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LOWER BIRTH RATES - SOME ECONOMIC ASPECTS

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LOWER BIRTH RATES - SOME ECONOMIC ASPECTS

PREFACE

This short essay is written by an economist [redacted]. It outlines some economic aspects of recent demographic and medical events that relate to the evolving population policies of the United States Government. It is offered as personal opinion for discussion only.

PART I - WHY FEWER BIRTHS?

A. The Demographic Threat

The demographic nature of the population threat is now so widely recognized among policy makers that only a few magnitudes deserve repetition.

(1) The LDCs are experiencing a natural increase in population of from 2 to 3 per cent a year - which means a doubling of population every 38 to 25 years.

(2) All LDCs have "high" birth rates of over 30 births per thousand population a year, and some approach 45. All MDCs have crude birth rates of under 30 per thousand a year. High birth rates are a characteristic, consequence and cause of underdevelopment.

(3) The rising rate of natural population increase during the last two decades is attributable to rapidly falling death rates. Mass epidemics have been largely controlled by such traditional public health measures as inoculation and quarantine. Malaria control, through DDT, has proved to be a successful and inexpensive way of indirectly reducing fatalities. In most LDCs it is expected that death rates will continue to fall, although not perhaps so fast or so inexpensively as in the recent past. Further improvements will have to depend more upon medical care and hospital treatment of individual patients. Nevertheless, over the next decade or two, many suppose that death rates will decline faster than will birth rates in a majority of LDCs.

(4) Current age specific fertility and death rates cannot continue for many more decades in already overpopulated countries. Either birth rates must decline, or death rates attributable to malnutrition must rise towards the end of this century. International migration is probably not a physically possible solution for Asia, even were it politically feasible. Nor can mass movements of food grains and concentrates, although free gifts, provide more than an extra decade or so in which to reduce birth rates before disaster.

(5) Little time remains for those countries that have (a) high rates of natural increase, (b) high population densities in terms of agricultural and other economic resources, and (c) too numerous and distinct a population for emigration to provide adequate relief. India, Pakistan, and Egypt notably fit this description. But there are many others.

B. Economic Cost of Uncontrolled Births

The economic cost of overpopulation and/or high birth rates takes several forms. The most serious are not always the ones most immediately recognized by governments. Thus, planning authorities in some countries are much concerned by the cost of extra schools and other social infrastructure necessitated by a rapidly increasing population. This is a serious problem. But other aspects of overpopulation and/or high birth rates are more critical and more pervasive.

Increasing population with over population: The countries that most rightly fear a doubling in population in 38 to 25 years are those that are already "overpopulated".[2/]

Officials in these countries sense that gross national output will not have doubled by the time that population has doubled. This is because a more or less doubled labor force, accompanying a twice as large population in say A.D. 2000, will not have doubled investment and doubled land resources with which to work. Innovations that result in more output per unit input of labor, capital, and resources may not be sufficient during the next 30 odd years to offset slow capital accumulation and the inability of "land" to multiply itself also. In this case there would be a reduction in output per head and no economic development.

Any extra GNP (ΔY) stems from extra employed labor (ΔL), extra capital stock (ΔK) and extra innovations that increase productive efficiency. There can only be a zero natural resource increase (ΔR).[3/] Thus, one possible macro-economic approximation for short time periods of say five years is:

$$\%\Delta Y = \left\{l\ (\%\Delta L) + k\ (\%\Delta K)\right\} + \left\{1 + \phi\right\}$$

where ϕ is increase in "productivity" over the period.

If population growth dynamics permit one to suppose that the ratio of population to labor remains unchanged over 5 years, and one assumes that the decree of employment of labor is about constant, some predictions can be made about the effect of extra population on output and income per head if the values of l, k and ϕ can be estimated roughly. In certain situations l and k may approximate the shares of labor and capital respectively in national income.[4/] Perhaps l = .5 and k = .2. That they sum to less than unity, leaving .3 attributable to fixed natural resources, is a measure of the diminishing returns of labor and capital together in terms of "land".

The use of this kind of equation can be demonstrated with a not unrealistic example. Assume a country with a 12% increase in P and L during 1965-1970. Perhaps %ΔK is 30% over these 5 years.[5] Then, in the absense of innovations (ϕ), there is a .5 times .12 (i.e., 6%) increase in Y, attributable to ΔL. Also there is a .2 times .30 (i.e., 6%) increase in V, attributable to ΔK.[6] Summing, after 5 years there is a 12 per cent more output to be distributed among 12% more people, so output per head has remained unchanged.

In this example the magnitude of l provides an inverse measure of "overpopulation". The smaller l, the greater "overpopulation". The smaller l + k, the more economically scarce are natural resources.

This hypothetical case also distinguishes an LDC from an MDC. A more developed country would probably have had a ϕ during 5 years of from .10 to .15. It might also have had a larger %ΔK.[7]

The main point, however, is that a 12% increase in population and employed labor force resulted in a 6% increase in output attributable to them. Thus, for all age brackets together, extra population means proportionately less increase in output than increase in consumers. Mouths are increasing more rapidly than food. This consideration of birth reduction policies is still too crude though, because age structure is ignored.

Adult males and females in the most procreative ages - say from 20 to 40 years in backward countries- produce more than they consume. This is especially true of the men, and could also be so of the women if they had fewer babies. It is the under 15 year olds who subtract from the economy as consumers while adding nothing as producers.

Thus, a reduction of births from 4% of population to 3% during 1965 - 1980 would reduce consumption by dependents without reducing production during the next decade and a half. All those who can enter the labor force at 15 years of age during the next 15 years are already born, of course. Thus, birth reduction must increase the near future consumption and/or investment per head of those alive in 1965.

High birth rates and excessive infant dependency: It is not sufficiently realized that high birth rates, even in the absence of "over-population", impose a severe economic burden on any nation.

The fraction of population under 15 years of age, comprising those too young to be anything but consumers, tends to be a function of the birth rate. The demographic explanation of this relation is somewhat involved. Significant here is that a country with a crude birth rate over 40 per thousand a year is likely to have about 40% of its population too young to work. And a country with a birth rate of 20 might have roughly 20% under 15 years of age. Thus, it is the poor countries with high birth rates that have the most onerous dependency ratios.

The cost of these dependents to an LDC's economy is serious in the aggregate. Most children in really poor and tropical countries may not cost much for clothing and shelter. But they must and do eat after weaning. And in the future they will occasion costs to government for social services.

In a country where per capita income is $100 yearly, a probably low estimate of the average annual cost of children under 15 years of age to their families and government would be $40 a year, or 11¢ a day.[8/] Each infant birth

prevented in 196X, if permanently prevented and not simply postponed for a year, would cause a considerable saving. Taking a 15 year period quite arbitrarily, and without discounting, the saving is $600.

Capital is alleged to have a high productivity in LDCs however, and poverty makes for urgent time preferences among households, so only the present discounted value of this saving should be taken. At 20% compound discount, $40 a year for 15 years is worth $176 now. At 15%, it is $233. And at 10%, it is $304. 9/

These three different estimated savings, as will be explained below (pp. 20-25) are far greater than the resource costs of perhaps permanently preventing a birth by several available methods.

Of course, some contraceptives may only postpone a birth. Thus, a couple, during their lives, may have 3 children and plan on 4. But they may wish not to have the fourth child this year. The worth to the economy over 15 years of such a one-year postponenemt - which will largely accrue to the couple - is $30 now at 15% compound discount. 10/ Even this value greatly exceeds the resource cost of postponing a birth by all methods except perhaps the contraceptive pill.

These economic savings from permanently preventing or temporarily postponing a birth result from high birth rates and not from overpopulation as defined. The argument for reducing births as an economic development measure is not vitiated if a particular backward country has abundant and fertile land as yet uncultivated. It is the high birth rates common to all LDCs that are one common cause of their poverty. 11/

Calculating the present discounted value of infants: Less crude calculations of the worth to an economy of birth reductions would combine the two approaches described above. These more refined estimates should take account of both the consumption of dependent children and the low marginal productivity of today's infants when they eventually join the labor force. This means that the incidence of both high birth rates and of the degree of overpopulation should be gauged so far as possible.

Ideally, in forming birth reduction policies, officials should have estimates of the present discounted value of a newly born infant to the national economy it is entering. This involves discounting to the present the future consumption and production streams attributable to a "typical" infant.[12/] In most, if not all LDCs, the present discounted value of the negative consumption stream will exceed the present discounted value of the positive production stream.

That infants should have a minus value to their country's economy is due to three elements:

(1) consumption starts now, but production through labor does not begin significantly for 15 years or so, and values in the distant future are compound discounted to the present;

(2) not all babies survive to enter the labor force, especially in poor and backward countries where death rates for children are relatively high; and

(3) the marginal product of labor (i.e., extra output per extra worker) in any country suffering from some degree of overpopulation will be less than the average product of labor (i.e., output per worker).

Imagine a group of 1,000 infants born early this year, having typical fractions of boys and girls, intelligent and stupid, strong and weak, etc. After one year as sucklings, and after customary infant mortality, perhaps 825 survive to become more normal consumers. Apart from a few chores around the family dwelling and land holding, they remain unimportant as producers for 15 years or so, by which time perhaps 750 survive.

These new members of the adult labor force add to output. However, if there are already many adults working with very little land and capital, the extra output of these extra workers will be less than output per worker in the country as a whole. Thus output per worker may be around $200 a year. But the extra output of the 750 new adult workers may be only $75,000 or $100 each.

Their individual remuneration - in subsistence or money - will be comparable though to that of other adults of the same sex, age, experience, etc. Thus in effect, wherever there is a degree of population pressure, any increment in population and labor force subsequently will add less to output than that increment subtracts in "wages" and consumption. And this disparity between marginal and average product, when combined with deaths in childhood and discounting the future, makes for negative value infants.

Depending on assumptions regarding diminishing returns, death rates, consumption, productivity, and proper discount rates, hopefully appropriate to each major LDC, the value of permanently preventing a birth can logically be estimated for it. Obviously a great deal of empirical research to determine these parameters by country needs to be undertaken. And the sooner the better.

As an order of magnitude, in populated countries with high birth rates, infants probably have a negative value between once and twice the annual per capita income. Hence, in a country with a serious population problem and an output per head of about $100, it is "worth" from $100 to $200 to prevent a birth permanently.

Perhaps more importantly, if several births can be prevented by a couple adopting some contraceptive method that is ordinarily lasting (e.g., vasectomy), the "worth" of this act is several times as large again (perhaps equal to five times per capita income in the case of a young couple with few children already.) 13/

C. Comparative Effectiveness of Resources Invested in Birth Reductions

A reduction of births in LDCs will not necessarily occur merely because it would advance them economically. Clearly a program is needed that will augment the ability and willingness of couples to have fewer babies. And any such birth control program will require the use of varied resources, some of which are scarce and costly.

Hence, a valid question concerns the comparative effectiveness of resources "invested" in reducing births rather than educating children, aiding farmers, or even building factories. Obviously, in a short run of five years or so, factories cannot be substituted for family clinics or engineers for doctors. But over longer periods a nation does have a choice between more output or fewer children than there would otherwise be.

Specifically, if an LDC's goal is to maximize aggregate gross output per head of population in each and every of the next 15 years, should it marginally divert some of its development budget and national resources from investment for extra output to investment for fewer consumers?

Output per head is a ratio of course. It can be raised by increasing the output numerator or decreasing the population demoninator from what they would otherwise be at some future date. Resources can be used for either purpose. For example, after 15 years, some given millions of dollars worth of resources invested in real industrial capital might increase national annual output by .004 times. Different resources of equal value, employed in a birth control program, might after 15 years result in a population .10 smaller than it would otherwise be. Such a birth control program would be 250 times more effective a means of raising per capita income per unit of resources so employed.

There are many contraceptive methods that could and should be made more available in LDCs. Any comprehensive program would include IUD's, condoms, etc. Simply for illustrative purposes in this section, the comparative effectiveness of resources invested in vasectomies only will be considered.[14/]

How much can vasectomies for instance, contribute to a reduction in population ($\Delta P/P$) over 15 years?

Let V be the number of vasectomies a year and f the otherwise expected annual fertility of the volunteers' wives, averaged over the next 7.5 years, say. Then, ignoring gestation lags, the <u>first</u> year's vasectomies will reduce births after N years by V.f.N. The <u>second</u> year's operations will

reduce births by V.f (N - 1) from start of the program. So, after N years, the absolute change (ΔP) in births is approximately V. f. $N^2/2$. [15/] The proportionate change is ΔP divided by P.

How can the proportionate change in output ($\Delta Y/Y$), related to this $\Delta P/P$, be estimated after N years? If the resource cost of a single vasectomy is \$c, then the resource cost of a constant scale vasectomy program is V. c dollars each year. Different resources of equal value, if invested in factories and the like, would earn a rate of return of i, say a year. So the absolute change in national annual output (ΔY) at the end of N years is about V. c. i. N. The proportionate change is ΔY divided by Y.

Thus the comparative effectiveness ratio [16/], of resources invested in reducing births rather than increasing output, is

$$\frac{\Delta P/P}{\Delta Y/Y} = \frac{V.\ f.\ N^2.\ Y}{2.\ V.\ c.\ i.\ N.\ P} = \frac{f.\ N.\ (Y/P)}{2\ c.\ i}$$

Some not wholly unreasonable values can be ascribed these parameters. Suppose f is 0.2 a year, N is 15, (Y/P) is \$100, c is \$4, and i is .15 a year. This makes the ratio

$$\frac{\Delta P/P}{\Delta Y/Y} = \frac{\$300.00}{\$1.20} = 250.$$

A 250 times superior effectiveness is a staggering ratio to encounter in socio-economic affairs. It therefore needs stressing that the values attributed to f, c, and i are hopefully intelligent guesses at best. But even if each of these three parameters was adversely wrong by a factor of 2, so that f was .1, c was \$8, and i was .3, the revised superiority ratio would still be over 30. And, if each were wrong by a factor of 4, the overall gain is still

4 times. (Contrarily, in many Latin American countries typical Y/P values are more like $250 a year than $100, thus raising these ratios 2.5 times again.)

Hence, the main conclusion must be that resources used in birth reduction programs can make an extraordinary contribution to income per capita in LDCs.

This does not mean, of course, that conventional development projects should be cancelled and all resources devoted to birth reduction programs. Practically, available resources that can be used for vasectomies are limited by the number of volunteers, and they may continue to be few. Other birth control methods, some of them only moderately less effective according to this criterion, are fortunately far more acceptable.

PART II - HOW FEWER BIRTHS?

A. Inability or Unwillingness?

Clearly, it is not enough to recognize that birth rate reductions are an important element in any LDC's economic development. Also necessary is a birth reduction program that makes medical and economic sense. There are many alternative contraceptive methods, each with its own practical limitations and specific advantages, and cost effectiveness studies to select among them are urgently needed. But these analyses - which to be made properly require more family formation and contraceptive performance data by country than is ordinarily now available - may be dominated by a larger issue. This has to do with the allocation of resources and budgets between overcoming inability and/or unwillingness to reduce births.

Ability: The ability of couples in LDCs to reduce births depends upon knowledge of contraceptive methods, availability of devices and materials at zero or low cost, and often living conditions permitting discreet use of the method adopted.

The resource cost of any program to overcome inability will not be insignifant, being perhaps 10¢ a year per head of population, plus or minus a factor of two. There is often ignorance of the most effective methods, which can only be overcome by time consuming and costly explanation. Necessary devices or materials may be cheap enough to make. But they have to be distributed to the right couples. And some contraceptive methods require individual medical attention. The cost of inserting an intrauterine coil or loop for instance, can be very many times the cost of manufacturing it.

Accordingly, even assuming eagerness for birth control on the part of couples, there are resource costs associated with any government program to provide these couples with the necessary ability to practice it.

Willingness: Couples' willingness to adopt some one or more contraceptive methods, even assuming knowledge of them and availability of means, cannot be taken for granted. Many couples may be willing to use some method but not others. Some couples may only practice birth control after a certain number of surviving children have been born.

Moreover, for cultural and private reasons, many couples wish to demonstrate fertility and want numerous children. It is far from evident that young Asiatic peasants, members of extended families working in agriculture, share the wish of isolated occidental couples in cities to practice birth control. Thus, at this date, perhaps only a minority of potential mothers will swallow free contraceptive pills and relatively few potential fathers will volunteer for a vasectomy.[17/]

Overcoming unwillingness to reduce births, once those couples who already accept contraception in principle have been contacted and serviced, could prove costly. These costs will be partly real (resource) costs, for radio time, film showings, newspaper advertisements, pamphlets, lectures, etc. Until attitudes change, the resource cost of overcoming unwillingness to practice contraception may prove greater than that of overcoming inability to do so, always supposing a program of sufficient scope to cut the birth rates by, say, one third in 5 to 10 years.

Bonuses could be another potent way of persuading couples to practice contraception. Thus, one suggested plan would have volunteer married women register with a clinic, submit to a superficial examination every 17 weeks, and receive a small bonus should they prove not to be pregnant.[18] Vasectomy volunteers receive a small bonus in some Indian states, and the "finder" receives a modest commission, although Part I demonstrates these payments could be many times larger and hence possibly more persuasive.[19] The important point, developed further below, is that these bonuses are transfer payments in the technical sense and do not occasion resource costs. For this reason along, the possibility of including bonus schemes in any comprehensive birth reduction program deserves careful examination.

B. Economic Aspects of Overcoming Inability

To facilitate analysis, consider first the problem of economically overcoming the inability of couples to reduce births, assuming their passive willingness to adopt any recommended method that is explained and made available to them. Under this assumption, the question is what contraceptive methods should be provided fertile couples through a government program to reduce births? What objectives should be maximized and what are the real constraints?

Objectives: Any definition of objectives, if operationally useful, must be precise on several points.

It must specify, for some stated time period, whether any prevented birth is the equivalent of any other prevented birth. For instance, to increase

the probability of each family perpetuating itself, should government assistance to reduce births only be granted to couples with at least two surviving children? Should prior aid be accorded to couples who are especially poor, perhaps because of bad physical or mental health, lack of training, or inadequate land holdings to work? Is it perhaps "counter-productive" to assist professionally educated and comparatively well-to-do couples to have fewer children if these children have a higher probability of possessing superior intelligence and being well educated in turn? Should a national birth control program indirectly incorporate some eugenic considerations?

Resources of given value can be expended in 196X in such ways - e.g., distribution of condoms - that almost the entire contraceptive effect will occur the same year only. Other methods - e.g., vasectomies - will prevent conception this year, next year, and probably many years thereafter. Hence, given some constraint, it is important to know what years' birth reductions are to be "scored".

Constraints: Constraints on birth reduction programs in the immediate future are numerous, specific, and not at once removed simply by expending funds.

Thus, there can be delays in importing or domestically producing IUD's, condoms, and other devices. There is often a scarcity of doctors and trained nurses to staff clinics and mobile units. Available midwives may be too ignorant. A new class of paramedics, that could be trained in a

month or so for IUD insertions and even vasectomies, may not be "acceptable" to the local medical profession. Demonstration equipment and educational displays may be lacking at present. Suitable buildings and adequate transportation may be promises and nothing more. For the next few years any successful program will have to determine and adjust to these specific constraints.

However, given decisions and expenditures soon, it should be possible to eliminate particular "bottlenecks" within a few years, so that the practical constraint becomes not people or things, but budget. This could mean the construction soon of condom factories in countries where imports are uneconomic or unacceptable. It could mean that training programs should soon be instituted for paramedics to insert IUDs and perform vasectomies. In nations where mass media reach only a fraction of the population, it takes people to reach people, and it is none too early to assemble the staffs that will be needed to contact and instruct participating couples. If these things are started in FY 1966, by 1968 the effective constraint in many countries should be funds, but only if.

Which contraceptive method is best? Any birth reduction program in an LDC will initially have to provide a variety of contraceptive devices that combine effectiveness, cheapness, and acceptability in varying degrees. Unfortunately, the method that is most effective biologically is not likely to also be both the cheapest economically and the most acceptable generally, and vice versa. What criterion then should be applied to determine the "best" contraceptive method?

Initially, assuming alternative methods are equally acceptable, something can be said about the trade-off between biological effectiveness and resource economy. Except by coincidence, the "best" method is not that which during some period:

(1) minimizes pregnancies by a given group of fertile and exposed women (i.e., has the lowest "failure rate");

(2) minimizes the cost of assisting a given group of fertile and exposed women to reduce pregnancies;

(3) minimizes pregnancies from a given group of fertile and exposed women, all of whom must be assisted, from a given budget; and

(4) minimizes pregnancies from a given budget.

Criterion 1 and 2 are grossly inappropriate. Criterion 3 is a suboptimization of Criterion 4. And Criterion 4 in turn is a less invalid suboptimization of the true economic criterion described below as Criterion 5.

Hypothetical, but not wholly unrepresentative data, are presented in Table 1 to explain the logic. Nine kinds of contraception - including zero control - are listed. These are: 1) withdrawal, 2) rhythm, 3) condom, 4) foam tablets, 5) caps, 6) pills, 7) IUD's, and 8) vasectomy. It cannot be emphasized unduly that both the effectiveness and cost "guestimates" in this table need to be known for particular countries with far greater reliability, and should be obtained where lacking as soon as possible through sample surveys and other research supported perhaps by A.I.D.

Table 1. Nevertheless, Table 1 purports in Column 1 to show "starting" cost. This is a "fixed" cost per couple assisted. It covers initial contact of an exposed and fertile couple, their contraceptive education, and perhaps the supply or insertion of some "permanent" means that is

biologically effective through many acts of sexual intercourse (e.g., vasectomy or IUD). Both withdrawal and rhythm are here assumed to involve some "starting" cost for contact and education.

Column 2 gives annual costs per couple. These annual costs are "variable" - i.e., dependent on frequency - in the case of condoms, foam tablets and contraceptive pills.[20] If an IUD has to be removed periodically, for inspection, drainage, etc., a time-dependent cost is occasioned, which has an annual rate.

Column 3 gives a supposed 5 year cost per 100 couples. It is assumed that these 100 couples become participants in the program at a steady rate throughout the 5 years. Hence, Column 3 equals 100 times the sum of Column 1 and 2.5 times Column 2, because on an average each couple only has 2.5 years of variable cost.

Column 4 gives expected failure rates, or number of <u>conceptions</u>, per couple over 5 years of practicing birth control. Although some of these rates are based on studies, some are not.[21] The conception rate when no control is exercised is a guess.[22]

Column 5 gives conceptions prevented for 100 couples over a <u>phased</u> 5 year period, in which 20 couples become participants in the program each year, and none terminate. Pregnancies prevented is obtained by multiplying 100/2 and the difference between expected pregnancies with contraception and expected pregnancies with zero control. Hence, the latter guess determines in part the absolute magnitudes of Column 5 but <u>not the ranking</u> of alternative methods.

Column 6 gives phased 5 year cost per conception prevented, and is obtained by dividing Column 5 into Column 3. Some of these prevented conceptions may be only postponed, of course. However, in the case of vasectomy (and to a lesser extent IUD's and other devices), the practice of contraception once gained may be extended into future years beyond this period.

Column 7 shows the number of thousands of possible "customers" - or couples assisted - from a given budget of $1 million for the entire 5 year period.[23/]

Column 8 gives conceptions prevented in thousands, during the phased 5 year program, per million dollars, and is obtained by dividing Column 6 into one million dollars.

Column 9 gives the number of <u>births</u> prevented per million dollars. This equals Column 8 multiplied by 1 minus the probability of a conception resulting in a miscarriage, abortion, still birth, and infant death during first week of life. For present purposes this probability has been set arbitrarily at .5, so that two pregnancies equal one "birth".

<u>Criterion 1:</u> Minimizing pregnancies by a given group of fertile and exposed women is not necessarily a valid criterion because there is no resource or funding constraint. In the abstract, the most biologically effective contraceptive means might be unjustifiably expensive, although this is unlikely to be the case if the "group" comprises <u>all</u> women that might be assisted. However, if the "group" were 100 women out of a larger community of, say 2,500 women needing assistance, it would be wasteful to spend $500

on vasectomies for their husbands (thereby preventing 124 pregnancies in 5 years), when this sum could explain withdrawal to 2,000 couples (preventing 1,700 pregnancies).

Criterion 2: Minimizing the cost of assisting a given group of women is not necessarily a valid criterion because the same budget might prevent more pregnancies if used to give fewer women a more effective method of contraception. This conflict does not occur in the hypothetical cases of Table 1. There the cheapest way to assist 100 women is to instruct them and their partners in withdrawal. This costs $25, it is supposed. No other method has a superior cost effectiveness apparently.

Criterion 3: Minimizing pregnancies for a given group of women with a given budget is not necessarily a valid criterion, if all the women must be assisted and all the budget must be spent, because the method that appears best will, except by accident, not have the highest cost effectiveness. Thus, if $250 is to be spent on 100 fertile and exposed women, which means $2.50 each, caps would have to be used in these examples. Pregnancies prevented would be 90 over 5 years. But more pregnancies would have been prevented if the same $250 could have been spent on either fewer or more women. Thus, $250 could finance the insertion of 125 IUDs during a phased 5 year program and thereby prevent 150 pregnancies. In this case the program's task is over-specified. Either the number of women to be assisted or the available budget should be a variable.

Criterion 4: Minimizing pregnancies from a given budget is a tempting and sometimes valid suboptimization. The contraceptive method that satisfies this criterion will be the one having the highest cost

effectiveness. Such a method will also, of course, minimize the cost of reducing pregnancies by some stated number.

The more or less representative data of Table 1 indicate that withdrawal occasions the lowest cost of $.29 per birth prevented over the period. This method permits the assisting of 4 "customers" per dollar. As a result, 3.4 pregnancies are prevented - always assuming 2.5 pregnancies per couple - over 5 years with zero control.

It may seem paradoxical that one of the biologically least effective practices should appear to be one of the most financially effective. Part of the explanation is, of course, that withdrawal is supposed to be so inexpensive. The rest of the explanation is that this criterion is valid only if the budget is irrevocably fixed at the time of selecting a method. Determining the budget then determines the method. But what should the budget be?

Criterion 5 - The economic optimum: The fundamental economic optimization is not to maximize pregnancies reduced from a given budget (because the budget may be "wrong") or for a given size of group assisted (because it may be wasteful to assist no more or no less than such a group of fertile men and women). The basic criterion is neither cost effectiveness rating (Criterion 4) nor contraceptive performance (Criterion 1). The proper objective of a government birth control program is to use resources and increase the budget until the cost of preventing the "last" pregnancies is equal to the worth of doing so.

Figure 1 explains what is meant. The vertical axis represents number of pregnancies over five years from a given population of 100 fertile couples. The horizontal axis represents phased 5 year costs of using one

method or another. The points on this scatter diagram are derived from Table 1. They indicate the pregnancy reduction effect - measured horizontally downwards from Point 0, representing no contraceptive practices whatsoever - and the total cost for each pregnancy control method.

An efficiency envelope can be fitted to the left and lower points of this set of points. Points on this envelope are efficient. Points lying within - i.e., above or to the right of the envelope - are inefficient.

Thus, accepting the assumptions of Table 1, withdrawal, IUDs, and vasectomies are efficient points. They dominate rhythm, condoms, foam tablets, and caps. The pill is so inferior economically that, although reducing births more than all save two other methods, there is not enough horizontal (i.e., cost) scale to plot its point.

It remains to determine which of the efficient points is "best" by the basic economic criterion. This entails a comparison of ratios of incremental cost to incremental conceptions prevented as one "moves" along the efficiency envelope of Figure 1. These ratios must then be compared with the supposed economic worth of stopping a conception.

Consider the alternatives of withdrawal and IUD for example. Per 100 couples assisted, IUDs cost $200 - $25, or $175 more, over 5 years. The incremental pregnancy reduction is 120 - 85, or 35. Thus the marginal cost to marginal effect ratio is $175/35 or $5.00. The extra cost of an extra pregnancy reduction is then $5.00, over this range of the envelope, during a 5 year phased program.

A change from IUD to vasectomy similarly occasions a ratio of $300/4 or $75 per extra conception prevented.

These ratios must be compared with the "worth" of preventing conceptions for at least 2.5 years on an average. This "worth" crudely depends on the dependent consumption thus saved, which at $40 a year would be $100 undiscounted, per birth prevented. However, if the ratio of conceptions to births is 2 to 1, the value of preventing a pregnancy is one half this sum or $50.

A further refinement would include discounting. In the phased 5 year program considered, expenditures in the second half would be about twice those in the first half, so that the present discounted value of the extra cost of preventing extra conceptions is about two-thirds that estimated above. It is also important that some methods (i.e., vasectomy) will continue to reduce births after the 5 years considered here.

Given the assumed values of the table and figure, the method of highest contraceptive performance (i.e., vasectomy) appears barely submarginal. The extra discounted cost of the extra birth reduction ($50 roughly), is not much above the extra discounted economic gain obtained. By Criterion 5, vasectomy and IUD are hence competitive, over a 5 year phased program. Other things equal, the vasectomy would appear better if a longer period were evaluated, and it would appear worse if acceptability were introduced into the analysis.[24/]

Some Other Points. The cost effectiveness of any method can be illustrated by a ray from Point 0 in the figure to the scatter point representing a particular method. The steeper such a ray, the greater the cost effectiveness of the method. Thus, in cost effectiveness terms, rhythm

is superior to caps and IUDs to vasectomy.

In this analysis it has been assumed that the population of couples is homogeneous as regards frequency of exposure, fertility, etc. This supposition is unrealistic of course. Any birth reduction program that can identify these differences among particular couples, and discriminate accordingly by suggesting one method or another, can accomplish more per unit of resources. But effective discrimination requires more knowledge of the relations among people, mode of living, and conception. Programs in many LDCs will have to be somewhat "hit and miss" while data from each country's first year's birth reduction program are analyzed.

As any econometrician will recognize, this discussion of criteria involves a three dimensional surface, in which number of births (or pregnancies) is on the vertical, and (1) number of women and (2) cost in dollars are on two horizontal axes. The aim of policy makers should be to ascertain and "land" on the most economical point on this surface. This requires selection of the right contraceptive methods, the right number of "customers" from a given population, and consequently, the right budget. Logically, defining the most economical point is simple enough, and demonstrated above. Practically, unless far more detailed information regarding family formation and sexual practices is obtained from sample surveys and other sources, the character of this surface will remain obscure for each LDC.

C. Resource Costs and Bonuses to Increase Acceptability

Couples are obviously not indifferent regarding the kind of birth control method they adopt. And some men and women wish more rather than fewer children. Any birth control program that is large enough to be effective in the LDCs may soon include all presently willing participants. It will then not be enough to provide contraceptive ability to those that want it. In addition, government will have to stimulate willingness.

Differential acceptability of different methods: Data of the kind presented in Table 1 - but more reliable - can be used to determine the value of resources that can justifiably be expended to induce couples to adopt a more efficient method, although they may personally prefer a less economic one.

Consider caps and condoms for example. According to Figure 1, the cost effectiveness of caps is much greater than that of condoms. But couples may prefer condoms to caps.

Suppose the object of a phased 5 year program is to prevent 1,000 pregnancies. Assuming equal willingness, and available couples in each case, such a reduction can be achieved at a cost of $2,900 (1,160 participants) using caps, or $7,200 (1,110 participants) using condoms). The difference in cost is $4,300. This, then is the maximum value of resources than can justifiably be used to persuade people, who favor birth control generally, to adopt the more efficient method.[25/]

Using resources for popularizing reductions: However, quite apart from alternative methods, there is probably a serious need to popularize birth reduction in general. Part of this can stem from word of

mouth and force of example as a program continues from year to year. But considerable resources may also have to be expended to this end.

Certain kinds of couples are easier to persuade than others. Couples who have four surviving children already are more susceptible to persuasion as a rule. But to fit the women of such couple with an IUD, or perform a vasectomy on the man, is to achieve but half a success. Here is a policy question of some importance. Should government give prior birth reduction assistance to those who want and are likely to have fewer additional children, or should it urge the more permanent kinds of contraception upon those who are still relatively young and have small families.[26/]

There are many media for changing public attitudes, all the way from films to personal discussion. In many contexts the impersonal approach through mass media may be more effective than direct face to face "persuasion". The latter could have adverse effects until such time that a couple is more or less "ready" psychologically. Most programs will have to use a variety of "educational" means. All these efforts to encourage couples to practice contraception must use valuable resources and are hence expensive.

In making cost effectiveness comparisons among different contraceptive methods, and in applying the economic criterion to determine what kind of methods government can properly afford to press, it is total resource cost that matters. Thus it is the costs of creating ability <u>plus</u> willingness to reduce births that must together be compared with the worth of preventing a birth. Resources are resources, however employed.

Financial incentives for program workers: Not all the doctors, paramedics, nurses, midwives, samplers, clerks, etc., who work in LDC birth reduction programs will be highly motivated. Many of them will be poorly paid, partly because their basic wages must be compatible with general civil service wage structures. Moreover, fear of dismissal from government jobs is usually remote in developing countries, where employment often depends on nepotism or politics.

Thus, payment of a "finder's" fee to staff workers and others who "introduce" birth control participants to the program might be tried.

For many reasons it is important that village midwives do not spread adverse rumors or otherwise work against the program. As a successful birth reduction program would impair their livelihood, this could well happen. Some way should be found to train the more intelligent, educated, and reliable of these to assist in gathering information, introducing women to the program, and perhaps even fitting caps or inserting IUDs, all for a unit fee.

Financial incentives might also stimulate the distribution of condoms, foam tablets, etc. These could be supplied free by clinics as "wholesalers" to midwives, country general stores, and travelling paramedics. These agents would be encouraged to "retail" these devices at a moderate stated price - printed on the wrapper possibly. The profit margin would encourage retail storekeepers, midwives, etc., to explain the advantages of contraception.

Financial incentives to attract participants: There is another way of inducing couples to practice birth reduction that should be effective in some circumstances and which involves few resource costs for administration. That way is to offer bonuses to participants. Ordinarily bonuses involve a transfer payment without resource costs.[27]

Suppose an LDC government offers a married man a bonus for a vasectomy of $250. The operation itself incurs some resource costs for surgeon, nurse, anaesthetics, etc. But payment of the bonus itself does not divert additional resources from producing GNP. There is no reason why a country should labor less or invest less because bonuses are being paid from its taxpayers to some of its citizens.

A vasectomy volunteer who gains the bonus does provide quid pro quo of sorts. He possibly relinquishes psychic satisfaction of having more children. He may become an object of ridicule and scorn in his village. He may worry about loss of virility as well as fertility, despite medical assurances to the contrary. He may be reluctant to enter a strange clinic and fear the operation itself. Only a substantial bonus will overcome all these inhibitions in the case of some men.[28]

Equity of bonuses: Taxpayers, who contribute to government the bonus that it pays, lose the purchasing power transferred through government to birth reduction volunteers. Why volunteers may have to receive a bonus has been explained. But is it equitable that taxpayers in general should be forced indirectly to pay the bonus?

In a society in which each married couple and their young children were exactly self-sufficient financially, on balance being neither a net contributor nor net recipient of aid from the State, levying taxes for bonus payments would well be considered inequitable. If such a family wants to have many children, and is prepared subsequently to consume less per head within the family, that might be considered its affair. And one would suppose that enlightened self-interest would be a sufficient inducement, without any bonus, to limit its progency.

This is not, however, the case in truly emerging countries. It is other taxpayers than the parents who finance the education of the children of a large family. It is taxpayers who often pay for subsidized food grains available at low price on ration to families that have too many mouths to feed. Although each working class family may not realize it, every extra child that another family bears and rears will reduce the productivity and earnings eventually of the first family's children. The more other people have children the more expensive one's own food becomes. In over populated countries, it is anti-social of a couple to have more than three living children.[29/]

It is in the libertarian tradition that private parties who act against the public interest should be induced by taxes or subsidies - rather than be compelled by police - to behave more in accord with society's interests. Thus industrial communities suffering from air pollution have taxed themselves to subsidize neighboring factories that install smoke abatement equipment. There is no obvious reason in equity why the people of a nation should not protect themselves, by transfer payments through their government, against families that threaten them economically by overbreeding.

Specific bonus plans: Can such bonuses be large enough to persuade, and yet be economical, however? How large such bonuses can be depends upon the "worth" of preventing a birth, as described above. Bonuses would presumably be larger in the case of young married couples who already have no more than one or two children than in the case of older couples possessed of numerous children.

Payments for vasectomy. Of all contraceptive methods available vasectomy can most obviously be rewarded with a bonus. If more detailed information were available regarding family formation, it should be possible to estimate the additional children that couples would be expected to have depending on their age, number of children, occupation, religion, etc. A vasectomy bonus could then be the "worth" of preventing a birth (say $150), times the additional children otherwise expected (say 3), minus discounting for probable spacing of births (maybe 3 years apart). All this might indicate a bonus approaching $325 for a vasectomy now. Such a sum, in terms of per capita income, would be analogous to around $10,000 in the United States. Such a bonus would guarantee that most adult males would soon try to learn about this operation. And the more who know, the more will be inclined to volunteer. 30/

Non-pregnancy payments. Bonuses can also be paid economically to married women who remain non-pregnant.

If a woman were of an age group having a .25 annual fertility rate, and the value of permanently preventing a

pregnancy were $120, she could earn $30 a year by remaining non-pregnant. To do so she would have to visit a clinic every 17 weeks (i.e., 4 months), plus or minus a few days, for an examination taking a few minutes of a doctor's time to "prove" non-pregnancy. Each 4 month successful examination would earn the participant $10. This would be credited to an account in her and/or her husband's name. When this account, with interest, reaches the supposed value of permanently preventing a birth, subsequent payments would be made in cash. As the woman graduates to older age groups with lower fertility rates, the bonus would decrease. Accumulated credits would be paid-out as soon as completion of menopause, or age of 50, or her demise. Should a woman not appear for examination, or prove pregnant on reporting, a varying fraction of her credits would be cancelled.

The main defect of such a non-pregnancy bonus plan is that it would occasion resource costs amounting to a substantial fraction of total bonus payments. But it has the advantage of not being as irrevocable, and probably far less repugnant, than bonuses for vasectomy. Also, to qualify for a bonus, each woman and her spouse can practice any method of contraception that their religion, culture, or other preferences dictate.[31/]

How persuasive are bonus payments in attracting participants? One question to which there can be no answer without experience is the degree to which bonuses will evoke voluntary participants in birth control programs.

The supply schedule of vasectomy volunteers, or of women seeking non-pregnancy payments by submitting to periodic examinations at a clinic, is quite uncertain. The only possible government policy is to experiment, beginning with bonuses almost as high as it can economically afford to pay, so that practically the entire worth of preventing a birth goes to the volunteer. Subsequently, as public acceptance and understanding increase, there could well be an increasing number of people seeking contraceptive assistance. At such a time the government might lower its scale of bonus payments. This would give a larger fraction of the benefits of birth reductions to the economy at large. Moreover, if government clinics and medical personnel prove too few to meet the demand, the volunteer supply would have to be reduced in the market sense through lower "prices". And it is even possible that a policy of slowly reducing bonuses might stimulate a small speculative supply.[32/]

In any event, although bonuses for participation will never substitute for "educational" campaigns, they would seem to have a role at some stage in any large birth reduction program. The great merit of such bonuses is that they are transfer payments and not resource costs. Hence, the evolving operating pattern for a program may prove to be (1) extensive mass media offering impersonal explanations of "why", (2) subsequent offers of bonuses to those who "do", and (3) clinics, mobile units, and midwives, etc., directly to provide the "how".

D. Magnitude and Cost of Programs

Any national contraceptive program that is to have a significant negative impact on population growth in the next 5 to 10 years will have

to induce a considerable fraction of the adupt population to practice birth control.

In a typical LDC about 35 per cent of the population are in the procreating age brackets, with another 40 per cent too young and 25 per cent too old. Approximately half this "target" group - or, say 16 - 19 per cent of the population - are potential female "customers" over a period of years. And, in any 5 year period, about one half of these women will have three quarters of the babies.

Exact birth reduction goals are a matter for a host government to decide. Japan halved its birth rate since World War II, from 34 to 17 per thousand a year in ten years, abortion being widely and openly used, but that nation cannot be considered typical of underdeveloped countries in Asia or elsewhere. Any realistic goal might have to be more modest, although this only experience can reveal.

Suppose several LDCs wished in one decade to reduce their natural increase rate from 2 to 1 per cent a year. Present crude birth rates could be 42 per thousand a year and death rates 22. Crude death rates will presumably continue to decline - unless deaths from malnutrition increase significantly - to perhaps 18 per thousand annually by 1975. The crude birth rate would then have to be cut to 28 to meet the stated goal. This would constitute a one-third cut of 14 points in the birth rate.

For the next 10 years a one-third reduction in crude birth rates can be considered only very roughly the equivalent of a one-third reduction in age specific fertility rates.[33/] As many women will ignore the

government program, those that do practice conception will typically have to reduce their pregnancies even more. Perhaps two-thirds of the fertile women will have to halve the births they would otherwise have had.

This means that over-all conception rates will have to be cut proportionately with birth rates.

How many fertile-age women, and/or their spouses, will have to be educated and assisted will depend upon the average response rate of those contacted. Even if those who respond do so "completely", deciding that they want no more children, some of them will bear future children because of accidents. (And the ones most susceptible to persuasion are probably those past their most fertile years.)

Under these circumstances, if the birth rate is to be cut by one-third, about half the fertile women should be practicing birth control with a high degree of success by the end of the decade. And these practicing women must be representative of all fertile-age groups. They cannot simply be mature women with several children already. The practicing group must proportionately include younger women who have become fertile and exposed during the ten year period. Although their response rate may be low, efforts will probably have to be made to persuade newly married couples to postpone children for a number of years.

Roughly, if at least half the fertile and exposed women or men must be regularly practicing contraception with considerable success, this means that about 8 fertile adults per 100 population must be participating seriously in the program. This could mean 50 million participants by 1975 in the extreme case of India.

The annual cost per participant depends, of course, upon the method of contraception used. What is cheapest for a single year - perhaps foam tablets - is not cheapest over 5 years or longer. A certain amount of "investment" is desirable in inducing participants to use a method having low annual costs despite high "starting" costs - especially if that effort does not require sustained motivation.

Combining variable or annual cost with amortized fixed costs, and excluding the more expensive and inefficient methods, cost per participant could vary from about 50¢ to $2.50 a year, simply to provide an understanding and ability to practice contraception. Willingness is assumed. Depending on the relative popularity of different methods, a representative annual cost might be $1.25 for each participant. This would be roughly equivalent to.10¢ per head of population. (Here it should be mentioned that at least one expert puts this same cost at around .05¢.)

What the resource costs of persuasion might be is anyone's opinion. As described above, there is a possibility of substituting bonus payments within limits for methods of persuasion that do employ resources. This writer's guess is that resource-costing methods of persuasion could double the resource cost per participant, possibly making it all together $2.50 each year, plus or minus a factor of two.

The budget cost of bonus payments is even more uncertain if possible. But if bonuses are offered they must be paid to everyone who qualifies and applies - there cannot be discrimination, unfortunately - whether or not the participant would have attempted birth control without this incentive. And there are no grounds for believing that the numbers

of people who must practice contraception, if the national program is to meet its goal, will ever be attained without bonuses.

Hence, it is not difficult to imagine cases in which the money cost of bonus payment per participant would exceed the total resource costs occasioned by each. Perhaps non-pregnancy payments equal to about one-fourth what the government could afford to pay would have to be offered. This would entail about $5 to $10 a year per woman using tablets or an IUD.

Summarizing, total resource costs of $2.50 a year for each participant - divided equally between overcoming inability and unwillingness to reduce births - are entirely possible. These costs are also government budget costs, of course. Additional budget costs might be $7.50 annually per participant for bonuses. The total financial burden a year is then $10 each participant or roughtly $.80 per head of national population.

In some LDCs this would constitute around 5 per cent of all government budgets.

A policy dilemma may exist. If government contraceptive programs do not use a bonus, the total resource costs per head of population for overcoming inability and unwillingness to practice contraception may be about .20¢ a year, but far too few participants may volunteer to reduce the birth rate significantly. If bonuses are used, the birth rate would be lowered further again, but by an uncertain amount, and the total financial cost could approximate .80¢ a head of population per year. Reducing births would still be well worth the resource cost - and the financial cost too - but

program adoption by an LDC becomes more dependent on a sincere desire to reduce births.

E. Conclusions for Programming by A.I.D.

Despite many uncertainties, stemming from lack of data and almost zero experience in this area, enough may be sensed to form some conclusions for country programming by A.I.D. The following ideas are offered most tentatively with few exceptions. This is pioneering with all its dangers.[34/]

First, if raising per capita output and income is an important object of A.I.D. supported development abroad, there is little question but that resources invested in reducing population growth can contribute many, and perhaps hundreds of times more than different resources of equivalent value invested in increasing physical output. It is to be hoped that host governments will also come to see development this way. Generally, and initially within modest limits, funds should be shifted from output expansion projects to birth reduction projects if limited budgets cannot finance both.[35/]

Second, usable budgets for reducing births may be limited for several years by lack of participants. What appeals will evoke the greatest volunteer response per unit resource cost is most uncertain. Hopefully, many host countries will instigate educational campaigns, using many appeals and media. Eventually these resource-using campaigns might well be supplemented by bonus payment arrangements. But ordinarily it would probably be impolitic to use money appeals at the outset. Unfortunately, if host countries do not devote adequate resources and/or funds to

overcoming unwillingness rather soon, birth rates may fall no faster than death rates during the coming decade. Therefore, they should be encouraged financially to undertake projects that promote the use of contraceptives. Such promotion may require the purchase of mobile film projection units, special radio programs, instructive cartoon books, etc. Construction of small and dispersed clinics, assuming they can be largely staffed with a new kind of paramedic, should be planned and budgeted.[36/]

Third, "good" rather than "best" methods of contraception will have to be supported on request during the near future. Usually there is not enough information from LDCs to know how each method will rank as regards cost effectiveness if and when in widespread use. And it is not evident to what extent contraceptive studies of developed countries are relevant to undeveloped ones. There are always local peculiarities. Fortunately, and especially while programs remain small, enough is known to determine some of the promising methods. It will always be desirable to offer several. These are likely to include IUDs, vasectomies, condoms, and tablets. The use of condoms and foam tablets is not constrained by lack of qualified medics - but they require sustained motivation, a good supply system, and repeated outlays. One advantage of IUDs over vasectomies is that they seem to be vastly more acceptable. The best policy is perhaps to provide all these and other means or information of contraception, obtain all usage data possible, and reconsider in several years' time whether there should be greater concentration on fewer and particular methods. Experimentation is inevitable.

Fourth, lack of medically qualified persons to insert IUDs and perform vasectomies is almost certain to prove a bottleneck if there is to be more than a token birth reduction program. Unless prevented by opposition from the medical professions, training should commence as soon as possible of a new class of paramedics, able to provide these services. The kinds of men or women who should be trained, and the exact nature of their training, will vary for cultural and political reasons from country to country.[37/]

Fifth, deep sample surveys are needed in many LDCs to provde detailed information regarding family formation, frequency of exposure, context of intercourse, etc. Answers to attitude questions are needed too. These stratified samples could probably be as small as 1 to 5 thousand depending on variety and size of population and country. Without such samples it will be impossible to make more than very rough cost effectiveness rankings of methods.[38/] Organizing such surveys, to be undertaken by local organizations with U.S. technical assistance when necessary, might be one of the first "population" projects in cooperating host countries. There is likely to be greater local acceptance of U.S.-supported fact-gathering than contraceptive-dispensing projects for awhile. Moreover, if experience elsewhere is a guide, the results of such sample surveys could stimulate more serious interest in birth reduction by host governments.

Sixth, it is hard to conceive of beneficial support by A.I.D. of birth reduction programs without additional or different staffing in Washington and in some of the missions. Needed are people with experience or aptitude in public health, sample surveys, operation analysis, and economic resource allocation. An early task for any new or expanded group at A.I.D./Washington would be to evolve an operating manual for the guidance of designated population officers in selected missions.

Seventh, there are undoubtedly ways in which the CAPs and LASs should be modified so that better estimates could be made of the economic incidence of dependency in terms of unproductive consumption and reduced saving, rates of return on marginal labor and capital, and the monetary "worth" of reducing birth rates, etc.

Inevitably, birth reduction programs will be experimental for years to come, and hence they must be flexible. Projects must be assessed promptly, and others of the same kind expanded or contracted according to evaluation. This sort of administrative felxibility is only possible, A.I.D. necessarily being a large organization, if "population" continues to enjoy a not unimportant fraction of the time and attention of senior staff in this Agency.

CONCLUSIONS

1. Resources devoted to reducing the number of births that would otherwise occur can contribute many times more - perhaps a hundred times more - to raising per capita income than other resources of equivalent value invested in conventional development projects that increase output.

2. In the poorest LDCs the present discounted value to its economy and inhabitants of permanently preventing a birth may be from $100 to $200 more than annual per capita income. The value of postponing a birth by one year may be from $25 to $30 in such countries. These values are based mostly on the consumption costs that dependent and unproductive children ordinarily incur.

3. Preventing conceptions requires that fertile couples are or become able and willing to procreate less. A government can provide ability only through using resources. But part of the financial cost of promoting willingness can constitute resource-free bonuses that are transfer payments.

4. The costs of preventing conception during a phased five year program depend on contraceptive method used and are uncertain. Any cost estimates are most sensitive to a variety of assumptions. Perhaps the more economical methods involve a cost of about $2 per conception prevented over 5 years. The cost of preventing a birth during this period may be twice as great, or $4. The contraceptive pill is a much more expensive means.

5. There are two valid economic criteria for selecting the "best" contraceptive method. A cost effectiveness ratio, relating births prevented to necessary resource costs, determines the most efficient method <u>given</u> a budget. A higher optimization, treating the budget as a variable, would select among "efficient" methods that which yields a marginal birth reduction to marginal resource cost ratio approaching the value of preventing a birth. A method having moderate biological effectiveness - such as withdrawal - may have the best cost effectiveness ratio. But the higher optimization would reject withdrawal and might select IUDs. In practice, several methods must be offered. And what is "best" in terms of cost and acceptability for one couple may not be for another.

6. The extent to which resources can be invested in improving the ability of fertile couples to have fewer children is limited by the willingness of such couples to participate in a birth reduction program. Hence, because of the fantastically high returns on resources invested in reducing births to raise per capita incomes (#1 above), it is economical to incur financial costs to make birth control more acceptable. Some of these costs may also be resource costs - for mass media, lecture, etc. Other costs may be bonuses. Thus, bonuses can be given to women who remain non-pregnant - by whatever means they prefer. Bonuses amounting to several hundred dollars can be paid in cash or kind to certain men volunteering for a vasectomy.

7. For a "typical" LDC, halving the natural increase rate from 2 to 1 per cent a year could require a one-third reduction in fertility rates. A birth

control program to this end would have to include about one-half of the fertile women as participants - or their sexual partners. Thus roughly 8 per cent of the population would have to become involved.

8. For a phased 5 year program of this scope, the annual resource cost of providing the ability to reduce birth rates by a third could very roughly be about $1.25 for each participant. This approximates 10 cents per head of population a year. Other resource and financial costs to popularize family planning might increase these very rough estimates by two, three, or more times. The cost per capita of a really large program, implemented within 5 to 10 years, and involving millions of people now largely apathetic and occasionally hostile, can only be intelligent guesswork.

9. There is an urgent need for deep sample surveys, to obtain reliable data on family formation, sexual practices, attitudes, etc. The launching of birth control programs in LDCs that want them should not be deferred until such surveys are completed. But programs started now should later be perturbated to accord with the results of such research.

N.B. All estimates in this paper could be wrong by a factor of two. They will be refined so far as possible during coming months. The object of this paper, however, is not to furnish parameter values but to establish a sound method or viewpoint for future use by others.

FOOTNOTES

1. Irene Taeuber, demographic consultant to TCR, has written several informative memoranda for A.I.D. officials on the future consequences for population of current birth and death rates.

2. Historically, given special circumstances, a rapidly increasing population can be advantageous economically. Thus, Canada's population at the turn of the century was growing at a rapid rate. This was not a disaster because birth rates were low, death rates were even lower, much of the population increase comprised immigrants reared and trained at the expense of other countries, capital inflows accompanied this labor inflow, and natural resources abounded.

3. The proving of previously unknown mineral reserves through exploration should be considered a form of investment.

4. This approximation is more likely to be true the more closely factors of production are rewarded according to their marginal productivity.

5. This would be consistent with a savings rate from gross income ($\Delta K/V$) of 9 per cent and a not atypical K/V ratio of 1.5 for one year.

6. The true rate of return on capital in this example - not the ICOR - is accordingly about 14 per cent a year.

7. Thus some MDCs have savings to income rates of over .2 after allowing for depreciation. But they typically also have higher K/V ratios. So $\%\Delta K$ for an MDC is not necessarily greater than for an LDC.

8. In such a country, for every sample 100 persons, there is an aggregate output worth about $10,000. Perhaps 10 per cent or $1,000 of this is saved and invested. The roughly 40 children under 15 years of age consume $40 worth each or $1,600 altogether. This leaves $7,400 for consumption by 60 adults of both sexes, or $123 of consumption by each on an average. This means that the over 15 year olds would be consuming more than 3 times as much as the under 15 year olds. Accordingly, in a country with the usually high dependency ratio and an annual per capita income of $100, an estimate of $40 consumption annually per boy or girl under 15 years is probably low.

9. A further benefit from reducing the number of dependents, but of second order importance, is that some small fraction of the consumption thus "released" may be invested in capital assets. If 10 per cent of the $40 released is invested, and this investment of $4 each year in turn earns 15 per cent a year compounded, additional assets worth $223 will have been

accumulated at the end of 15 years. At 15 per cent rate of return, this would provide extra income from capital worth $33 after 15 years, and having a present discounted value of about $4.

10. This again assumes $40 a year consumption for 15 years, after which the girl or boy supposedly becomes adult and self-sufficient. At 10 per cent discount the saving is $25 and at 20 per cent it is $31. The source of the saving is the displacement in time by one year later of the whole consumer cost stream otherwise attributable to the unborn infant.

11. Thus per capita incomes in some obviously overpopulated Asian countries are not significantly below those of some not obviously overpopulated African ones.

12. Of course there is no "typical" infant. It is either male or female for example. So estimates have to be made in terms of a representative sample of, say a thousand infants (as described below).

13. A more precise statement of what is meant by "worth" and especially "worth to whom", is included below (pp. 29 - 30).

14. A vasectomy sterilizes the male by cutting the vas ducts. This operation can be performed quickly under a local anesthetic and does not require hospitalization. The comparative cost effectiveness of other birth control measures are considered later.

15. An average value for f over 7.5 years is taken because in this example N is 15 years. In a more accurate formulation the average survival rate to 7.5 years of age should be multiplied with f. Second generation effects are ignored.

16. Because $\Delta P/P$ is a stock, and $\Delta Y/Y$ a flow, this ratio increases proportionately with the length of the assessment period, N.

17. A young wife's position in her husband's family may be inferior until she bears him a son. Generations of high infant mortality have made it traditionally desirable to bear many babies. Rural peoples everywhere, and especially agriculturalists, consider fertility a boon rather than a burden. Sons, and even daughters, are still viewed as a form of old age insurance in most LDCs. And, in societies where loans and jobs tend to be given to relatives rather than "outsiders", large families are often regarded with favor.

18. See pp. 31 - 32; Also References annexed.

19. See p. 31 below; also References annexed.

20. An annual exposure frequency of 50 is used in this table. What this should be for typical participants in a control program is very hard to estimate. But there are indications that exposure may be lower. Many LDCs publish fertility statistics showing rates of about .25 annual births per woman in the fertile 20 to 30 year age groups. Allowing for 10 per cent who are not exposed, or do not conceive from intercourse with their partner, this gives a more meaningful fertility rate of .275 a year. Perhaps .5 of all conceptions result in miscarriages, induced abortions, or still births. This gives a conception rate of .55 a year for this subset of women. Perhaps each conception results in 6 months on an average during which "reconception" is impossible. Then these women are pregnable about 9 months of each year. But .55 conceptions in 9 months, allowing for 4 conceptions in 100 acts of completed intercourse as a rule of thumb, means an exposure frequency of around 20 per year. Otherwise, if frequency of intercourse is really much higher, there must be extensive practice of primitive contraception (e.g., withdrawal) <u>or</u> published fertility rates are understatements.

21. The rates for condom, diaphragm (cap), rhythm, and condom are based on data published by the Population Council, but for groups of women whose experience may not be pertinent to every LDC.

22. A five year conception rate of 2.50 is consistent with the considerations outlined in Footnote 20.

23. This is assumed to be a phased 5 year program, with the same number of participants being added each year, with no terminations. Thus the annual "variable" expense will increase each successive year. The 5 year budget is not expended at a uniform rate.

24. Application of the economic criterion to IUDs and vasectomies is not affected by uncertainties regarding the number of conceptions there would be if no controls are practiced.

25. The logic of this analysis is not impaired because condoms and caps are apparently represented by "inefficient" scatter points in Figure 1.

26. Greater effectiveness per dollar of resources may in time come from concentrating on the "harder" cases of acceptance.

27. A transfer payment is a payment for something other than productive services and does not ordinarily affect output of goods and services.

28. There is a strong atavistic repugnance attached to the idea of reproductive powers being "sold". It is generally considered proper to spend resources to persuade a man but not to give him money directly. Thus bonuses might have to be paid in kind rather than in cash - examples being so many extra years of schooling for the eldest boy, equipment for agriculture of equal value, etc.

29. Within extended families so typical of many LDCs there is an artificial economic incentive to have excessive children that can best be countered by a bonus perhaps. In these families young married couples live within the household of either the husband's or the wife's parents. In that household there will be other young married couples. All contribute labor and outside earnings to the older head of the extended family. Under these circumstances each extra child that a young couple has affects their consumption, and that of their own children, only a little. All their children's cousins and aunts and uncles then eat less too. However, when the youthful parents have become old, their children will be grown and mature enough to support them in their last years. Hence, to the couples having them, infants are not much of an immediate liability and potentially are an asset. A countervailing bonus, especially if held in trust, bearing interest meanwhile, and denominated in real terms as a safeguard against inflation (e.g., sacks of grain), might prove effective if generous enough.

30. In India modest compensation is paid to vasectomy volunteers who have the consent of their spouse and some living children. This payment is ostensibly to compensate for loss of work following the operation. But sick leave is not necessary and the payment is in a reality a bonus.

31. Credits are temporarily blocked to ensure that a bonus based on permanently preventing a birth is not paid out in cash to a woman who it later proves has only postponed a birth (see "The Gains to India from Population Control: Some Money Measures and Incentive Schemes", Review of Economics and Statistics, May 1960).

32. It is to be hoped that favorable reactions to the program will over time increase the number of exposed women and their men who wish to participate in birth reduction programs. If the supply schedule of volunteers shifts to the right, the bonus can be cut. The elasticity of supply is most important because, if bonuses are offered to anyone, they must be available on equal terms to everyone.

33. Translating crude birth rate decreases into age-specific decreases in fertility is impossible over time without detailed assumption regarding age-specific death and fertility rates. A reduction in birth rates after 10 years say lowers the fraction of population under 15 and increases the fraction of fertile population. Thus the crude birth rate could rise without any changes in age-specific fertility rates.

34. If the following "conclusions" are stated dogmatically, it is only for brevity's sake and to surface the issues.

35. This does not mean that projects for improving population quality through better education and health should concede to projects for decreasing population quantity. The relative merits of resource expenditures for these two purposes is most uncertain. What does seem definite is that it is better to invest in people (through training, etc.) than it is to invest for them (through factories, etc.).

36. In larger towns there are likely to be older buildings that could be converted. However, a newly constructed building is more likely to attract volunteers, if not too grand and forbidding. It would also serve to underline the importance hopefully ascribed by the host government to its national birth reduction program.

37. Whether birth control clinics should be closely associated with public health clinics is a complex question not considered here. Perhaps contraceptive and pediatric clinics should be. Many fertile and exposed women might be contacted regarding contraception if and when they bring existing children to the clinic for examination or treatment. Psychologically, if a clinic is known to provide child care, the place and its staff may be more accepted when it comes to facilitating and promoting birth prevention.

38. Having the sort of data that are logically required, one could then reconstruct Table 1 and Figure 1 with some confidence.

REFERENCES

The following works by the author underlie some of the analysis and suggestions contained in this paper.

"The Gains to India from Population Control: Some Money Measures and Incentive Schemes," Review of Economics and Statistics, May 1960.

"The Economics of Government Payments to Limit Population," Economic Development and Cultural Change, July 1960.

"Government Bonuses for Smaller Families," Population Review, July 1960.

"Reply to Demeny's Comment on Vasectomy-Bonus Schemes," Economic Development and Cultural Change, July 1961.

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"Some Misconceptions of Krueger and Sjaastad Regarding the Vasectomy-Bonus Plan to Reduce Births in Overpopulated and Poor Countries," Economic Development and Cultural Change, July 1962.

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Economics for Development, Prentice Hall, 1963, Part IV.

Table 1

HYPOTHETICAL COSTS AND EFFECTIVENESS OF ALTERNATIVE CONTRACEPTIVE MEASURES DURING A PHASED FIVE YEAR PROGRAM

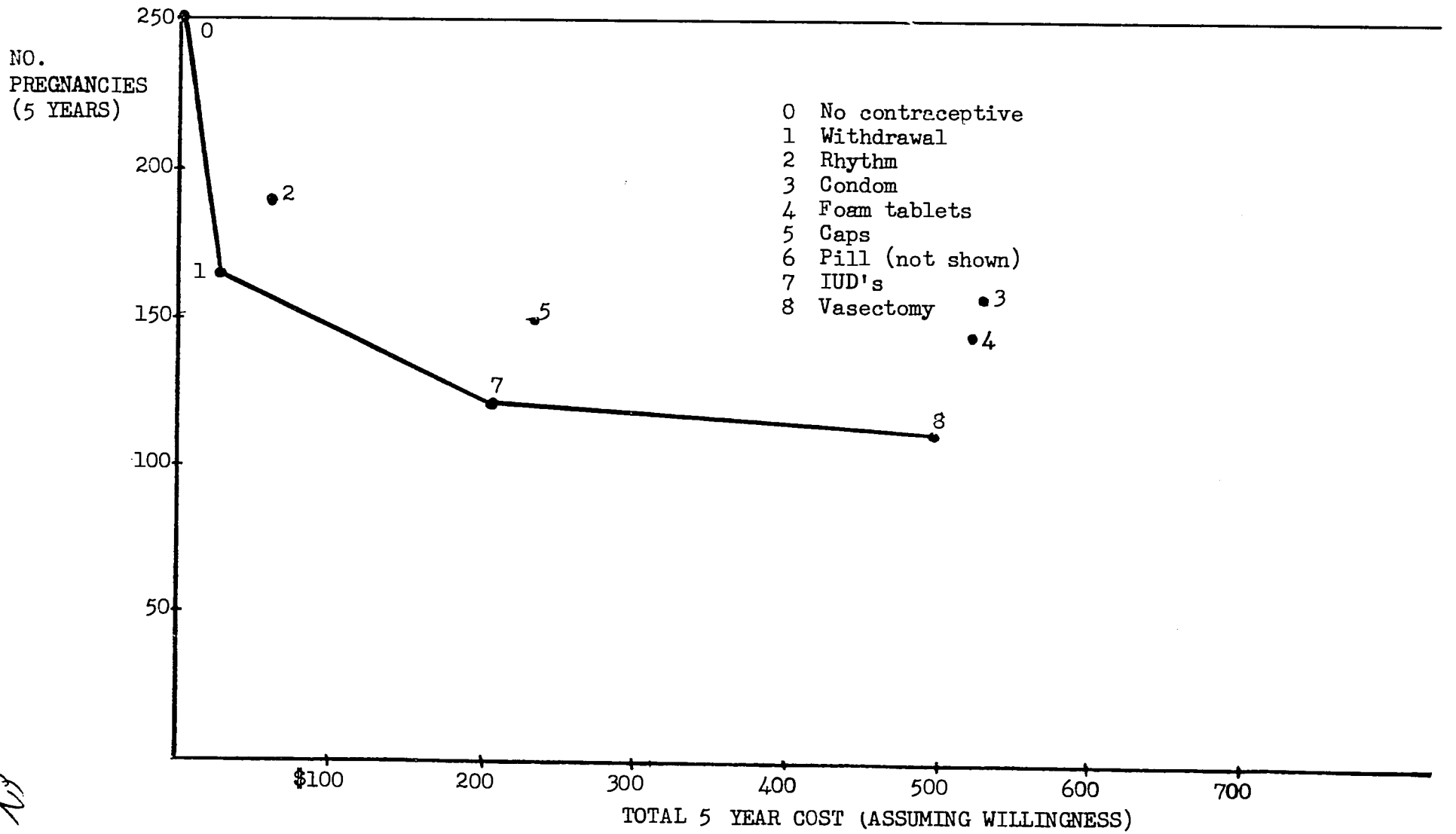
	(1) Fixed Starting Cost per Couple	(2) Variable Annual Cost per Couple	(3) Phased 5 year cost per 100 Couples	(4) Expected 5 year Pregnancies per couple	(5) Phased 5 yr. Prevention of Pregnancies per 100 Couples	(6) Cost per Prevented Pregnancy	(7) Number Customers Assisted per $1 m (000)	(8) Pregnancies Prevented per $1 m (000)	(9) Births Prevented per $1 m (000)
0. Zero Birth Control	$. 0	$ 0	$ 0	2.50	0	0	0	0	
1. Withdrawal	.25	0	$ 25	.84	85	$ .29	4,000	3,400	1700
2. Rhythm	.50	0	50	1.9	30	1.7	2,000	600	300
3. Condom	.25	2.5	650	.69	90	7.2	150	139	70
4. Foam Tablets	.40	2.4	640	.50	100	6.4	156	156	78
5. Caps	2.50	.0	250	.72	90	2.9	400	350	175
6. Pills	.50	24.	6000.	.3	110	55.	170	18	9
7. IUD	1.0	.40	200	.1	120	1.7	500	600	300
8. Vasectomy	5.0	.0	500	.01	124	4.0	200	250	125

NB - These magnitudes are good at best to one significant digit. The variable costs assume about 50 exposures a year. Fiscal starting costs include "education" of the subject plus cost of supplying and perhaps inserting any "permanent" device good for many exposures. No account is taken of possible deaths or reconsorting during the year. One-half of all conceptions are assumed to result in early miscarriages, abortions, or peri-natal deaths. No allowance is made for drop-outs. Practically, because of uncertainties regarding costs and performance, these assumptions have limited significance.

Figure 1

HYPOTHETICAL PREGNANCY REDUCTIONS AND COSTS ASSOCIATED WITH DIFFERENT CONTRACEPTIVE METHODS PER 100 ASSISTED

(Phased 5 Year Program)



Source: Table 1