparent divergencies between theory and fact disappears” (p. 460).

5. Do lower population densities cause lower per capita incomes by reduced stimulus to innovation and reduced economies of scale?

One of Adam Smith's greatest contributions to economics was his analysis of the interrelationships between specialization, the extent of the market, and the existence of economies of scale. The NRC Working Group concluded that for manufacturing, the economies of scale can be achieved at an unspecified moderate-sized city. The liberalization of international trade in agricultural products and the international flow of capital and technology probably does mean that low rates of population growth are without significant effect upon innovation in manufacturing productivity. And the same answer seems to apply if the question is put differently: Does rapid population growth reduce the growth of labor productivity in manufacturing? The answer also seems to be in the negative.

The Working Group concluded that low density of population could and probably did have adverse effects upon productivity in agriculture. This effect resulted from the costs of the infrastructure, such as roads, communication, marketing services, agricultural research and extension. While Boserup (1981) showed how increased population density influenced the intensity of cultivation and encouraged technological change, it cannot be ruled out that after a certain density of agricultural population is reached, the productivity effects of increased density are either nil or negative. This still seems to be an open question.

6. Will slower population growth increase per capita levels of schooling and health?

This question needs to be considered in two parts. The first is the effect of an increase in the average number of children in a family upon family expenditures on education and schooling. The evidence supports the conclusion that having more children reduces the amount spent on each child.

The second part is the response of the public sectors to an increase in the number of children. T.P. Schultz (1987) found that the percentage of school-age children enrolled in school was not associated with the size of the school-age population relative to the total population. He found, however, that expenditures per child were a negative function of the relative size of the school-age population. These results are quite striking; they indicate that during recent years of rapidly growing populations in developing countries, these countries were able to increase the places in school rapidly enough to keep pace. In fact, in almost all developing countries the percentage of school-age children

in school has increased. Increasing the number of places, unfortunately, was apparently associated with little increase in total expenditures on education as the percentage of the population in school increased.

The Working Group could not isolate any effects of population growth on health expenditures due to the poor quality of the available data.

7. Will slower population growth decrease the degree of income inequality?

In the short run the effects of slower population growth on income inequality depend on the distribution of the fertility decline among income groups. If the fertility decline occurs first in the higher income groups, the short-run effects will be to increase the inequality of the income distribution. If the fertility decline is greater in urban than in rural areas, there will be a short-run increase in income inequality, since urban incomes are significantly higher than rural incomes in developing countries

In the long run the effect of a decline in fertility on the distribution of income is likely to work through increasing the amount of capital per worker as the number of entrants to the labor force declines. This conclusion depends on the earlier conclusion that savings rates are independent of population growth or age composition. In effect, if labor becomes more scarce, it may command a higher share of the national product and in this way somewhat reduce the inequality in the distribution of income.

8. Will slower population growth facilitate the transfer of workers into the modern sector and alleviate problems of urban growth?

It cannot be doubted that rapid urbanization has occurred in the developing countries since 1950, nor can one doubt that the rapid growth was a response to population growth rates. Approximately 60 percent of the increase in urban population has been due to natural population growth; the remainder has been due to migration from rural areas (NRC 1986, p. 67).

But once these facts are noted, it is important to recognize that part of the rapid growth of cities such as Mexico City and Cairo has been due to policies that subsidized living in cities, especially by providing large food subsidies that in most cases were not available to farmers. In addition, the income differences between urban and rural populations

in developing countries have been very large, generally with urban per capita incomes ranging from 2.5 to 5 times rural incomes. Often the low rural incomes have reflected an urban bias, as well as the taxation of agriculture through low prices for farm products and high prices for farm inputs.

Consequently, governmental policies have had a role in rapid urbanization in the developing countries. If agriculture and rural areas were permitted to share more fully in economic growth, there would be less concern about too rapid urbanization. But economic growth does result in a shift of population from rural to urban areas, and this shift can be avoided only at large cost. Except to protect the relatively high incomes of those now in the cities, it is not obvious why there should be objection to the growth of urban populations.

9. Can a couple's fertility behavior impose costs on society at large?

The apparent answer is in the affirmative. Where there are public goods such as parks and roads, another child increases congestion. Given that most schools are publicly financed, an additional child imposes costs upon taxpayers generally. Furthermore, additional children will in due course increase the number of workers and thus reduce wages, resulting in a potential increase in income inequality. This is essentially the answer in the NRC Working Group report.

It was an answer that I found unconvincing because it ignored the general thrust of the report, namely, that population growth had little or no effect on per capita income growth. True, some negative effects were noted, such as on the quality of education or at least on per capital education expenditures. But there were also some positive effects, such as economies of scale. On balance it seems to me that there is little evidence to support the position that a family imposes net negative externalities upon society when it chooses to have another child. The family does impose certain costs upon others, but the most important of these—the cost of schooling—is a cost that most societies have chosen to bear publicly for the general benefits that a society derives from having a well-educated population.

At least the Working Group came down against governmental coercion to control fertility decisions, although it was unwilling to use the word coercion and instead said that it preferred using changes in incentives rather than quantity rationing. Quantity rationing—limiting the number of children a couple may have—can only be imposed by the

application of coercion. Finally, the following was stated: "It is important to note, however, that current data and theory are inadequate to quantify the size of the external effects; certainly there is no evidence to suggest that drastic financial or legal restrictions on child bearing are warranted" (p. 84).

What is the Value of a Person?

The last of the questions concerning whether an added birth imposes costs upon society generally, is not quite the question that I posed at the beginning of this paper. The question I posed was whether adding to the population lowered the level of per capita income. Put another way, the question was whether in a developing country the total marginal product of a person of average human capital was below the average product of that economy. I interpret the evidence, including the research and conclusions of the Working Group, to support the conclusion that the population growth rates that we have observed in recent decades have had little or no significant effect upon the level or the rate of growth of per capita income in either the long or the short run.

I wish to note two caveats to the conclusion that I have just stated. First, there are reasons to argue that moderate rates of population growth are more supportive of economic development than either low, including negative, or high rates. I define moderate rates of population growth in the approximate range of 1.25 to 2.5 percent. Population growth rates of 3 percent or more may reduce rates of per capita income growth primarily because of the stress placed upon institutions, such as education, health, and city governments, by the high rates of adjustment required. High rates of population growth may require rates of response that are beyond the capabilities of such institutions. Second, even if population growth rates have no significant effects upon economic development, governments should pursue many ordinary economic and social programs, such as universal elementary education, maternal and child health care, and institutions that assist individuals in providing personal financial security, that have the effect of reducing the rates of population growth, although that is not the primary objective of such programs.

A Positive Population Policy

I strongly support a positive population policy that seeks the objective of assisting every family in a country to have the number of children that each family desires. By definition, such programs must be voluntary; coercion and compulsion are simply not consistent with each family achieving its objectives. Thus I strongly favor governments making both relevant information and contraceptive materials available to every family that desires such information and materials. As I argued above, a case has not been made that there is a significantly negative externality to the number of children a family has. But, because I believe that the welfare of families is enhanced if they are given the resources that they need to limit the number of children to the number each family desires, I believe that governments should accept the responsibility of assuring that such resources are available and their availability is highly publicized.

I would argue that governments should go well beyond what many would argue is a passive population policy such as I have described, though in most real world situations policy makers would not agree that such a policy can be carried out without addressing some real conflicts. While ruling out coercion, governments can and do influence the number of children a family desires as well as the number a family has. This can be done by influencing conditions that are recognized to have an effect upon the number of children desired. Education, especially of women, has major impacts on both the desired and the actual number of children. Creating conditions that reduce infant mortality leads to a reduction in the number of children born, though with a lag.

In many rural communities old-age security is achieved primarily through having several children, especially male children. In rural China, for example, the rural reforms have not produced any alternative sources of old-age security to having one or more sons. While the ownership of land is one means for providing security in one's older years, private ownership of farm land does not exist in China. Not only can rural families not own the land they farm, they cannot assume that the land use rights assigned to them can be readily marketed. There are other alternatives for making provision for the uncertainties of old age and death, such as life insurance and access to reliable savings institutions that are allowed to have positive real interest rates. The most

immediate and direct approach for the provision of old-age security in China would be the extension of the social security system to the entire population, rather than restricting it to the employees of the government and state and some collective enterprises.

The cost of providing a pension to all rural residents 65 years and older at 80 percent of the average annual income of all rural residents would not be beyond the financial resources of the Chinese government. In 1989 there were 56 million persons living outside of cities who were 65 years of age or older. If the average pension were 50 yuan per month, the annual cost would be 34 billion yuan. This is less than the budgetary cost of the grain price subsidy in 1991! This subsidy went to urban residents who, on average, had far higher incomes than rural people. It appears that the grain price subsidy is being phased out. It would be hard to think of any alternative use for those funds that would create greater happiness and contribute more to the future viability and tranquility of the Chinese society than the creation of a universal social security system.

Such a system, especially if combined with providing the institutional and legal framework for individuals to make some provision for their financial security, would achieve two major objectives. It would significantly alter the incentives to have large numbers of children, and it would reduce the neglect and mistreatment of female babies. Put more directly, much of the pressure in rural China for violating the restraints of the coercive population policy would be eliminated if rural families had viable alternatives to a son or sons to provide security for their old age.

Coercive population programs do great harm, not only to families but to a nation. Fortunately, policies and programs that will lead to reductions in population growth rates need not be coercive. The appropriate criteria for evaluating programs that directly influence the number of births is the degree to which families are assisted in having the number of children they desire. Lacking evidence that family decisions with respect to the number of children have adverse external effects upon others, there is no basis for coercive behavior by governments. Even if there were some adverse external effects, however, I would still hold that decisions with respect to the number of children should be made by the family. It is difficult to imagine that anyone who accepts the Western concept of human rights would approve of the use of coercive restraints placed on such a fundamental right.

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