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POPULATION GROWTH AND ECONOMIC DEVELOPMENT: BACKGROUND AND GUIDE

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PREFACE

This document is a thoroughly revised and expanded version of an earlier one (68 TMP-119) that was written to assist AID officials in explaining to host government officials why reduced human fertility would accelerate the economic development of their countries. It contains a survey of issues relating to population growth and economic development, an empirical chapter describing how developing countries are not following the European demographic experience, a discussion of psychological and sociological factors affecting fertility, and a section on how parents can have fewer children yet enough sons for old age insurance. In addition to applying the TEMPO economic-demographic model to hypothetical "Developa", this revised document also applies the model to distinctly different Mexico, Taiwan and Tanganyika. It also gives reasons why fertility continues at a high level and why governments should make family planning services available.

This document has been prepared by TEMPO, General Electric's Center for Advanced Studies, located in Santa Barbara, California, under contract to the Agency for International Development, U.S. Department of State. Other TEMPO documents in the same AID series on population growth and economic development include **Description of the Economic-Demographic Model, Calculating the Benefits of Slower Population Growth: A Short Method and Workbook, Manual for Calculation of Government Expenditures for Selected Social Services, Economic Benefits of Slowing Population Growth,** and the **Economics of Limiting Population Growth.**

This work was under the general supervision of Dr. Stephen Enke. Other members of the project were Dr. James P. Bennett, Dr. David N. Holmes, Jr., and Mr. Richard Brown. This particular document was the special responsibility of Dr. Bennett and Dr. Enke.

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CHAPTER 1

ECONOMIC DEVELOPMENT AND HUMAN FERTILITY

It is the thesis of this document that a decline in human fertility would raise per capita incomes, extend social and public services to proportionately more people, and slow urbanization in most developing countries.

The demographic experience of most less developed countries (LDC's) is historically without parallel. Their populations are now growing at 3 percent and more a year, doubling every 22 years or so, because mortality rates are declining but fertility rates remain high. Such rapid rates of growth cannot be compounded indefinitely. Eventually birth rates must fall and/or death rates rise. The outcome is still uncertain.

Economic development is slowed when fertility rates are high, simply because too large a fraction of the population are then children, old enough to consume but too young to produce. As a result there is less saving and investment. A reduction in fertility would reduce the child dependency ratio, increase aggregate savings, raise capital to labor ratios, decrease labor unemployment, and make workers more productive.

Economic development is also retarded when population growth is rapid. The national capital stock cannot then sufficiently outpace the growth in labor force. There is also less time for improvements in technology to augment national output.

Finally, economic development is inhibited when there is excessive population pressure, with too many people relative to capital and natural resources.

Any one of these demographic burdens, whether high fertility, rapid population growth, or extreme population density, can alone slow economic development. High fertility imposes a burden even in countries that are very sparsely populated. When all three disadvantages are present, as they are in several lands of ancient culture, the situation is truly desperate.

Countries that are "overpopulating" have greater need of foreign assistance if they are to improve consumption per head at politically acceptable rates. But the very lack of domestic savings that places them in need of development assistance makes it difficult for them to repay loans later. High fertility can impair the credit worthiness of an LDC.

The validity of these assertions can best be demonstrated through the use of computer models that simulate the demographic and economic interactions of a typical LDC. Almost regardless of functions and parameters used, a decline in fertility results in a more rapid improvement in per capita income. This effect is reinforced if mortality rates were previously low and population growth was very rapid.

Moreover, not only does a decline in fertility hasten per capita income improvement, but it also distributes income more equitably among individuals. This is due to changes in relative factor prices, with hourly wage rates rising, interest rates on capital falling, and rents on land staying rather constant instead of increasing.

Obviously, there is far more to economic development than a rise in the ratio of GNP to population, but other aspects of a better life are closely associated. Along with high per capita income go high investment rates, high capital to worker ratios for greater productivity, more education and improved health, longer life expectancies, and of course increased freedom from want.

A slowing of population growth, and more particularly a decline in fertility, permits higher school attendance ratios without extra cost. With present fertilities, and even though enrollment ratios are improving, within a decade there will probably be more illiterate adolescents than today in many LDC's. Other social services than education can also be provided to relatively more users when population growth slows.

Too rapid urbanization is a serious problem in many developing countries. Cities are typically doubling their populations every 15 years. Many in-migrants remain underemployed. For obvious reasons, sewers, sanitation, and at least token housing have to be provided at considerable expense. Although the blame for these problems is often placed on migrants, the real "devil" is excessive urban and rural fertility. Over half the population growth of cities is usually due to their natural increase. And migrants often leave their villages because not enough good farming land is available to avoid serious rural underemployment for an increasing population.

These numerous problems, exaggerated as they are by an excessive fertility, have resulted in demands that governments should promote birth control by making contraceptive information and devices readily available at no cost to acceptors. The cost of large programs to governments can be low per contraceptive user. For a typical LDC to halve its population growth rate, about a third of all exposed and fecund women would have to practice effective contraception, but no LDC has yet achieved as much.

Stressing birth control is opposed by some who feel that economic development can better be promoted through greatly expanded education and health programs that invest in so-called human capital. But human investment and birth control are not mutually exclusive. In fact they reinforce one another. Reduced fertility makes labor scarcer relative to capital, and hence wages higher relative to interest, so that investment in people is cheaper and more rewarding. Moreover, when there are fewer children, their parents and government can afford to take better care of them.

Some have opposed government contraceptive programs on religious grounds. Several demographers have also argued that in Europe the birth rate soon followed the death rate downwards, and that this will also happen in the developing world, but this comforting theory of demographic transition may not really have applied to Europe and is not yet generally occurring in the LDC's. Others believe that urbanization will alter living patterns and lower birth rates, because the two were associated historically in Europe, but recent studies suggest that migrants recently off the land continue to have undiminished fertility.

Opposition to government contraceptive programs also comes from those who feel that the corollary to reducing birth rates may be to de-emphasize public health programs that lessen death rates. To some it seems inconsistent to be reducing infant mortality rates at the same time other programs are reducing fertility rates. However, in a more fundamental sense, birth control and death control are supplementary ways of giving people more control over their lives.

Economic development means more than increased consumption. It means fewer economic uncertainties and disasters. It means the avoidance of premature deaths and unwanted births.

CHAPTER 2

CONTRASTS BETWEEN DEVELOPING AND DEVELOPED COUNTRIES

The less developed countries (LDC's) contrast markedly with the more developed countries (MDC's) in many non-economic ways, such as much higher human fertility, much faster population growth, and a much swifter rate of urbanization. These contrasts between LDC's and MDC's exist despite differences that also appear among developing countries regarding education, health, and society. The developing countries are not only distinctly poorer, as evidenced by lower incomes per capita, but demographically they are quite different.

CONTRASTING FERTILITY RATES

Women in the LDC's typically have more than twice as many children as women in the MDC's. This limits them in the kind of work that they can do. In many ways it profoundly affects their status in the family and society.

Table 1 contrasts 36 MDC's (with annual incomes per head over $600) with 41 LDC's (with average per capita incomes under $600 a year.) The crude birth rate for the MDC's was 20.1 births a year per 1000 population, but for the LDC's it was 43.0. Moreover, this contrast somewhat understates the fertility differential.

The crude birth rate, simply being the ratio of annual births to total population, ignores the underlying age distribution. And high fertility countries can proportionately have twice as many children in the population, who are too young themselves to have children, than have low fertility nations. Thus it is the proportionately fewer female adults in the LDC populations that are having over twice as many children per head of population than in the MDC's.

CONTRASTING RATES OF POPULATION GROWTH

High birth rates make for rapid population growth unless they are almost matched by high death rates. In most LDC's, until this century, there were many births and deaths per head of population. Many babies died within a year. Of those that survived, no more than a half reached 40 years of age. Life was short, living was primitive, and growth of population was slow.

During the past 50 years, life expectancies have increased remarkably in the LDC's. In countries where once half of those born would die before 35 years, perhaps half those born in 1970 will live at least 65 years and be alive in

AD 2045. In these same countries age specific fertility rates have not declined, but as reported many even have risen slightly.*

The annual rate of a nation's population growth is given of course by the difference between the crude birth and death rates. Thus a country with a birth rate of 45 babies per 1,000 head of population a year, less a death rate of 20 per 1,000, will be experiencing a growth rate of 25 per thousand (or 2.5 percent) each and every year. Moreover, if this growth rate should continue to compound, population will double in 28 years.**

Table 1 indicates that those MDC's surveyed had an average population growth rate of 1.2 percent a year while the LDC's had a 2.7 percent rate of growth. Thus these MDC's are currently doubling their populations in about 59 years. But the LDC's, if their growth rates were to continue, will quadruple their populations in 52 years.

The rapid population growth of the LDC is not surprisingly associated, as Table 1 shows, with higher crude birth rates, a lower percentage of annual output saved and invested, and a lower income per capita that is also rising more slowly than in the MDC's.

In more detail, the LDC's had a ratio of Gross Domestic Product (GDP) to population of $233 a year as against the MDC's $997 annually. Moreover, in the LDC's, only 14.9 percent of this lower per capita income was saved for investment, against 21.1 percent of a four times greater income in the MDC's. Perhaps most distressing, the economic gap between the two groups of countries is widening, with the GDP/Population rate rising over half again as rapidly in the MDC's (3.9 percent a year as against 2.3 percent for the LDC's)*

Table 1. Per capita income, growth rate of population and per capita income, investment rate, and crude birth rate for 77 countries.

	GDP/ Population 1960 (US Dollars)	Compounded Average Annual Rate of Growth 1955-1965[a] (percent)		Gross Investment/ GDP 1960 (percent)[d]	Crude Birth Rate 1965 (per 1000)[e]
		Population	GDP/Population		
More Developed Countries (36) [b]	997	1.2	3.9	21.1	20.1
Less Developed Countries (41)[c]	233	2.7	2.3	14.9	43.0

[a]Data from Everett E. Hagen and Oli Hawrylyshyn, "Analysis of World Income and Growth, 1955-1965", **Economic Development and Cultural Change,** October 1969.
[b]Includes Anglo America, Puerto Rico, Western and Eastern Europe, U.S.S.R., South Africa, Israel, Japan, Australia and New Zealand.
[c]Includes 20 Latin American, 7 African, 6 Near Eastern and 8 Far Eastern Countries.
[d]**Yearbook of National Accounts Statistics** 1967. United Nations 1968.
[e]Donald J. Bogue, **Principles of Demography.** Wiley, 1969.

ASSOCIATION OF FERTILITY WITH POVERTY

Among different nations, as among families within a single country, there is a tendency for fertility to be associated with poverty.

Figure 1 is a scatter diagram that locates each of the same 77 countries in terms of its crude birth rate (on the horizontal axis) and its GDP per capita (on the vertical axis). A legend is included because the "scatter" can be better interpreted if the identity of the countries is known. The countries are ranked in this legend by crude birth rate, starting with Sudan (54.9 births per 1000 yearly) and ending with Hungary (13.1).

The distribution of birth rates exhibits no central tendency but is instead bimodal.* There are far more countries with crude birth rates of between 10 and 25 per 1000 a year, or between 40 and 55, then there are between 25 and 40. Countries tend to have either high or low fertility but not "average" fertility. Modifying the relation between fertility and poverty is the cluster of countries located at the lower left corner of the diagram. Most of them, such as Spain and Portugal, are on the periphery of developed Western Europe. All the Socialist economies of Eastern Europe, excluding East Germany, are among the exceptions having low fertility and low income. Largely because of these non-conforming countries, a fairly "low" income below $1500 per capita yearly does not assure a "high" fertility above 30 per 1000 annually. Similarly, a low fertility does not ensure a high income**

Nevertheless, the diagram demonstrates that a crude birth rate of over 30 per 1000 a year means an income of under $600, just as a "high" income of over $1500 a year practically means a "low" fertility of under 25 per 1000 annually.

Such demonstration of statistical association of itself proves nothing of course about cause and effect. Is the economic performance of the LDC's disappointing because of their high crude birth rates and rapid population growth? Or do the LDC's have high fertility rates because their peoples are mostly poor?

In all probability both hypotheses are valid. Practically, this means that women living in poverty must somehow be induced to have fewer children (despite the obstacles outlined in Chapter VI), so that a reduction in fertility can of itself promote economic development (for the reasons explained in Chapter III).

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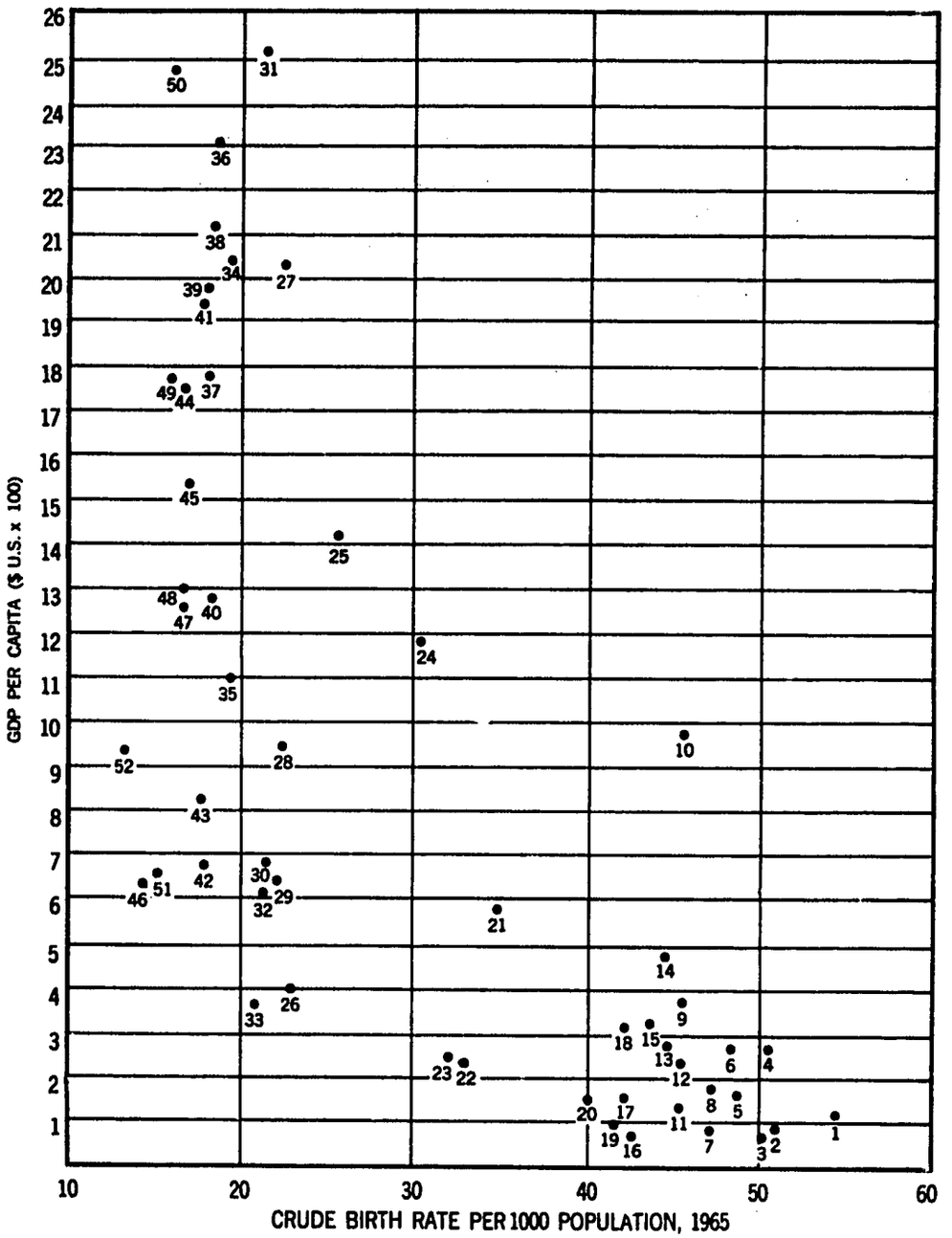
*Better food and health can increase frequency of coitus and reduce miscarriages. In some societies there is today less strict control of adolescent girls. Now that babies are less likely to die in infancy, there may be more willingness to report their births soon after delivery.

**The number of years taken to double population at different growth rates are: 23 years at 3 percent annual increase, 28 years at 2.5 percent, 35 years at 2.0 percent, 47 years at 1.5 percent, and 70 years at 1.0 percent.

*While the above Table 1 values are for the period 1955 to 1965, their relative magnitudes had not changed significantly by 1970. Thus, if current growth rates of per capita income persist, by 1990 the average per capita income of the MDC's will be over $3100 compared to about $460 for the LDC's. The per capita income superiority of MDC's, which was four-fold in 1960, will be seven times by 1990 if present trends continue.

*Because of this bimodality, simple regression analysis is not strictly appropriate. However, if a linear regression is estimated that explains the logarithm of per capita income in terms of a country's birth rate, a reduction of 10 points in the crude birth rate is associated with a 28 percent improvement in per capita income. This relation "explains" about 66 percent of the variation in per capita income.

**Among the countries that have birth rates of under 20 per year, their per capita incomes have a mean value of $1489, and a difference of $1867 between lowest and highest.



1. Sudan
2. Indonesia
3. Nigeria
4. Iraq
5. Philippines
6. Turkey
7. Uganda
8. Morocco
9. Peru
10. Venezuela
11. Thailand
12. Ecuador
13. Brazil
14. Mexico
15. Malaysia
16. Burma
17. UAR
18. Colombia
19. South Korea
20. Ceylon
21. Chile
22. Taiwan
23. Syria
24. Puerto Rico
25. Israel
26. Portugal
27. New Zealand
28. Ireland
29. Uruguay
30. Argentina
31. Canada
32. Spain
33. Yugoslavia
34. Australia
35. Italy
36. Switzerland
37. United Kingdom
38. Denmark
39. West Germany
40. Austria
41. France
42. Greece
43. Poland
44. Finland
45. Netherlands
46. Rumania
47. East Germany
48. Czechoslovakia
49. Belgium
50. Sweden
51. Bulgaria
52. Hungary

Figure 1. Relationship of crude birth rate and GDP per capita.

LDC's EXPANDING CITIES

A most obvious and dangerous manifestation of population growth in LDC's is the explosive growth of their cities. This growth in urban population is largely the result of natural increase. But it is also caused by extensive migration from the countryside.

Some of the least developed LDC's, as recently as a decade ago, had an urban-to-rural population distribution of around 30-to-70 percent respectively. But at least one percent net of the remaining rural population has been moving annually to the towns and cities. Hence, in 10 years alone, the urban population of such a country has increased by one-fifth from 30 to 36 percent of the total population. This is a 2 percent **annual** increase in population from migration alone. To this must be added a natural increase of from 2 to 3 percent.

As a result the cities of the LDC's are growing almost twice as fast as are their rural areas in terms of population. The number of persons dwelling in cities is doubling about every 15 years. Almost every LDC has at least one major city, whether it be Sao Paulo, Calcutta, or Cairo, that is constantly threatening to outgrow its social services and physical infrastructure.

Many more social and political problems arise when millions of people, instead of being spread among thousands of villages, are concentrated in a city with little employment. The sewage and sanitation needs of a million families are quite different within a densely populated city than when living on farms. In cities there may need to be large new buildings to house people, whereas in the villages it is enough for each family to have a hut that it can make itself. Migrants often discover that it is harder to fend for themselves in an alien city, but they are reluctant to go home. For these and other reasons the major cities of the developing world include expanding and menacing slums.

Governments seek to counter the threat by spending funds and resources for streets, housing and utilities. The value of these expenditures could otherwise have been invested more productively. Thus there is a considerable lost investment cost due to excessive urban growth.

Further, governments often try to lessen urban growth through programs designed to reduce migration, and to this extent attention is diverted from the need to lessen fertility and hence the urban natural increase. But future urban growth can only decreasingly come from migration. In many LDC's the urban population already outnumbers the rural.

The growth of cities and towns in the developing countries of today is without historical precedent.* The "new" cities of Europe, partly the result of the industrial revolution, had to compete for labor against a modernizing agriculture. But many LDC's have experienced no such agricultural revolution until quite recently, and their migrants are often more "pushed" by rural underemployment than "pulled" by available urban jobs.

Today's widespread migrations, prompted by a desperate search for some livelihood in the cities, is propelled by excessive fertility among the rural population. The villages are producing more young men than land to work and

*See Kingsley Davis, "The Urbanization of the Human Population," Scientific American, September 1965.

capital to assist in its cultivation. Underemployment and low hourly output are the result. Thus a too rapid urbanization is due both directly to the natural increase in the cities and indirectly to the natural increase in the countryside. The root cause of too rapid urbanization is a too high fertility. The ultimate remedy is extensive birth control.

LDC's DEMOGRAPHIC EXPERIENCE APPEARS UNIQUE

The LDC's high birth rates and low death rates are a totally new experience for mankind. It is certain that such a demographic anomaly cannot continue for more than a century or so. Clearly, the developing countries of today are not repeating the earlier demographic performance of the European countries that did develop.

Most of the leading European countries, throughout the 19th century, seem to have experienced a slow and steady decline in both crude birth and death rates. Expanding application of new medical discoveries through public health programs, together with a gradual improvement in living conditions, combined to extend life expectancies. Also, for a variety of reasons not clearly understood, fertility also declined. Although means of contraception were primitive and often illegal it is evident that many adults were practicing, and not only through abortion, a degree of effective birth control. The motivation and discipline needed to control fertility must have been strong to have so reduced fertility despite unavailability of reliable condoms, intrauterine devices, and contraceptive pills.

Table 2 indicates the situation of six leading European countries towards the end of the 19th century. The average population growth rate was already down to 1.1 percent a year despite the continuation of some illiteracy (22 percent) and a considerable fraction of the labor force remaining in agriculture (44 percent). Per capita income was improving at a modest but accepted 1.8 percent a year.

Table 2. Population growth rates, per capita income growth rates, illiteracy rates, and fraction of labor force in agriculture for six European countries in the 19th century.[a]

	Population Growth Rate 1891-1900[b]	Per Capita Income Growth Rate	Illiteracy Rate 1891 (percent)	Fraction of Labor Force in Agriculture (percent)
Great Britain	1.2	2.0 (1890-1895)	6	17 (1881)
France	0.7	1.7 (1895-1900)	10	51 (1872
Italy	1.1	.3 (1888-1893)	50	51 (1870)
Germany	1.4	1.5 (1890-1895)	NA	42 (1883)
Denmark	1.2	2.3 (1893-1895)	NA	51 (1870)
Sweden	1.1	2.9 (1893-1898)	NA	50 (1880)
Average	1.1	1.8	22	44

[a]Source: OECD, **Population Programmes and Economic and Social Development**, Paris, 1970.
[b]1830-1860 for France.

The recent contrasting situation of eight representative LDC's is shown in Table 3. The percentage of labor force in agriculture averages 59 percent and the illiteracy rate averages 56 percent. But most significant, the average annual increase in population during a recent 10 year period was 2.6 percent, well over double the population increase of the European countries almost a hundred years ago.

Table 3. Population growth rates, per capita income growth rates, illiteracy rates, and percent of labor force in agriculture for eight less developed countries.[a]

	Annual Rate of Growth 1957-59 to 1964-66		Illiteracy Rate 1960	Percentage of Labor Force in Agriculture
	Population	Per Capita Income	(percent)	1960 (percent)
Morocco	3.0	0.2	86	56
Brazil	2.8	1.9	39	52
Bolivia	2.4	2.8	68	63
Colombia	3.4	1.4	38	47
Iran	3.1	3.7	87	47
India	2.5	1.7	72	73
South Korea	2.8	3.2	29	52
Thailand	3.1	4.2	32	82
Average	2.9	2.4	56	59

[a]Source: OECD, **Population Programmes and Economic and Social Development,** Paris, 1970.

A small fraction of this differential rate of population growth is attributable to international migration. For several decades prior to WWI, almost a million persons a year emigrated from Europe, mostly to the US, but also to Canada, Argentina, and Australasia, etc. However, relative to all of Europe, this annual migration amounted to perhaps one-third of one percent of population.

The developing world of today is moving to some still unpredictable demographic revolution. There can be no significant relief through emigration. It is by no means clear even that food production in these countries can be multiplied as fast as the mouths to eat it. Sooner or later, unless birth rates fall, death rates will rise until population growth is slowed to a rate that is more sustainable.

Most human aspirations require for achievement a slow rate of population growth based on low birth and death rates. A slow population growth that depends on many births and deaths entails an enormous wastage of life. A stricter control of fertility, through the voluntary participation of individual parents, today appears a necessary precondition of continued economic development in nearly every country.

CHAPTER

HOW REDUCING FERTILITY YIELDS ECONOMIC GAINS

Economists with demographers can now determine, by applying a complex of equations, approximately the extent to which postulated changes in future human fertility will alter the projected per capita output and income of a nation. This chapter outlines a simple version of such a computer model. It also describes the application of the model to a hypothetical but typical LDC called Developa.

The direct effects of a fertility decline are seen to be reductions in the growth of population, the labor force, and consumption. The retarded population growth accelerates growth of income per head by reducing the denominator in the GNP/Population ratio. Retarded labor force growth slows GNP growth, since labor is a major contributor to output, and retarded consumption accelerates the GNP growth by increasing aggregate savings and investments. These direct effects combine with such other factors as technological change and varying unemployment to indirectly affect projected output and income per capita.

Briefly, there is a set of complex forces, some tending to accelerate and others to retard the growth of income per head. The TEMPO mathematical model captures important relationships that are quantifiable. Only with the aid of some such model can an analyst numerically evaluate the economic consequences of a declining fertility.

DESCRIPTION OF THE TEMPO ECONOMIC-DEMOGRAPHIC MODEL*

Introduction

The model has a set of inputs, functions and outputs.

The main demographic inputs are age and sex specific survival rates, age specific fertility rates, and size and age distribution of the initial population. Future age distribution and size of population can either be generated within the model or be exogenously stipulated. The principal economic inputs include age and sex specific labor force participation rates and the initial capital stock.

There are several important relations. Aggregate national consumption (or saving) is held to be a function of national output and population. The number of persons actively employed is a function of the capital stock and the available labor force. Total output increases depend upon increases in employed labor, capital stock, and technology improvements.

The major output variables of the model can include projections of population by size, age and sex, urban and rural populations, gross national product,

*This is described in full technical detail in Description of the Economic-Demographic Model, TEMPO, Center for Advanced Studies, General Electric Co., 1968 (revised 1971).

income per head, total labor force, employment and unemployment, present capital stock, the number of people living below a so-called "poverty line", and if required the amount of foreign assistance needed to maintain a stipulated annual improvement in per capita output and income.

Demographic factors affect economic inputs, as for example age distribution influencing labor force, but as yet the model does not include the impact of living standards on fertility and mortality for example.

Diagram of Interactions

A simplified illustration of the main variables that interact within the model appears as Figure 2.

Income per head depends directly on output (V) and population (P). Population change depends only on births and deaths, as there is no international migration in the model. The number of births and deaths depends upon the size and age distribution of the population and upon age-and sex-specific fertility and mortality rates, respectively. Hence, there is a year-by-year interaction among population, births and deaths.

Aggregate national income (V), depends upon employed labor (E), stock of capital (K), and state of technology (T).

Employment (E) depends upon capital (K) and the available labor force (L). The rates of growth of K and L determine the growth in employment and,

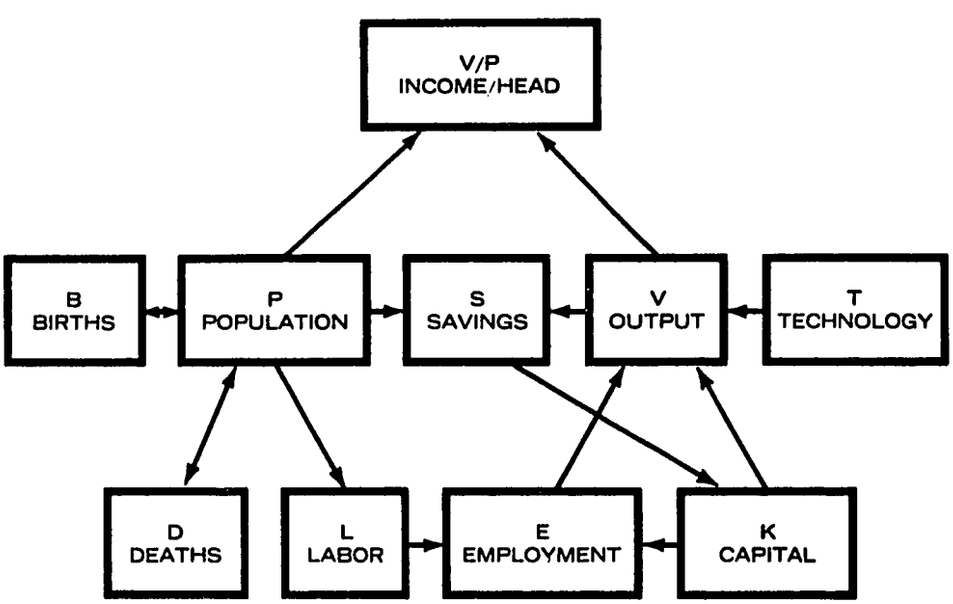


Figure 2. Determinants of income per head.

hence, unemployment. An increase in L with K constant means a higher unemployment rate. As K increases, it tends to create more jobs and employment but more K also means more capital per worker if L is not increasing as rapidly as K.

Labor force (L) is a function of Population (P). If P is increasing very rapidly, the L/P ratio is low, as there emerges a large fraction of dependent children who are too young to work. A slowing of population growth increases the L/P ratio and, hence, contributes to V/P.

The capital stock (K) increases annually by the amount of domestic saving (plus possible assistance from abroad). Savings are related positively to output and negatively to population. With a given output, more population means less saved.

The Production Function

The model uses an aggregate production function that determines output in terms of employment, capital, and technology. The one used in the model is of the so-called Cobb-Douglas type. It has a number of special characteristics.

Each of the factors of production — land, labor, and capital — is represented in the production function explicitly or implicity. Naturally endowed resources (land) are included only implicitly. Employed labor and capital are explicit factors.

There is an output response (called an elasticity) for both employed labor and capital. If the labor output elasticity is 0.6, it means that a 10 percent increase in employed labor will yield a 6 percent increase in output. If the output elasticities of employed labor and capital sum to less than unity, it means that a doubling of employed labor and capital will not double output. In some countries there is in fact a serious scarcity of usable land resources relative to population, that subject labor and capital to diminishing returns.

Technology (T) operates as a shift factor. Thus, if T is 0.015, it means that each year there will be a 1.5 percent increase in output without any increase in labor and capital. (Practically, this "technology" factor includes all changes that increase output without factors of production being more available).

EXAMPLE OF DEVELOPA

An analysis of a typical but imaginary LDC called Developa, with 10 million population and an income per head of $200 a year in 1970, is presented below as an example of how the model can be used.

Assumptions

This typical LDC has to be "described" for the computer model. The necessary description includes initial conditions in 1970 such as size and age distribution of the population. These initial conditions are listed in detail with their symbols in Table 4. Also required are "performance" parameters and functions that describe how the economy and population behave.

For the "standard" case, the results of which are presented here, the following where among the assumptions: (1) annual savings is equal to 20 percent of GNP minus 30 dollars for each person in the population, (2) technological change by itself increases output at a rate of 1.5 percent per year, (3) a 10 percent increase in employed labor increases output by 6 percent, (4) a 10 percent increase in the capital stock increases output by 3.5 percent, and (5) the initial ratio of capital to output is 2.5.

Alternative fertility assumptions can be summarized by crude birth rates.* The ones used in the "standard" case appear below.

Case		Crude Birth Rate (per thousand) 1970	1985	2000
I	"High" fertility: no decline	44	44	44
II	"Medium" fertility: slow decline	44	40	36
III	"Low" fertility: accelerated decline	44	30	26

In all cases life expectancy increases between 1970 and the year 2000, from 52 to 57 years for men and from 55 to 61 years for women.

Results

Projections from 1970 to 2000 were made by the model, using the above assumptions, to isolate the effects on GNP, population, and other variables of the alternative fertility assumptions.

The most important and striking finding, when comparing the economic incidence of high and low fertility in this case, is that future growth of GNP is almost **unaffected** by fertility differences over the time span of the projections. Although low fertility means a smaller labor force, it also results in a faster accumulation of capital. These two effects tend to offset one another (see Figure 3).

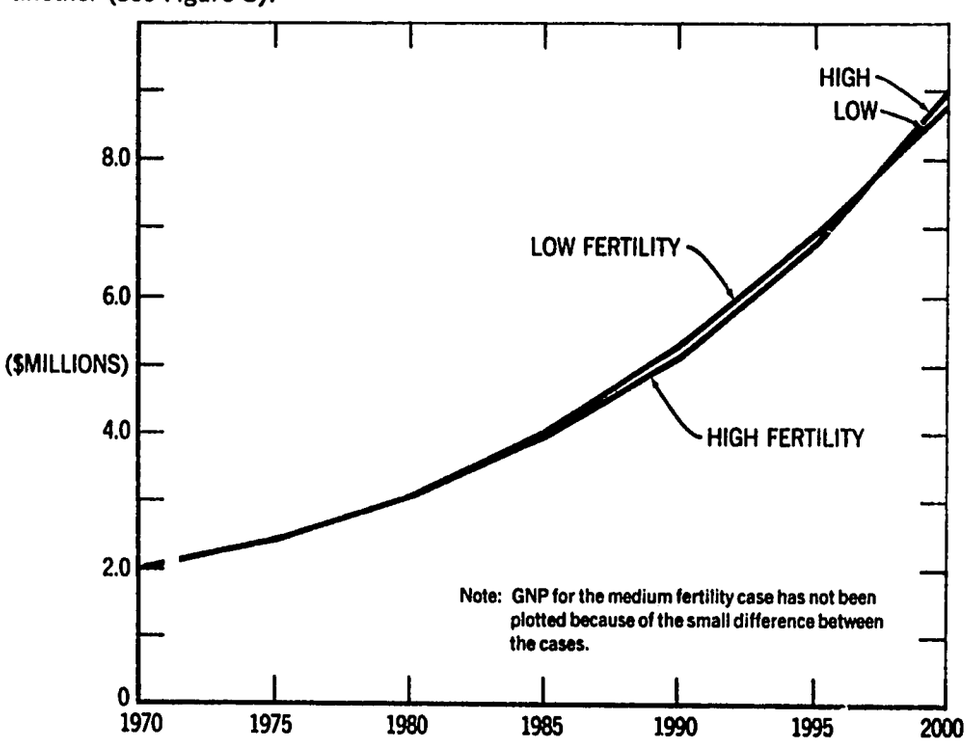


Figure 3. Growth of GNP.

*The crude birth rate (live births per thousand of total population) is sensitive to changes in the age and sex composition of the population. Had the composition of the population remained unchanged, the crude birth rate in the low fertility case would have dropped by the year 2000 to 22 per thousand instead of 26 per thousand.

Obviously, population grows less rapidly with low fertility and by 2000 AD will be 18.8 million as against 25.7 million with high fertility (see Figure 4).

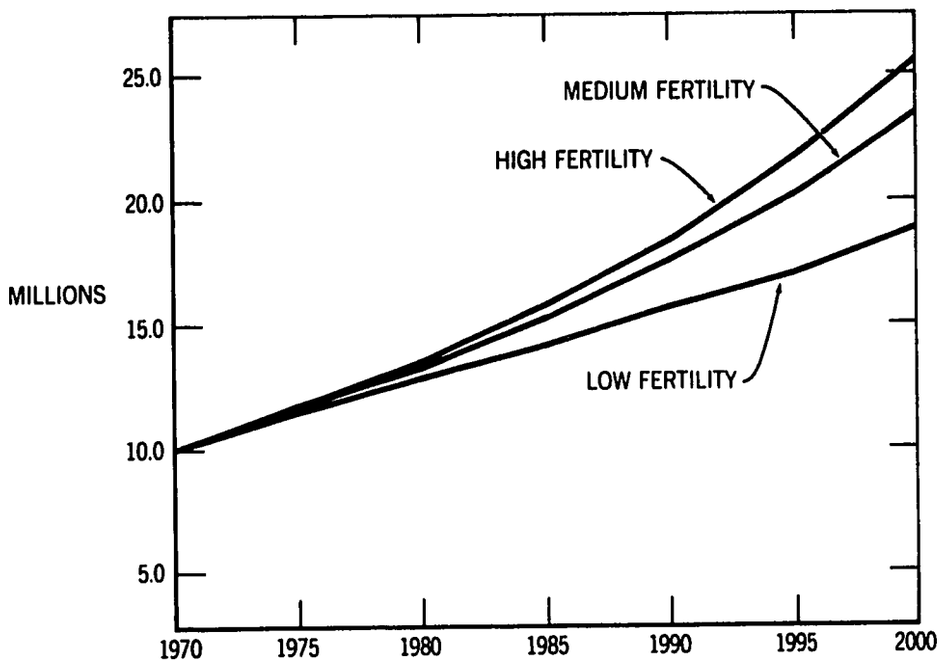


Figure 4. Growth of population.

The combination of a smaller population with the same GNP means a higher income per capita with reduced fertility (see Figure 5).

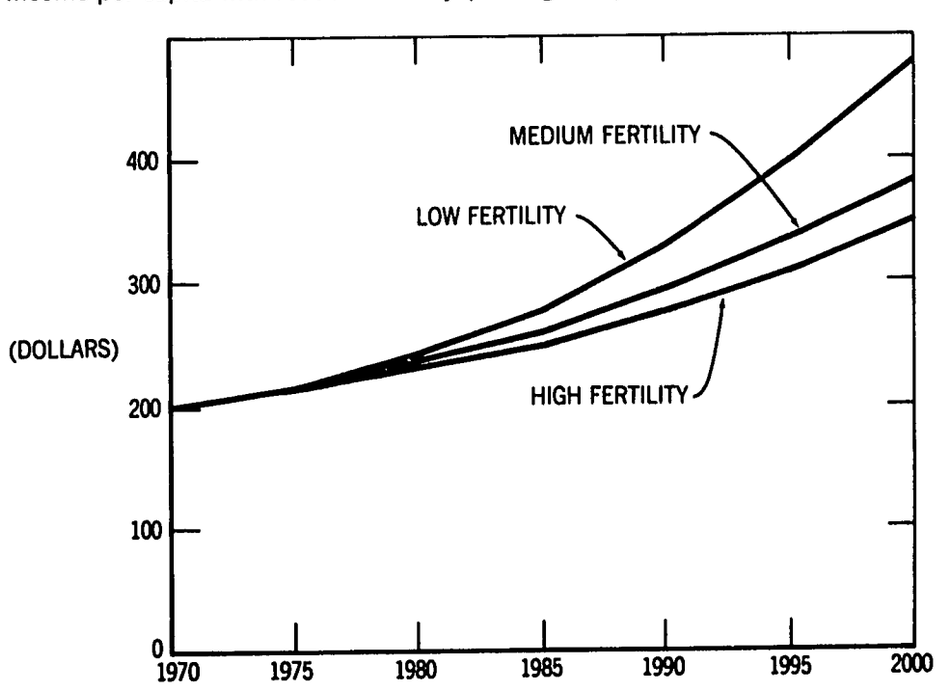


Figure 5. Growth of income per head.

Table 4 compares initial conditions in 1970 with conditions in 1985 for high-, medium-, and low-fertility projections. This 15 year time interval provides a comparison during which fertility changes do not yet affect the size of the labor force. The minimum work ages are assumed to be 15. Thus, all persons who will be in the labor force on and before 1985 are already born in 1970. However, under low fertility, the fraction of population that are children under 15 years declines by 1985 to 39 percent from 44 percent in 1970. As a result, there is more saving and hence capital accumulation, less unemployment, and some additional output. Output per head rises from $200 a year to $255 with high fertility (largely because of technology)* and to $284 with low fertility (mostly because of fewer persons).

Table 4. Main consequences of reducing fertility to advance development (1985 vs 1970).

		AD 1985		
	1970	High	Medium	Low
P, Population (millions)	10.0	15.9	15.5	14.4
V, Gross National Product ($ billions)	2.00	4.05	4.06	4.10
V/P, GNP/Population ($)	200.	255.	262.	284.
L, Available Labor Force (millions)	3.62	5.69	5.69	5.69
Urban Population (millions)	3.00	6.29	6.13	5.72
School Age Population (millions)	2.64	4.23	4.07	3.65
Living in "Poverty" (millions)	2.50	2.34	2.18	1.85
Children/Work Age	0.83	0.845	0.797	0.674
K, Capital Stock ($ billions)	5.0	8.47	8.52	8.65
K/N, Capital per worker ($ thousands)	1.63	1.68	1.69	1.70
S/V, Savings/GNP (%)	6.9	9.7	10.0	10.6
Unemployment Rate (%)	15.0	11.5	11.3	10.7
Capital Marginal Product (%)	14.0	16.7	16.7	16.6
Labor Marginal Product ($)	390.	482.	482.	484.
L/P, Labor/Population (%)	36.2	35.9	36.8	39.4
N, Employed Labor (millions)	3.07	5.04	5.05	5.08
Children/Population	0.44	0.44	0.43	0.39
Reduction in Births (thousands)	0.	0.	80.	250.

Table 5 compares the outcome in 2000 AD with initial 1970 conditions for high-, medium-, and low-fertility. Income per head is $352, $386, and $478, respectively, as compared with $200 in 1970. The increase in output per head with high fertility is almost entirely the consequence of improving technology.

The interacting economic results are what would be expected. Higher income per head results in more saving, higher employment rates, more capital per worker, and more output per head of population. Lower fertility means that labor becomes more scarce relative to capital so that the annual earnings of a typical full-time worker increase from $390 to $684.

The demographic consequences reinforce the economic results. With low

*Given constant population, employed labor force, and stock of capital, technological change of 1.5 percent per year would result in a per capita GNP of $250 in 1985, and $312 in 2000.

fertility, the number of dependent children falls from 44 percent of population in 1970 to 32 percent by 2000 AD with low fertility, as against 45 percent with high fertility. The percentage of population in the labor force by 2000 AD is 44 percent with low fertility, and 35.5 percent with high fertility, as against 36 percent in 1970 for both. It is this "maturing" of the age distribution, as a result of a decline in fertility, that does so much to promote economic development.

Table 5. Main consequences of reducing fertility to advance development (2000 vs 1970).

	1970	AD 2000		
		High	Medium	Low
P, Population (millions)	10.0	25.7	23.4	18.8
V, Gross National Product ($ billions)	2.00	9.03	9.03	8.98
V/P, GNP/Population ($)	200.	352.	386.	478.
L, Available Labor Force (millions)	3.62	9.11	8.89	8.32
Urban Population (millions)	3.00	12.30	11.20	8.98
School Age Population (millions)	2.64	6.94	5.97	3.89
Living in "Poverty" (millions)	2.50	2.36	1.87	1.03
Children/Work Age	0.830	0.866	0.745	0.501
K, Capital Stock ($ billions)	5.00	18.65	19.16	20.30
K/N, Capital per worker ($ thousands)	1.63	2.23	2.33	2.58
S/V, Savings/GNP (%)	6.9	12.6	13.2	14.4
Unemployment Rate (%)	15.0	8.3	7.4	5.4
Capital Marginal Product (%)	14.0	17.0	16.5	15.5
Labor Marginal Product ($)	390.	648.	658.	684.
L/P, Labor/Population (%)	36.2	35.5	38.0	44.4
N, Employed Labor (millions)	3.07	8.36	8.23	7.87
Children/Population	0.44	0.45	0.41	0.32
Reduction in Births (thousands)	0.	0.	330.	810.

POPULATION GROWTH VERSUS POPULATION SIZE

A distinction needs to be made between absolute population size and population growth rate. A developing country may have a large population relative to available natural resources and accumulated capital, and this "pressure" of population may be reflected in lower productivities for labor and capital, but if it has zero population growth it must experience higher living standards over time because of expanding investments and improving technology. Alternatively, a country that has usable land in abundance may be seriously disadvantaged from high fertility with rapid population growth.

The importance of population growth rate, considering Developa again, is shown by Table 6. The comparison is for the same population of about 18.7 millions. But in the high fertility case this population is achieved by 1990. In the low fertility case it is reached more slowly, ten years later, in AD 2000.

The slower growth of population allows an additional ten years of improving technology to increase output. With slow growth the capital stock is almost twice as great by the time the 18.7 million mark has been achieved. With slow

Table 6. Economic results of achieving same population rapidly or slowly.

	Rapidly: High Fertility (1990)	Slowly: Low Fertility (2000)
Population (millions)*	18.6	18.8
GNP ($ billions)	5.26	8.98
GNP/Population ($)	283.	478.
Children/Population	0.466	0.320
Labor Force (millions)	6.64	8.32
Capital Stock ($ billions)	10.8	20.3
Capital per Worker ($ thousands)	1.80	2.58
Savings/GNP (%)	10.7	14.4
Labor/Population	0.357	0.444
Unemployed Labor Rate (%)	9.8	5.4
Capital Marginal Product (%)	17.1	15.5
Labor Marginal Product ($)	526.	684.

Note:
*These estimates are for Developa. With low fertility, it reaches a population of 18.8 millions in 2000 AD. With high fertility, it reaches this same population in 1990 AD.

growth, available labor force is greater, and a higher percentage of it is employed. Also each worker typically has more capital to assist him. Moreover, with slow growth, there are about one quarter fewer children who consume but do not produce. Altogether, it is not surprising that per capita income is $478 instead of $283 a year, for the population has 30 rather than 20 years in which almost to double in size.

All this is especially relevant to those countries that include large areas of supposedly usable but sparsely populated lands. It is often argued that rapid population growth is needed to fill these empty lands. Although superficially plausible, this argument is unsound, for rapid population growth will sacrifice much of the capital that is also used to develop these areas. Unfortunately, rapid population growth means high fertility, which means proportionately more children, and reduced aggregate saving. Such empty lands should be utilized **some** day that is not too soon. Every nation can reasonably have a much larger population at some future but remote date.*

HIGH FERTILITY AND FOREIGN ASSISTANCE

The TEMPO model is also applicable to a nation that borrows from abroad by importing more than it exports.

The Trade Balance

Part of the national output (V) is presumably exported abroad. And some of the aggregate domestic investment and consumption comprise imported goods and services. In the foregoing analysis it was tacitly supposed that the value of such exported output exactly finances imports for investment and consumption.

However, if the value of imports exceeds that of exports in any year, the national economy is currently borrowing the equivalent of that negative balance; conversely, if a country has an export balance. financiallv this represents a repayment of former borrowings (or positive lending if it is a net creditor rather than debtor.)

External borrowing and lending are related to dissaving and saving respectively. Algebraically, current national savings equal domestic investment plus external lending (or debt repayment). A typical LDC, if it is domestically investing $X and borrowing $Y from abroad, is saving $X — $Y on balance.

Borrowing for Development

Many LDC's seek annual improvements in per capita income that cannot be attained without more domestic investment than can be financed from domestic savings. Some are able to obtain enough foreign assistance in the form of development loans to meet the difference. The higher is present fertility, the more will have to be borrowed to achieve any stipulated improvement in per capita income.

Considering Developa again, special computer runs were made with the stipulation that per capita income increased by exactly 3 percent a year, with foreign assistance presumed equal to any excess of required domestic investment over actual domestic saving.

"Current Foreign Assistance Needed" was found to be considerably less by 1985 with low fertility (almost zero) than with medium fertility (7.5 percent of annual V) or high fertility (10.9 per cent of annual V.) By AD 2000, the currrent foreign assistance requirement has ceased with low fertility but with high fertility it is 15.4 of V (or $1,395 millions, equal to $54 a head.) These considerable differences reflect the fact that, when the population is growing more rapidly, more investment per capita is required but less saving per capita occurs.

High Fertility Impairs Credit Worthiness

Savings are the source of all debt repayment. And high fertility ordinarily reduces aggregate domestic savings. Hence, the very fertility that makes the need to borrow more urgent, also lessens a nation's ability to repay with interest.

Table 7 gives some numerical examples of this truth. The first column gives "target" rates of annual improvement in per capita income that might be set by the government of Developa. The second column shows the first year in which Developa can commence net service of its debt: i.e., its annual savings exceed required domestic investment plus 4 percent interest on the outstanding principal and interest debt. The third column shows the maximum debt, including accumulated principal and interest obligations, when repayment begins. In every case the debt is greater and more difficult to repay with higher fertility.

The maximum attainable improvement in per capita income, subject to eventual repayment with interest at 4 percent, is slightly over 3.0 percent a year with low fertility. With high fertility it is above 2.0 percent. This difference of one percent a year is relatively large.

Table 7. Number of years until principal repayment begins and ends, and maximum debt outstanding, for different required rates of GNP per capita growth.

Required Annual Growth in GNP Per Capita	Year When Repayment of Principal Begins		Year When Loans Completely Repaid		Maximum Debt When Repayment Begins[c] ($ Millions)	
(Percent)	Fertility		Fertility		Fertility	
	High	Low	High	Low	High	Low
1.2	3	(b)	5	(b)	12	(b)
1.5	3	3	12	5	98	16
1.8	18	6	23	9	506	100
2.0	32	7	45	11	2038	174
2.2	(a)	9	(a)	14	(a)	300
2.5	(a)	13	(a)	20	(a)	674
2.8	(a)	18	(a)	28	(a)	1502
3.0	(a)	22	(a)	40	(a)	2680
3.2	(a)	(b)	(a)	(a)	(a)	(a)

Notes:
(a) Debt never repaid.
(b) No foreign debt required.
(c) As compared with an initial GNP of $2,000 millions.

Alternatively, contrast the situation between low and high fertility when the "target" improvement is 2.0 percent a year. With low fertility, net debt service can begin in the 7th year and end in the 11th year, but with high fertility it can only start in the 32nd year and end in the 45th. With high fertility the maximum debt outstanding at any time is $2,038 millions, slightly greater than initial GNP in 1970, while with low fertility it is $174 millions.

International and national agencies that make development loans have a responsibility to assess the comparative credit worthiness of rival applicants. The higher fertility countries may have a more desperate need. But it is the lower fertility countries that have the greater ability to repay.

SENSITIVITY OF MODEL TO CHANGES IN PARAMETERS

The thrust of the above analysis is that high fertility slows improvements in per capita income. The demographic projections of the model cannot be controversial for they differ only to the extent that different fertility rates are assumed. There will, however, be readers who understandably wonder how sensitive the economic projections are to the particular economic functions and parameters used. Obviously, lower fertility means a more slowly growing population, but it is less evident why differences in fertility should have almost offsetting effects on employed labor force and invested capital stock, so that GNP projections are practically unaffected.

Accordingly, one valid test of sensitivity is to observe what changes there are in the ratio of GNP with high fertility to GNP with low fertility, when different economic assumptions are made. Using standard parameters, this ratio is 1.005, for the year AD 2000, which means that with high fertility GNP of that

year was half of one percent greater than with low fertility. But how sensitive is this ratio of 1.005 to changes in certain functions and parameters?

Table 8 indicates that relatively large changes in the rate of technical progress, in the output elasticities of capital and labor, and in the consumption function, cause comparatively small changes in projected GNP under different fertility assumptions. Consider the change in output elasticities for instance. A 20.0 percent change in the parameters occasions a 1.7 percent change in the GNP ratio for 2000 AD. Apparently, GNP as estimated, and projected per capita incomes also, are very insensitive to these elements of the national production function.

Table 8. Sensitivity of GNP to changes in selected economic parameters.

	Standard Developa Parameter	Alternative Parameter	Ratio: High Fertility GNP To Low Fertility GNP Year 2000
None			1.005
Rate of Technological Progress	1.5	2.5	1.022
Elasticities of GNP with Respect to:			
(i) Capital	0.4	0.5	0.988
(ii) Labor	0.6	0.5	
Consumption Function Coefficients			
(i) GNP	0.80	0.77	1.019
(ii) Equivalent Consumers	$30.00	$30.00	

Increasing familiarity with the TEMPO model, acquired in part through its application to ever more countries, reveals that it contains many offsetting relations. This must be a considerable relief to practicing econometricians who use the model. Estimates of specific parameters can be most approximate without affecting the validity of the basic finding, namely that a declining fertility accelerates improvements in per capita income, and to this extent promotes economic development.

CHAPTER 4

HOW FERTILITY AFFECTS SOCIAL AND PUBLIC SERVICE COSTS

Almost every LDC government finds itself confronted with the need to extend social and public services to an increasingly large and urban population. In some cases these needs are almost beyond the capability of the government to provide. But in practically every instance the economic and financial cost of such services would be more than proportionately reduced if fertility rates were to decline.

NUMBERS OF PERSONS LIVING IN POVERTY*

Many social services are extended to people because they are poor, such as low-rent housing, subsidized school lunches, old age pensions, etc. Demands on medical services are also heavier when more people are poor, because sickness and poverty are usually associated. The Developa projections of Chapter III indicate that by 1985 that there will be half a million fewer people living in poverty if there is low rather than high fertility (see Table 4). By 2000 AD this reduction is 1.3 million, or about 5.6 percent of the population. Despite improvements in per capita income, there will be far more poor people in Developa after 30 years if present fertility rates are not reduced, a projection that probably applies to most LDC's.

UNEMPLOYMENT

Unemployment, and its common associate underemployment, can add to the costs of government as well as losing output for the economy. Such costs are reduced by fertility declines. The Developa projections again provide numerical estimates of such gains.

Developa's unemployment rates in 1985 are 10.7 percent with low fertility and 11.5 percent with high fertility (see Table 4). By 2000 AD these respective percentages are 5.4 and 8.3 (See Table 5). The reduction in unemployment with lower fertility would be greater except that the amount of capital assisting each worker is about 10 percent greater with low fertility.

The main reason that a lower fertility eventually lowers unemployment is that after 15 years there are fewer adults seeking paid jobs or gainful self-employment. The other reason, but less than proportionately, is that extra

*Persons "living in poverty" here means persons able to command less than $100 worth of goods and services a year. In 1970 one quarter of the population was assumed to have $100 or less to consume. The current income distribution always assumes that one quarter of the population always has less than one half of the current per capita income.

capital creates extra jobs. A lower fertility increases aggregate savings, the total stock of capital, and the capital to labor force ratio.

MATERNAL HEALTH AND CHILD CARE

A significant fraction of all medical, nursing, and health program costs relate to pregnancy, miscarriages, abortion, delivery, and care of mother and child. The number of births in a year, numerically related as it is to these other events, is one element in calculating what these various costs may be in the aggregate. There are obviously more births, miscarriages, etc., when a population is both larger and more fertile.

In Developa the number of births under the different fertility assumptions in 1985 (before there are second-generation effects) and 2000 AD (when there are such effects) are approximately as follows:

Fertility	1985 (000)	2000 (000)
Low	450	570
Medium	580	820
High	650	1,030

Even in 1985 there are 200,000 fewer births with low fertility as against high fertility. What the difference in cost is will depend upon the proportion of mothers that are delivered in hospitals, have prenatal and postnatal care from a physician, and so on.

Perhaps the average cost of all pregnancy-related services is $30 per live birth. By AD 2000, with low rather than high fertility, there could be a reduction of 460,000 births that year for a saving of $13,800,000. Alternatively, with low fertility, better services costing about 80 percent more per patient, could be provided at no increase in overall budget.

CHILDREN NEEDING EDUCATION

One of the most immediate benefits of a decline in birth rates comes from a slower growth of school-age population. Even by 1985, after 15 years, the school-age population in Developa is 4.23 million with high fertility as against 3.65 million with low fertility. This difference of 580,000 children can be translated into taxpayers' savings of almost 1 percent of GNP in any year.

In a typical LDC, annual recurrent school costs are approximately $5,000 per 100 attending pupils. The cost of training extra teachers and building extra schools is approximately $10,000 per extra 100 pupils. Hence, with 100 percent enrollment, the **additional** recurrent costs **in 1985** because of high rather than low fertility are $29 million. And **by** 1985 extra net investment in schooling capacity, because of high rather than low fertility, is $58 million. Thus the extra 580,000 children cause extra costs of $87 million, or $150 extra per extra child, which is three times the average cost of educating a child if the school age population remained constant.

However, the enrollment ratio will not be 100 percent, and might be as low as 50 percent. In that event the educational cost savings of low fertility will be half as much. Alternatively, if these halved "savings" were used to increase pupil enrollment, it could be raised by about 15 percent (to 58 percent of total school-age population).

HOUSING AND UTILITIES IN CITIES

High fertility rates for LDC's can only augment their increases in urban population. Throughout the developing world there is also a massive internal migration to the cities. While in practice it may be impossible to provide adequate housing for all extra urban dwellers, there is certainly an urgent need to provide at least extra sewers and water supplies.

The Developa example estimates the urban population at five year intervals.* By 1985 the urban population is put at 6.29 million with high fertility but at 5.72 million with low fertility. By 2000 AD the difference is much greater, the urban population being 12.3 million with high fertility, but 9.0 million with lower fertility. This difference of 3.3 million persons living in cities amounts to roughly one third of what the average current urban population would be.

A reduction in urban population should bring significant financial savings to state and local governments. The annual operating costs of all municipal services are reduced, including garbage collection, police stations and patrols, collection and disposal of sewage, etc. Moreover, and more important, various **investment** costs, such as for additional streets, fire stations, and water works should be reduced (more than proportionately.)

In the Developa example, over a 30 year period there was an increase with high fertility of almost 10 million in urban population, a number equal incidentally to the 1970 national population. The investment costs in urban infrastructure alone must be at least $300 per person if minimum housing is included. Thus the investment cost occasioned by the extra urban population is at least $3,000 millions, or about 5 times the total income of the urban population in 1970.

DISPROPORTIONATE SAVINGS IN INVESTMENT COSTS

A decline in the rate of population growth will **disproportionately** reduce the investment costs of expanding public and social services so long as the decline continues.

The cost of any activity, including the provision of social and public services by public or private agencies, involves both an annual operating cost and an occasional investment cost. If the number of people served has been **steadily** growing at 3 percent a year, the operating **and** investment costs will have been increasing at 3 percent a year on an average.* However, if the growth rate falls to 1 percent, operating costs will decline proportionately, but investment costs will fall disproportionately.

Thus some hypothetical service may cost $10 a year per person but it may cost $50 to serve one **extra** person. If those served are increasing steadily at 3 percent a year, and there are about 1,000,000 people served, the total cost will be **increasing** each year by about $300,000 for operating costs and $1,500,000 for investment costs (for a total of $1,800,000).

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*It assumes initially for 1970 that 70 percent of the population is rural, and that in each year one percent of last year's rural population migrates (net) to cities. Meanwhile there is a natural increase of over 2 percent a year for the urban population. Within a decade or so the urban population is growing more from natural increase than in-migation.

*The extra investment may occur discontinuously over time at any one location but be continuous on an average for the whole system — e.g., the investment cost for schools throughout a country might be growing at 3 percent even though a particular village only gets a new school every 30 years.

However, if the growth in service fell to 1 percent from 3 percent, this budget would be increasing yearly for a while by $100,000 for operations and $500,000 for investment (or a total of $600,000). The saving for the year is $900,000 (or 40 percent less than the previous increase).

Such disproportionate savings only occur for so long as the service growth rate is declining. And they are less marked when investment costs do not overshadow operating costs. Nevertheless, much of the infrastructure that governments must provide, whether dams, aqueducts, power stations, canals, or roads, do have exactly this characteristic.

EXTENDING SERVICE COVERAGE

Most LDC governments are attempting to increase the percentage coverage of their social services. Specifically, they are seeking to increase the percentage of school age children actually attending school, the percentage of dwellings having sanitation, etc. Clearly, coverage could be increased more rapidly if population would increase more slowly.

If potential users of a service are increasing at 3 percent a year, and the budget of the government agency that serves them is increasing in constant dollars at 3 percent a year also, it surely cannot extend coverage. However, if potential users are increasing at only 1 percent annually, this agency can increase its coverage so long as its budget is growing at 3 percent a year. Specifically, if it had been servicing 75 percent of potential users, in 5 years it could be servicing about 83 percent of them.

This is one additional reason why many of those who wish to extend the coverage of social and public services also favor a decline in fertility. They are impressed for example by the fact that, with continued high fertility in many LDC's, there will probably be more children **not** going to school after a decade because enrollment ratios cannot increase fast enough. Here is yet another example of how there is often a choice between more quantity and quality of life.

CHAPTER 5

APPLYING THE MODEL TO TANGANYIKA, MEXICO AND TAIWAN

The purpose of this chapter is to present the analytical results of applying the model in various ways to three distinctly different developing countries — Tanganyika, Mexico and Taiwan. For each country, three different analyses are performed. First, the predictive capability of the model is examined and its estimating errors in forecasting actual GNP and GNP per capita are analyzed. Secondly, the model is used to contrast the **present** economic consequences of two **past** fertility patterns — one actually experienced in the last two decades and one that could have occurred. Finally, the model is used to project the **future** economic consequences of two alternative fertility patterns that are assumed to begin **currently.**

CONTRASTS AMONG THE THREE COUNTRIES

The three countries were chosen for reasons of differences in geography and culture, fertility and mortality, and size and growth rates of GNP and GNP per capita. Table 9 summarizes their economic and demographic characteristics.

Tanganyika, a recently independent East African country with a lingering tribal society, is just beginning her process of development and large segments of her economy have not yet joined the modern market sector. Her measured per capita income in 1967 was $73, among the lowest in the world, and its growth rate was about 2 percent per year, in turn below the average for all LDC's. Her population growth rate is about the same as the average for LDC's (2.4 percent a year) but this has come about because of very high fertility rates and somewhat lower but still high mortality rates. As mortality declines further, her fertility is not likely to fall as fast, and as a consequence her popuation growth rate will probably rise.

Mexico, a large Catholic country deriving many economic and social characteristics from the United States has for decades experienced an impressive rate of growth of GNP. Her per capita income of about $600 in 1970 and its high growth rate of nearly 3 percent a year are other indications of her progressive economy. Mexico's population growth rate, on the other hand, has been averaging about 3 percent a year and is among the highest in the world. While mortality has been falling rapidly, her fertility has remained unchanged for two decades at the high gross reproduction rate of 3.0.

Taiwan, considerably unlike either Tanganyika or Mexico, is a small urbanized island with a predominantly Chinese population, most of whom arrived from the

mainland in the late 1940's. Her GNP growth rate has been one of the highest in the world. But even of greater significance is the dramatic fall in fertility over the past 15 years. From 1954 to 1969 the gross reproduction fell from 3.0 to 2.3 and the crude birth rate declined from 45 per thousand to 32.

Most demographers agree that the existence of a widespread birth control program in Taiwan is only part of the reason for the rapid fertility decline. The decline had already begun before the program was initiated but accelerated after the program got underway. Unlike Tanganyika and Mexico, it seems clear that Taiwanese attitudes have evolved to the point where family limitation has become a important individual and social value.

Table 9. Demographic and economic comparison of Tanganyika, Mexico and Taiwan.

	Tanganyika	Mexico	Taiwan
Population, average annual rate of growth (percent)*	2.4	3.2	3.1
GNP, annual average rate of growth (percent)*	4.4	6.2	8.6
GNP per capita, annual average rate of growth (percent)*	2.0	2.9	5.4
Gross reproduction rate*			
Initial Year	2.9	3.0	3.1
Terminal Year	2.9	3.0	2.3
Crude birth rate (births per thousand of population)*			
Initial Year	51.3	48.3	44.5
Terminal Year	47.0	42.0	32.0

*Growth rate spans and initial and terminal years refer to 1950 and 1970 for Mexico, 1957 and 1967 for Tanganyika, and 1954 and 1969 for Taiwan
Source: Agency for International Development

THE CAPABILITY OF THE TEMPO MODEL AS A PREDICTIVE TOOL

It is first important to establish the TEMPO model's reliability as a predictive tool, not only to give credence to the analysis of past economic experience, but also to permit acceptance of the model's simulation of the economic and demographic future.

In Table 10, **actual** GNP and GNP per capita for 1967 are compared to **predicted** GNP and GNP per capita as generated by the model. To make these comparisons the computer was "started" a decade or more before 1970 depending on the country. The predictive error is measured by the difference between the actual value and the predicted value divided by the actual. In general, the model tends to underestimate the variables slightly, but clearly produces predicted values that are well within the range of acceptability. The errors in predicting GNP range from 2 percent for Tanganyika to .3 percent for Taiwan. The errors in predicting GNP per capita cover a somewhat wider range.

It is important to note that measurement errors in GNP accounting are of such magnitude that the predicted values from the model may be just as accurate as those given by the national income accountants. A common source of error

in estimating real GNP, for example, is to underestimate the rate of inflation and hence overestimate the increases in real GNP. The values generated by the model are always in real terms.

Table 10. Model errors in predicting GNP and GNP per capita for 1967.

Country	(1) Actual GNP* (millions of US Dollars)	(2) Predicted GNP (millions of US Dollars)	(3) Predictive Error (1) - (2) / (1) (Percent)	(4) Actual GNP/ Population* (US Dollars)	(5) Predicted GNP/ Population (US Dollars)	(6) Predictive Error (4) - (5) / (4) (Percent)
Tanganyika (Base Year=1957)	813	796	2.0	73	69	5.3
Mexico (Base Year=1950)	23,408	23,656	−1.1	541	536	1.0
Taiwan (Base Year=1954)	3,587	3,575	0.3	279	272	2.5

*Constant dollars of base year noted. Yearbook of National Accounts Statistics, 1969. United Nations, 1970.

THE PRESENT ECONOMIC CONSEQUENCES OF PAST FERTILITY PATTERNS

This section contasts for each of the three countries the economic experience that actually occurred with the experience that would have occurred, had fertility been different in the past. Because of the availability of data, the analysis for Tanganyika runs from 1957 to 1967, for Mexico 1950 to 1970, and for Taiwan 1954 to 1969.

Tanganyika

The first two columns of Table 11 show the actual economic and demographic experience of Tanganyika from 1957 to 1967. The third column shows the experience that would have occurred had Tanganyika's gross reproduction rate, instead of remaining unchanged at 2.9, declined to 2.4.

With the passage of only ten years, Tanganyika would have had a half million fewer people, a somewhat larger GNP, and a per capita income about 4 percent higher. Her child dependency ratio, instead of rising to .82 would have declined slightly from the level experienced a decade earlier, and her school age population would have been nearly 100 thousand less.

This improvement would have come about not only because there would have been fewer people to share the GNP, but also because a more slowly growing population would provide a higher saving rate and hence a higher investment rate. While the labor force would have been the same as that actually experienced, each worker would have been equipped with about 1 percent more capital. Clearly, a decline in fertility starting in 1957 would have made Tanganyika measurably better off in only a decade.

Table 11. Tanganyika: main consequences of reducing fertility to advance development*.

Variable	1957	1967		1987	
		Actual Fertility	Declining Fertility	Continued High Fertility	Declining Fertility
Population (millions)	8776	11165	10755	18389	14051
GNP (millions of 1968 U.S. dollars)	527	813	816	2348	2268
GNP/Population (1968 U.S. dollars)	60	73	76	128	161
Labor Force (millions)	1671	2076	2076	3450	3157
Labor Force/Population (percent)	19.1	18.6	19.3	18.8	22.5
Child to Work-age Ratio	.76	.82	.75	.82	.51
School Age Population (thousands)	3097	4099	4003	6614	4286
Crude Birth Rate (per thousand)	51.3	47.0	41.0	43.0	28.0
Gross Reproduction Rate	2.9	2.9	2.4	2.9	1.5
Investment/GNP (percent)	10.0	14.4	15.2	23.3	25.7
Capital Stock (millions of 1968 U.S. dollars)	1500	2272	2293	7800	8334
Capital Stock/Employed Labor (1968 U.S. dollars)	897	1094	1105	2261	2640

*Male and female life expectancies are assumed to increase from 37 and 40 years in 1957 to 47 and 51 respectively in 1987.

Mexico

The case of Mexico, shown in Table 12, is more interesting because the time span of the analysis is 20 years, a period long enough for an assumed fertility decline to have produced a labor force smaller than that actually experienced. Starting in 1950, had Mexico's gross reproduction rate fallen from 3.0 to 2.0 by 1970, her labor force would have been about 1 percent less. In spite of the fewer workers, the GNP associated with declining fertility would have been equal to the actual GNP of 1970 because of the higher past investment rate. This would have enabled capital per worker in 1970 to be well over 100 dollars more than actually existed. Thus, with no decline in GNP and a population 12 percent smaller with falling fertility, Mexico's per capita income in 1970 woud have been 14 percent higher than it actually was.

Of equal interest is the effect on the economy's investment budget for health services, housing, education and other social services. With 6 million fewer people and 3 million children of school age that would have typified Mexico in 1970 with declining fertility, the scheduled investment outlays could have been used to improve the quality and coverage of education.

Table 12. Mexico: main consequences of reducing fertility to advance development*.

Variable	1950	1970		1990	
		Actual Fertility	Declining Fertility	Continued High Fertility	Declining Fertility
Population (millions)	25342	47562	41724	92534	57641
GNP (millions of 1968 U.S. dollars)	8.5	28.5	28.4	114.9	100.2
GNP/Population (1968 U.S. dollars)	337	599	681	1241	1738
Labor Force (millions)	7643	13582	13443	26568	21492
Labor Force/Population (percent)	30.2	28.6	32.2	28.7	37.3
Child to Work-age Ratio	.75	.89	.67	.90	.46
School Age Population (thousands)	9416	18578	15527	34991	16999
Crude Birth Rate (per thousand)	48.3	42.0	31.0	43.0	22.0
Gross Reproduction Rate	3.0	3.0	2.0	3.0	1.3
Investment/GNP (percent)	14.1	16.7	17.1	18.4	18.8
Capital Stock (millions of 1968 U.S. dollars)	35.0	84.4	85.1	296.0	287.9
Capital Stock/Employed Labor (1968 U.S. dollars)	4597	6212	6328	11142	13395

*Male and female life expectancies are assumed to increase from 48 and 50 years in 1950 to 59 and 62 respectively in 1990.

Taiwan

The Taiwan analysis, instead of comparing the effects of a hypothetical fertility decline with what actually happened, does the opposite. Thus the effects in 1969 of the **actual** fertility decline that occurred are contrasted with the effects that would have obtained had fertility remained unchanged at the levels of 1954. Table 13 shows these results for the period 1954 to 1969.

With unchanged fertility, the Taiwanese population would have been almost 8 percent larger by 1969, GNP would have been about the same, and per capita income would have been 8 percent smaller in comparison to the actual experience.

The improvement that Taiwan actually experienced in the 15-year period compared to the unchanged fertility case came about because of a more slowly growing population and a slightly higher investment rate. Capital per employed worker was 1 percent higher than it would have been had fertility not declined. Thus even for a highly successful developing country, whose GNP is growing at nearly 9 percent a year, a decline in fertility will provide an added and important improvement in the standard of living.

Table 13. Taiwan: main consequences of reducing fertility to advance development*.

Variable	1954	1969		1989	
		Actual Fertility	Fertility Unchanged at 1954 Level	Fertility Unchanged at 1954 Level	Continued Declining Fertility
Population (millions)	8592	13426	14533	29919	19640
GNP (millions of 1968 U.S. dollars)	1237	4283	4261	25329	23304
GNP/Population (1968 U.S. dollars)	144	319	293	847	1186
Labor Force (millions)	2563	4050	4050	8113	6907
Labor Force/Population (percent)	29.8	30.2	27.9	27.1	35.2
Child to Work-age Ratio	.78	.74	.89	.92	.46
School Age Population (thousands)	2912	5304	5711	11318	5789
Crude Birth Date (per thousand)	44.5	31.0	40.0	42.0	21.0
Gross Reproduction Rate	3.1	2.2	3.1	3.1	1.2
Investment/GNP (percent)	14.1	21.7	21.2	25.6	26.3
Capital Stock (millions of 1968 U.S. dollars)	3000	9574	9464	64536	64647
Capital Stock/Employed Labor (1968 U.S. dollars)	1377	2517	2491	8386	9664

*Male and female life expectancies are assumed to increase from 59 and 63 years in 1954 to 69 and 72 years in 1989.

THE FUTURE ECONOMIC CONSEQUENCES OF A FERTILITY DECLINE

Having shown the model to be reliable and useful for predictive purposes by analyzing past economic and demographic experience, it is important to explore the **future** impact of a fertility decline. The last two columns of Tables 11, 12 and 13 show for each country the effects of two alternative fertility patterns for 20 years into the future.

In Table 11, Tanganyika's fertility is assumed to remain unchanged at 1957 levels, and the effects are contrasted with the effects of fertility declining to near European levels. The population with constant fertility will be 8 million larger and the school age population will be over 2 million larger in contrast to declining fertility. Given the phenomenon and problem of rising expectations in most developing countries it is important to emphasize the effect of fertility on the growth rate of per capita income. By 1987 with declining fertility, Tanganyika will have a per capita income 26 percent higher than with constant fertility. With unchanged fertility, her per capita income will grow from 1957 to 1987 at an average rate of only 2.5 percent a year, but with declining fertility the growth will rise to 3.3 percent.

Mexico's economic and demographic future is strikingly different if one contrasts the continued persistence of her present fertility to a fertility level in 1990 that is about equal to that of the United States today. From Table 12,

the population under declining fertility will be 35 million less, the child dependency ratio will be 90 percent in the high fertility case but only 46 percent with declining fertility, and the school age population will be 18 million less. The school age population would nearly **double** from 1970 to 1990 with continued high fertility but **decline** by about a million and a half with lowered fertility.

Equally dramatic are the different levels of per capita income that Mexico would experience in 20 years under the two alternative fertility assumptions. With continued high fertility, Mexico's per capita income in 1990 would be about equal to that of Puerto Rico today, but with declining fertility it would be about equal to that of Great Britain today. Thus the respective growth rates under the two assumptions would be 3.7 and 5.5 percent, such that by 1990 per capita income under declining fertility will be 40 percent higher than that under unchanged fertility.

The long run impact of a continued fertility decline for Taiwan is shown in the last two columns of Table 13. The population under a continued fertility decline would be 10 million less than under fertility levels of 1954, and because of the smaller labor force, GNP will be smaller by about 8 percent. The impressive growth rate of the Taiwanese economy even under the high fertility levels of 1954 would produce a per capita income growing at the very high rate of 5 yercent a year. By 1989 Taiwan would have a per capita income equal to that of present day Poland. But with continued decline in fertility her per capita income growth rate would average 6.8 percent a year, and by 1989 she would have a per capita income about equal to that of Italy or Austria today.

SIMILAR ANALYTIC CONSEQUENCES

Analyses with the model have shown that for Tanganyika, a measurable improvement in the standard of living could occur in just a decade, for Mexico, her excellent economic performance could be improved still more, and for Taiwan, her experience would have been less brilliant had her fertility decline not occurred. The beneficial consequences of a lower fertility in each case stem from the same interactions. First, the changing age distribution reduces the child dependent population and increases the work force. Second, the saving rate and hence the investment rate rise as the average family size declines. Thus the growing GNP is divided up among fewer people, the rising labor force employment allows GNP to grow about as fast as it would with unchanged fertility, and each worker is employed with more capital.

CHAPTER 6

FACTORS AFFECTING COMPLETED FAMILY SIZE

Reduced birth rates would contribute significantly to the economic development of most developing nations. Yet individual women in many of these countries continue to have about as many children as their mothers and grandmothers. At the same time women in a few other developing countries (e.g., Korea) are having fewer children. What explains why some countries experience no changes in fertility while a few others show declines? Why is it that most couples apparently have a larger family when completed than they profess to consider ideal? What really determines family size?

THE GREAT DEBATE

There currently is a great debate between those who advocate wide-spread expansion of family planning clinics and those who argue that increased provision of contraceptive information and devices will have little effect.

The family planners assert on the basis of surveys that a majority of women want to have fewer children then they will ordinarily have without birth control. Surveys also suggest that most women prefer contraception to abort as a means of birth control. The logical deduction is that these women have more children than they want because contraceptive knowledge and means are lacking or inadequate. The asserted solution is more clinics, doctors, nurses, devices and education, so that more women will use IUD's and pills and more men will use condoms or have vasectomies. Allegedly, the demand for contraceptives is there, but not enough supply of devices and advice.

The opposing view, held by many sociologists and anthropologists, is that the demand for contraceptives is very modest, and that the supply of means and information will soon be excessive in many LDC's. They emphasize that many maternity clinics have few visitors seeking contraceptive assistance. They explain in detail the many social institutions and attitudes that make women desire more children than some national economic planners happen to approve.

The family planners may retort that in many countries the birth control clinics are operated by doctors who are more interested in curing the ills of mothers and children than in inserting IUD's or prescribing pills. They stress that, so long as there are so few qualified doctors and these are only in the cities, no contraception program can succeed until paramedics and nurses are authorized to assist women without supervision. They deny that there is an oversupply

of family planning assistance, and explain that, while there may be millions of IUD's in warehouses, there are not enough trained personal available to put them to use.

Accordingly, if this debate is to be resolved, there is still a need for sample surveys that will explore in detail whether women do not practice contraception because they are ignorant of techniques, unwilling to use them, or unable to obtain them.

SOME EXPLANATIONS OF HIGH FERTILITY

Numerous explanations have been offered of why more women do not practice contraception. These include biological drives, sociological compulsions, and lack of means. No one explanation is convincing by itself, but together they suggest why fertility rates are not declining more rapidly in most LDC's.

Uninhibited Biological Drives

It has been argued by some, and especially by those not overly familiar with anthropology, that the poor and ignorant women of the underdeveloped world are more "animal" than rational. The number of pregnancies are said to approach the biological maximum. Any failure to attain such a maximum is attributed to health, diet, climate, etc.

This is generally held to be an overly simplistic view. The number of children a woman has depends on customs and institutions. In some societies marriage is early and in others it is delayed. In some cultures widows are expected to remarry and in others they are not. In some communities, men do not take their women on long trips from home, and in others they do. The religions of some countries consider celibacy ennobling. Tolerance of male homosexuality varies too. Breast feeding of infants is by custom more prolonged in some cultures than others. Certain tribes discourage intercourse at certain seasons. All of these differences affect the extent to which women are exposed to sexual intercourse. Even were there no deliberate restraint by exposed couples — and certainly no attempt at contraception — these sociological differences could account for differences in gross reproduction rates.*

These and many other customs and institutions affect fertility. At issue is whether these effects are incidental or deliberate. There are some who feel that customs affecting exposure have evolved more or less consciously depending on whether society's collective wisdom favors more or fewer children.

"Rational" Preferences for Large Families

Exposed couples may have large families simply because they prefer them and not because they copulate with no more thought than animals. These preferences may be based on reasons that seem logical to the women and men involved. There may be pressures from relatives to have children soon and often. Boys may be valued far beyond girls, in which case parents who have girls first will continue pregnancies if possible until they have one or

*Anthropological and social studies have clearly shown that all cultures have evolved institutions that incidentally or deliberately encourage larger or smaller families. Many societies with strikingly different social institutions have reached similar fertility levels by quite different social mechanisms. (See Kingsley Davis and Judith Blake, "Social Structure and Fertility: An Analytic Framework, Economic Development and Cultural Change, April, 1956),

more boys. Parents may want many children to support them more comfortably in their old age.* Moreover, where "extended" families of three generations live together and share food, the infants born to young parents are no special burden upon them. So long as these circumstances are perceived to exist the availability of contraceptives may so little affect fertility as to be practically irrelevant.

Poor Contraceptive Performance

Another argument is that fertility is high because couples use ineffective contraceptive methods ,e.g., rhythm or withdrawal) due to religious training, unavailability of more recent and effective techniques, or other reasons. It is held that parents may not want small families, but that one way or another nature "tricks" them into larger families than they want. In partial support of this view are numerous surveys indicating that the ideal family size is about one quarter smaller on an average than completed family size.**

LAISSEZ-FAIRE THEORIES

There are a number of demographic theories that encourge complacency and have laissez-faire implications. One of these is the so-called theory of demographic transition. Another is that urbanization of itself results in parents having fewer children. Still another is that higher living standards following economic development will also provide emerging parents with the preference, will and means to have fewer children. If these views are correct there is little LDC governments need do but reduce mortality, encourage urbanization, promote development and wait for parents to start practicing more effective contraception, abortion, and infant "neglect".

Supposed Demographic Transition

The current population "explosion" is frequently held to be a transitory phenomenon peculiar to the 20th century. It is claimed that as mortality rates continue to fall, parents will become generally aware of lengthening life expectancies, and that accordingly they will no longer have extra infants to replace other children who die prematurely. This theory assumes that parents have an ideal family size in mind that is not uneconomically large, that they make the necessary calculation, and have the capability of controlling pregnancies accordingly.

The experience of Europe in the late 19th century is often cited in support of this hypothesis. During this period mortality rates fell slowly, but fertility rates slowly followed them downwards too, the small excess of births over deaths limiting population growth to under one and a half percent a year. The developing countries are allegedly passing through this same demographic transition and will shortly experience declining fertilities.

Recent research suggests, however, that this theory of demographic transition

*Analyses performed at TEMPO in 1970 by Dr. Donald J. O'Hara demonstrate that the familiar argument that parents need to have 6 or more children in order to achieve a high confidence of one son surviving until both parents are 65 years of age, is erroneous under typical mortality rates. Some of these past calculations have used expected values estimated, as it were, when a couple first cohabited. However, if contraceptives were used to space children, a couple could wait to ascertain whether each successive child survives the first dangerous years of childhood. It now appears that with life expectancies above 50 years, parents who "space" can have a .95 confidence of one son surviving until they are 65, and yet have small enough families that the rate of population growth is around 1.5 percent a year.

**See Table 14.

is neither consistent with the experience of 19th century Europe nor the 20th century's developing nations.* Demographic investigations reveal that the accelerated rate of population growth in Europe during the 19th century came more from an increasing birth rate than a decreasing death rate. Recent evidence also shows that, in a relatively large number of LDC's, the birth rate is rising or constant at the same time that the death rate is falling.

Latin America is a good example. Table 15 shows, for periods between 1930 and 1959, life expectancy at birth and crude birth rates for eleven countries. At the same time that mortality fell sharply, with life expectancy at birth rising from about 34 to 53 years, the crude birth rate rose from about 42 to 45 per thousand.

Table 14. Completed and "ideal" family size.

Country	Completed family size	"Ideal" family size	"Ideal" to completed (percent)
Ghana (urban)	7.0	5.3	76
Tunisia (national)	5.9	4.3	73
Korea (national)	5.4	4.2	78
Taiwan (urban)	5.5	3.9	71
Thailand (rural)	5.2	3.8	73
Turkey (national)	5.8	3.5	60
Colombia (urban)	4.8	3.6	75
Venezuela (urban)	4.3	3.5	81
Mexico (urban)	5.0	4.2	84
Panama (urban)	3.8	3.5	92
Brazil (urban)	3.3	2.7	82
Costa Rica (urban)	4.3	3.6	83

Source:

Bernard Berelson, "KAP Studies on Fertility", in Bernard Berelson, et al, **Family Planning and Population Programs,** University of Chicago Press, 1965, p. 658.

Table 15. Life expectancy at birth and crude birth rate for eleven Latin American countries (combines Brazil, Chile, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay and Venezuela).

Period	Life Expectancy at Birth	Crude Birth Rate
1930-34	34.4	42.4
1935-39	36.9	42.4
1940-44	40.2	43.6
1945-49	44.3	44.3
1950-54	48.8	45.5
1955-59	53.4	45.0

Source: Eduardo E. Arriaga, "The Nature and Effects of Latin America's Non-Western Trend in Fertility", **Demography,** November 1970.

A number of demographers, noting the unrealism of the theory of demographic transition, have argued that major institutional changes are needed before fertility rates in many LDC's will begin to fall. The claim is that fertility declines in many countries cannot be attributed to the introduction of family planning programs. They are rather said to be the result of altered social and economic circumstances.

Urbanization and Fertility

In the developed nations there was a tendency for urbanization and reduced fertility to be associated in time, leading to the belief that urbanization **caused** this decline, and there are some who believe that rapid urbanization will have the same beneficial effects in the LDC's of today.

It is certainly true that the costs of rearing children are higher and more explicit in cities. Also children are of less productive use around an urban hovel than a rural hut. Accordingly, if parents really exercised control over pregnancies, one would expect city dwellers to have fewer children.

A distinction needs to be made between those city dwellers who are relatively educated and well-to-do, and whose daughters may be emancipated and hold jobs, with those slum dwellers who have arrived in the cities from the countryside. These migrants are poor and uneducated. They pass through no cultural change because of their geographic move. Their knowledge of effective contraception techniques does not increase as a result. Most statistics indicate that poor and new city dwellers do not.

Will Economic Development Lower Fertility?

Some feel that the modest economic development that is continuing in many LDC's is a cause of declining birth rates. Higher living standards mean more education, more jobs for younger women, and more vigorous efforts by parents to ensure that their children achieve higher status. The policy implication is that if governments concentrate on promoting economic development, and are successful, fertility will decline without direct official encouragement.

However, accepting this relation, it has been demonstrated (see Chapter III) that lower birth rates in turn promote economic development. If there is a circle of cause and effect between lower birth rates and higher Personal incomes, governments might best intervene wherever in the circle they can most economically do so. It may be much cheaper to "invest" in birth control programs than in additional plants and equipment, at least to a degree, if the objective is higher individual incomes.

Pessimistically, without declining fertilities, there may be very little economic development. The rising aspirations of city populations may be more seriously disappointed. Not only economic development but also social progress may be threatened because of opposition to birth control programs.

USEFUL NEXT STEPS

National economic development would be advanced in a typical LDC if about one out of two fecund and exposed women were to practice effective birth

*Riad B. Tabbarah, "Toward a Theory of Demographic Development", Economic Development and Cultural Change, January 1971...

control, preferable by means of contraception, in any year. However, while information is very meager, it is unlikely that one in five is practicing pregnancy prevention. The explanation must be some combination of ignorance, unwillingness, and inability.

Ignorance

Women vary enormously in what they know about contraception, and some of what they "know" is incorrect. Knowledge about what an IUD is, and how it is inserted, is often rumor. Few village women have ever seen a diaphragm. Word concerning the contraceptive pill has spread, but there is uncertain information about possible side effects, and most women will not know how to get a prescription or where to go for resupplies. The traditional methods that are best known are likely to be least effective. The man involved may know about withdrawal but not favor it. He may have used condoms on occasion but not know where he can obtain them readily and cheaply. If he has heard about male sterilization (vasectomy) he may confuse it with castration.

Neither the man nor woman may know where they can go for information and counselling. Contraception, as distinct from abortion, may simply not be understood as a possibility. Even the idea of "spacing" children may still be unknown.

In so far as women and their men are ignorant of these matters, their failure to practice effective contraception cannot be attributed either to unwillingness (because they want a child soon) or inability (because the means are not available to them). But the anthropologists can misinterpret ignorance as unwillingness. And family planners can just as readily misinterpret it as inability.

An urgent first step is increase the knowledge of fecund and exposed adults regarding concepts, practices, and locally available means of contraception.

Unwillingness

It is important also as a next step to survey enough of those who are informed (non-ignorant), but do not practice contraception regularly, as to whether the reason is primarily unwillingness or inability as defined above.

Scattered information concerning abortion is relevant here. It has been estimated for one Latin American country that there are two abortions for every three births, and in one Eastern European country, where abortion is legal and safe, there are more reported abortions than recorded live births. Most but not all of these women who resorted to abortion would probably have preferred contraception if the means had been cheap and available. Moreover, for each woman who is prepared to seek an often risky abortion, there are probably others less desperately anxious to avoid giving birth.

Governments need to know far more through surveys of the reasons why many women are unwilling to use contraceptives. Do they **want** to become pregnant **soon?** Do they have unreasonable fears that deferring pregnancy may mean no more children later? Do they erroneously believe that their old age support depends on having as many children as possible? Are they motivated by parents and in-laws, a general cultural orientation favoring fertility, or specific

religious injunctions? Only when governments have such knowledge can they seek to affect certain of these attitudes.

Inability

Finally, there remain those who are informed about contraception, willing to practice it, but fail to do so because effective and preferred means are not conveniently and cheaply available. Sample surveys are needed to identify specific obstacles. Is it remoteness of the clinic, the hours it is closed, the difficulty of entering it privately? Is it unwillingness to discuss such matters with a strange nurse or doctor? Is the clinic sometimes out of stock of devices? It there too much waiting in discomfort? Is it expense? Contraceptive services and devices have to be marketed like any other product, the convenience factor is important, and successful contraceptive dissemination can only be based on an understanding of user likes and dislikes.

CHAPTER 7

PRONATALIST VIEWS ANALYZED

There are some who still disagree that a reduction in human fertility should have if possible a high priority as a means of accelerating economic development. Thus there are a few eminent economists who hold that more may be gained from increasing saving rates, or speeding technical innovation, than reducing the number of births. There are many government leaders who wish to develop now sparsely populated regions of their countries, and who rightly or wrongly believe that increased population is the way to fill and develop these empty lands. Most businessmen associate more people with more customers, and in turn with more profits. A few historians assert that population pressures may be necessary to force a country into rapid industrialization and technological advance. And some geopoliticians feel that increased international influence comes from having a larger national population. The reasonableness of these views is assessed here.

RELATIVE IMPORTANCE OF FERTILITY DECLINES

Can the relative importance of reduced fertility, as compared say with increased savings propensities or more rapid technological innovation, be roughly shown?

Obviously, within certain limits, there is a "trade-off" between a higher savings rate and a lower fertility rate. Using Developa again as an example, the same annual improvements in income per head of the low fertility case can be achieved with high fertility, if there is a sufficient increase in savings. How much greater savings there must be, expressed as a percent of GNP, varies over time as follows:

Year	Actual Savings Rate	Required Savings Rate
1975	7.7	18.1
1980	8.7	19.5
1985	9.7	20.7
1990	10.7	21.7
1995	11.7	22.6
2000	12.6	23.3

Analogously, the trade-off between fertility decline and technological innovation can be derived from the Developa case. To do so, one must calculate what the productivity improvement resulting from technological innovation would have to

be each year to attain, with high fertility, the annual improvements in income per head of the low fertility case. Instead of a constant 1.5 percent improvement a year, the required productivity increase by year then is:

Year	Required Productivity Increase
1975	2.1
1980	2.1
1985	2.1
1990	2.1
1995	2.2
2000	2.2

The theoretical alternatives for a single year such as 1985 can be calculated. The same improvement in income per head can be achieved with a high gross reproduction rate of 3.0 as was achieved with one of 1.8 if **either** the rate savings from income was 20.7 percent (instead of 9.7 percent) **or** the productivity increase from new technology was 2.1 percent (instead of 1.5 percent). Clearly, reducing fertility is not the only way to raise income per head rapidly.

Which change in behavior might be "easier" for the people of a given nation to make presumably depends on its culture, traditions, and institutions.

For many families there probably is some interdependence between fecundity, savings, and productivity. The sort of family that is disciplined and materialistic, and plans to advance its wellbeing, is more likely to save and innovate and limit its progeny.

In many cases, having fewer children makes it easier to save more, and those who accordingly can and want to invest in new productive methods can more readily innovate. Conversely, families that consider only the present are likely to consume what they have, do each job with the tools at hand by traditional means, and engage in coitus with little thought of preventing conception.

The fact that there is some numerical equivalence between less fertility, increased saving, and more innovation does not mean that these three behavior parameters are **operational** alternatives. It certainly does not follow that most families will save or innovate more **because** they are having more children. And it does not follow that because a nation is able to save more it should not seek to reduce fertility also.

MORE PEOPLE AND BETTER BUSINESS

Many merchants, industrialists, and even farmers believe that more people mean more customers, and more customers mean more financial gain. Owners of land, whether they rent or use their land, also believe that a growing population contributes to their incomes. All these and many others tend to favor high fertility and low mortality on the grounds that an increasing population is "good for business."

However, this is too simple a view, and there are many offsetting factors.

As more people live in a town, more rival merchants and artisans probably enter each line of trade, so each storeowner may gain no more customers for himself simply because the city's population is growing.

People are only customers to the extent that they have money to spend and goods to exchange. If higher fertility means slower growth of output and income per person, each customer can only buy less, and indeed more customers could very well mean the same total purchasing power. If families are individually less well off, they may spend proportionately more on "necessities" such as food and textiles, but this means fewer sales by those who provide other products.

Increased sales do not even guarantee increased profits, for in addition to extra prime costs there may have to be expensive capacity additions, some of which may prove later to be excessive and unprofitable.

As for landlords, a larger population does mean higher rents per hectare of land, just as it means lower wages per day of work. But total rents paid to all owners of land may be about the same, and these will presumably have to be shared among more landowners, so that each owner may receive less rents. Considering Developa again, after 25 years total land rents with high fertility were 1.1 times what they were with low fertility. But the number of people, including owners of land presumably, were 1.4 times as great. Thus a typical landowner received 22 percent **less** in total rents.

Emphasizing the incomes that families receive as merchants and landowners may be too narrow a view. The owner of a small business or farm usually receives income also for his labor. Families that own land usually receive income from capital investments also. Thus a better measure of most families' wellbeing is purchasing power available per family member. And this is ordinarily achieved through a decline in fertility.

DEVELOPING "EMPTY" REGIONS

Many LDC's include large undeveloped regions, almost devoid of population and infrastructure, the existence of which "proves" to some observers that rapid population growth through high fertility rates is economically desirable. Thus many a Brazilian cannot understand the advantages of increased contraceptive use so long as the enormous Amazon Basin remains practically unpopulated. Physically, many tropical countries are under-populated in this sense, but what presumably matters more is the future rate of improvement in output (income) per person now living in the country.

One fundamental confusion is between absolute population **size** and population growth **rate.** It is absolute population size, relative to the existing stock of national capital and available natural resources (including usable land), that determines population pressure and relative rates of interest on capital, wages for labor, and rent of land. It is the population growth rate, and especially the underlying fertility rate, that influences the rate of saving from income, the ratio of productive-age to non-productive subpopulations, and the extent of improvements in income per head.

Most LDC's can eventually have much larger absolute populations **and** considerably higher incomes per head if population growth rates are slow because fertility is declining. When population grows slowly, there is more time

for capital accumulation and technological advances to keep ahead of the ever more numerous workers and consumers. Brazil for example can sometime in the future support a population perhaps of a billion, but hopefully not in the 21st century if the income per capita is to be much improved in that nation.

Also often overlooked is the necessity of having extra capital as well as extra labor to develop an "empty" region. Workers and their families would have a most miserable time in any now populated region if they had to earn a living there without the assistance of tools and equipment, shelter and facilities, transport and communications. But the very increase in population growth that provides extra labor also tends to prevent accumulations of extra equipment, infrastructure, and other forms of capital.

Nor is it an accident that most of these empty regions remain undeveloped economically. For one or more reasons entrepreneurs, investors, and workers have not been attracted into them. Where there is dense tropical vegetation, clearing is costly, and the properties of the local soil when exposed to rain and sun are often unsuitable to agriculture. These areas remain empty, not because they are remote, lack consumer amenities, and transport to and from them is costly, for this was once also true of other regions now developed and prosperous. The real problem is that capital is scarce and there are more attractive investments in already developing regions.

Finally, continued high fertility tends further to populate existing cities rather than empty regions, for babies are born where their mothers are. An extra birth in say Bangkok does not produce an extra peasant cultivator in the underdeveloped Northeast of Thailand for instance. Generally, if and when these empty regions are thoroughly developed, it will be because of serious population pressures in already developed and once more economically attractive regions.

INNOVATIONS INSTIGATED BY POPULATION PRESSURES

Many civilizations of history owe their genesis in part to challenges that they successfully overcame. And certain countries such as the Netherlands were encouraged by their comparative lack of land to take to the sea, whether to fish for food or to explore and colonize. In the 19th century the British demonstrated how to exploit an advancing technology to import much of their food from overseas. In this century Japan has provided a striking example of how profitably to export industrial goods for raw material imports. But does it follow that population density or population growth, through some describable cause-and-effect reaction, generates a more rapid technological advance?

There is nothing about rapid population growth that in principle should generally promote faster innovation. An **increase** in the rate of population growth more than proportionately increases the drain on savings by requiring infrastructure investments of all kinds. A fast population growth attributable to high fertility results in a relatively larger number of children. Population growth with an already low and constant fertility, but a still lower and falling mortality, can increase the relative number of people too old to work.

Where usable land is very scarce, relative to people and workers, a doubling of population will theoretically result in far less than a doubling of output. Extra capital investments will also be subject to diminishing returns because

of land scarcity. Moreover, if output per head is low, capital accumulation will be difficult and slow.

A survey of countries with rapid population growths, most of which are in central Latin America, does not indicate any unusual association with an unusually rapid advance in technology. It is true that countries with rapid population growths have rapid GNP growths, but this is to be expected, for extra population means a larger labor force and hence more output. However, the increase in output attributable to labor is ordinarily less than proportionate, so that income per head declines unless capital and technology can keep pace.

As for density of population, the most crowded areas of the world outside of Northwest Europe and the Northeast United States are Java and the river valleys of China, India, and Egypt. Early development in the Yellow, Ganges, and Nile river valleys resulted in considerable food supplies, but the very population growth resulting from food availability seems to have choked rather than instigated later progress in technology. Thus the economic performance of the Netherlands, Britain, and Japan, may really be **despite** pressures of population, and attributable to their cultures. Certainly, the numerous mechanical inventions leading to the industrial revolution in Great Britain occurred at a time when the population was growing slowly.

NATIONAL POWER AND LARGE POPULATIONS

The most powerful nations of the world are among those with large populations — thus the US has more influence in world affairs than Canada, the Soviet Union more than Sweden, or Great Britain more than Ireland. On the other hand China and India, while among the more important nations, do not have an influence and power proportionate to their populations. What relations if any seem to exist between population size and national power?

The United States and the Soviet Union are "large" countries more in terms of their physical area than their population size — in fact the population density of the Soviet Union outside of European Russia is very low indeed. Being geographically large, each of these nations has a great variety of resources and climate, each constitutes a free trade area fully able to exploit economics of scale in production, but each country must incur considerable transportation costs. Both countries have high savings rates and — even allowing for Soviet losses in war — fairly low population growth rates.

However, the real source of a nation's power is a large GNP **surplus,** available to each government for non-sumptuary uses, and this surplus does not increase proportionately with population. Suppose for example that 30 percent of GNP is so available for prestige, military, and other "influence" purposes. Suppose also that a 10 percent increase in population and labor will increase output by 7 percent, assuming no change in capital stock or technology. Theoretically, if the availability of civilian type goods and investments per head is unchanged, this will leave the military "surplus" unchanged.

Traditionally a large population has been considered a military asset because of the many army divisions that could be mobilized. And in WWI the nation able to sacrifice the most "cannon fodder" had an advantage. However, with changing military technology, sophisticated weapons having great fire power

and mobility are usually decisive. Thus the few weeks Indian-Pakistan war essentially involved tank battles and the Arab-Israeli Six Day War stressed preemptive air strikes. These modern tanks and aircraft are extremely costly to import and difficult to maintain in commission. Thus developing nations with substantial export balances and many skilled workers can most readily maintain armed forces that are militarily effective. Neither rapid population growth nor extreme population density contribute export balances or skilled technicians.

The real basis of national power and influence is the "surplus" described above. For a GNP of given size, the higher is the per capita income, the larger should be this surplus. And this argues for a slowly increasing population, one that can be outpaced by capital accumulation and technological innovation, for national power depends perhaps more on high living standards than on population size alone.

CHAPTER 8

SHOULD GOVERNMENTS PROMOTE FAMILY PLANNING?

There are many officials and citizens within the United States, other advanced countries, and certainly within the LDC's who oppose the mounting of government information and assistance programs to increase voluntary contraceptive use in the developing nations. Even though economic development would apparently be increased by reducing fertility, many would prefer to concentrate on accelerating GNP growth than on retarding population growth. How logical is this attitude?

MOST GOVERNMENTS ADOPT PATERNALISTIC ROLES

Nearly all governments adopt a paternalistic role in many areas of public concern. They enforce exchange controls to protect the national currency. Governments also interfere with the lives of their subjects in the name of education (compulsory school attendance) and health (compulsory smallpox vaccinations). As the LDC's "modernize", and their governments enforce more regulations of the kind so commonplace in developed countries, anything as passive as providing contraception assistance on demand can hardly be considered excessive "interference".

SPECIFIC PRONATALIST STATUTES

A majority of governments have crudely pronatalist laws on their statute books.

The most obvious are those that make abortion illegal, penalities being imposed on those who procure, perform, or request such relief. Some jurisdictions still have laws against the distribution, possession, or use of contraceptive information or devices. Although these laws may not always be enforced, their mere existence increases the dangers and costs of birth control.

In not a few LDC's, the policy of the government might be caricatured as compulsory pregnancy if cohabitating and compulsory birth if pregnant. These same governments also hold economic development to be a national objective. Any reconciliation of this contradiction means for some a difficult balancing of material and moral values.

IMPLICIT PRONATALIST PROGRAMS

Many government activities have a definite pronatalist thrust that often remains unrecognized because it is indirect. The following are some examples:

- Early marriages permitted: children born sooner;
- Child labor allowed: sons can earn wages for parents;
- Free public schooling: children cost less;
- Inadequate social security: parents depend on children in later life;
- Inflation: threatens financial investments and makes for greater dependence on children;
- Uncertain inheritance laws: each parent "invests" in children instead;
- Female employment discouraged: parents need more sons to support them;
- Subsidized public housing: children cost less;
- Pregnancy leaves with pay: confinements cost less;
- Family allowances and tax deductions for children: create fiscal incentives for larger families;
- Compulsory military service: peasants need more sons to have a given number working on their land;
- Expanded public health: child mortality is further reduced.

It is not suggested that such programs, activities, and policies should be terminated, and their direct social goals accordingly abandoned, merely because they have injurious indirect effects. Their pronatalist influence should, however, be recognized. Also, consideration should be given to **offsetting** these effects, through positive birth control programs for instance. Thus increased infant care could be balanced by increasing contraceptive availability. Free public schooling could be offset by contraceptive education. Parents could be assisted in exercising their preference not to have more children. Governments would then be more truly neutral.

ACROSS FAMILY EFFECTS

In extremely primitive subsistence cultures, the activities of one extended family do not impinge upon other families except for occasional clashes, perhaps over riparian or grazing rights. Each family is self-employed and consumes its own production. There are hardly any taxes paid to government or services received from it. Under such conditions the size of each extended family is primarily its own concern. The gains or costs of a larger family accrue almost entirely to it alone.

As LDC's modernize and develop, so that farmers' sons work elsewhere and farm crops are sold to others, the welfare of different families becomes less independent. When LDC governments increasingly tax families to provide them with a variety of social services, such as education, the well-being of formerly unrelated families becomes linked through these transfer payments. Each family becomes more affected by the sizes of other families.

Within a truly developing nation, the "across family effects" of different family sizes can become significant. The large-size family depresses the wages of labor, and hence reduces the earnings of workers from small families too.

Large families tend to raise the price of food, thereby increasing its cost to small families also. Free public schooling results in small-sized famiies partly subsidizing the schooling of large-size families of the same class and income. Through economic markets, and so-called "free" government services, larger families reduce the welfare of smaller families.

There is obviously no direct way that smaller families can protect themselves economically and financially against larger famiies. The only way is indirect and through government. But what can government do in a free society?

The libertarian approach in all such situations is to have government modify antisocial behavior through establishing positive inventives or negative penalties. Mining operations that impair health are often taxed more heavily for workmen's compensation. Factory owners are sometimes taxed or fined to the extent that they do not limit air and water pollution to acceptable limits. Similarly, if excessive fertility by some families is considered antisocial, financial incentives and penalties are equally justified. Government bonuses for not having more than a few children might be provided for instance.

REDUCING MORTALITY AND REDUCING FERTILITY

Some people fear that acceptance of arguments for fertility reductions in the name of economic development must logically imply acceptance of current or higher mortality rates for the same reason. Superficially, infant mortality is seen as an alternative to contraception. Logically, should a government family planning program imply a budget "freeze" on public health services?

Fundamentally, as indicated in Chapter I, any apparent conflict between birth control and improved health is specious. Health, in a sense of avoiding illness and premature death, is itself a goal of true national development. For many it may rank as more important than raising per capita incomes.

Improved health and long life expectancies contribute indirectly to economic advancement. A healthier labor force means a more vigorous and productive labor force. And where people have a substantial expectation of life, with reduced risk of death at each age, they are encouraged to make economic plans and investments because they expect to survive and enjoy the benefits.

High death rates make it impossible for a family to plan either its size or economic activity. Lack of contraceptives also makes it impossible for a family to plan its size, and too many children can threaten its financial future. When birth control becomes available concurrently with a fall in mortality, each family at last has an opportunity to become a rational unit, capable of planning and organizing for the future. Such a change of life style is undoubtedly a most important impetus to economic development. True national development occurs when people of a country acquire the means to exercise greater control over their lives, over their production and consumption, and over the sizes of their families.

Falling mortality rates make falling fertility rates more imperative than ever. They are not substitutes but supplements. When the medical community increases mankind's ability to defer death, it should also seek to increase mankind's ability to defer life.

THE ETHICAL ISSUE

Many people still feel that governments should not concern themselves with such a delicate and personal matter as the private and voluntary use of contraceptives.

Yet governments already assume a wide variety of responsibilities for social welfare. Governments also intervene very directly in the lives of their subjects, by restricting imports, monopolizing certain enterprises, and only permitting certain products to be sold at approved prices. These and many other state interventions are all justified in the name of public welfare.

Most governments also conscript men for their armed forces in the national interest. But some of these same governments will not provide adequate family planning services for the sake of economic development. The former involves compulsion and killing. The latter is voluntary and prevents life. Ironically, while military conscription involves extreme State intervention, it is government assistance to family planning that often arouses more controversy.

A free society is supposedly characterized by free individual choice when the evercise of it does not harm the common weal. There are few individual choices more socially important than the decision not to have another child if it can be prevented. In most LDC's, if governments assisted in making this choice a real alternative, they would not be harming society but contributing to each family's welfare.

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