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CENTER DISCUSSION PAPER NO. 187

POPULATION GROWTH, OUTPUT GROWTH AND DISTRIBUTION OF INCOME

R. Albert Berry

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surrounds the issue for the reason that, whereas on many issues economists can legitimately assume that their contribution extends only to measuring impacts of policy variables on total income and its distribution, when policy may affect the population size that assumption no longer holds. The economic component of a society's welfare is assumed to be related to income per capita⁴ and its distribution; when population is exogenously given, a policy which affects total income affects income per capita in the same direction; when both economic variables and population are affected by a

given level of techniques per capita income will be lower in a densely populated country than in a less densely populated one. But technical progress can raise per capita income in a densely populated country as readily as in a less densely populated one, even though because of diminishing returns to capital the rate of rise, ceteris paribus, may be somewhat slower. Moreover, rapid population growth is not a bar, and perhaps not even a hindrance, to rapid rise in per capita income. In recent decades, the rate of rise in per capita income has been as high in densely populated countries as in less densely populated ones, and in countries with rapid population growth as in countries with slow population growth.

These are somewhat startling conclusions. Stated in starkest form, they seem to say that while initial population density matters somewhat, the rate of population growth does not matter at all. Is it really possible that the "conventional wisdom" about population is simply wrong? That the fear of the consequences of population growth is based on an uneasy unconscious alarm at an inexorable process, and not on rational considerations?" (p. 269)

"Moreover, economic logic, if not the recent statistics, suggests that population density does make the task of increase in income somewhat more difficult. Economic logic suggests that, innovational energy and ingenuity and the rate of capital formation being equal in two countries, the rate of increase in the more densely populated country would be expected to be lower and therefore the "income gap" between them would be expected to increase indefinitely. "

Hagen, incidentally, presents a scatter graph (p. 268) which he feels "suggests neither a positive nor a negative correlation between the growth of per capita output and population growth." A few far-outriders among these countries leave open the possibility of a fairly significant negative correlation; much depends on how these outriders are to be interpreted. (p. 270)

⁴ Or per adult equivalent or some related measure.

policy, this is no longer necessarily true and a new and complicated problem enters the analysis. Among countries with the same per capita income (and distribution) is social welfare--assuming that is the variable to be maximized--greater the larger the population? If the answer to this question is yes, and it would seem logically that it must be, then discussions of population policy cannot focus solely on income per capita (and distribution). The objective function must also include population, i. e. social welfare is a positive function of the welfare of each person, so the more people a country has at a given level of welfare, the higher is total social welfare.

Population policy raises, in a sense, a new problem of interpersonal comparisons; one between people who now exist or who definitely will and others who will or will not exist according to the policy measures taken. And it underlines again the need not only for a cardinal utility concept (a necessary but not sufficient condition to permit any interpersonal comparisons) but also for a concept of zero level utility rather than just cardinal measurement of utility changes (all that is necessary to permit the interpersonal comparisons necessary in this context of policy measures which do not affect population).

Suppose, for example, that a population control policy presents a country with two alternatives, the second involving a lower population and higher income per capita than the first. Clearly if in the first state, (abstracting from questions of distribution) the average utility level is zero, but utility is a positive function of income, the second state is superior. The same would be true if everyone were at a negative utility level in the first state. But the choice is more complex if utility is

positive in both states. If social welfare (W) is a positive function of the welfare of each individual-- W_1 to W_n --and the welfare of the i th individual is a positive function of $c_i - k$, where c_i is the consumption of the i th individual and k is a consumption level at which utility is zero, then (a) it is always better to have more people than less at a given c level ($c > K$): (b) whether the social (total) welfare derivable from a given national income is greater with more or less people depends on whether the marginal utility of income is rising or falling in the relevant range; if it is falling, welfare rises with population.

To summarize, if it may be assumed that the typical person in a society for which population policy decisions are being made has a positive level of utility, then the inclusion as arguments in the objective function of the welfare level of each individual, and the presumption that social welfare is a positive function of the welfare of each individual implies that social welfare depends both on average welfare of the individuals and on the number of people. Income per capita is obviously an inappropriate indicator of social welfare under such circumstances, and in fact the typical situation might be represented (see Figure 1) as involving a choice between higher population and higher income per capita, and therefore necessitating indifference curves between these two variables to make the policy decision. A policy which

¹At this point we for simplicity assume no interrelationships in consumption, i.e., we assume that each individual's utility is a function only of his own level of consumption, and disregard such complexities as would result from consideration of unequal distribution of income.

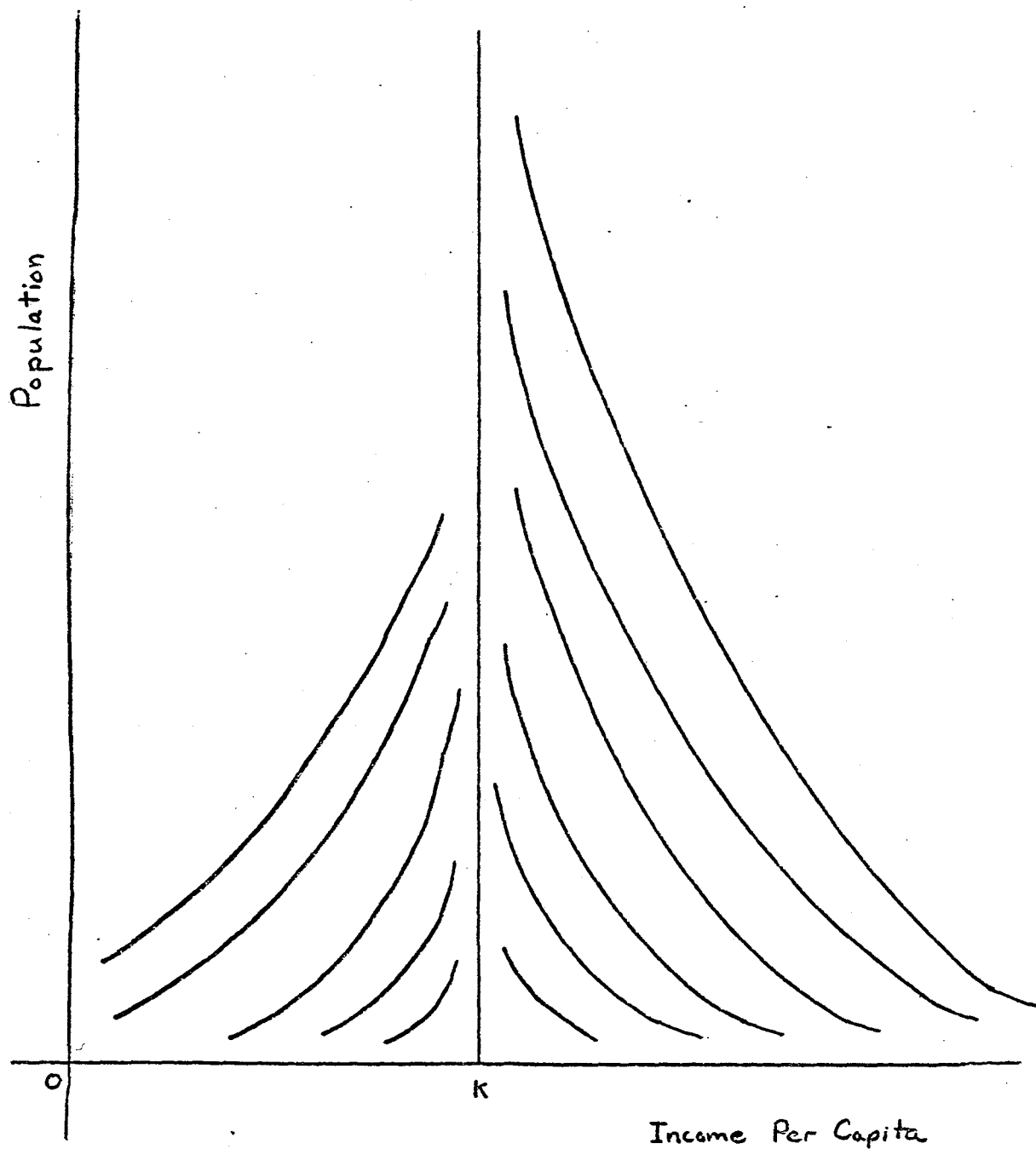


Figure 1

increases both variables clearly dominates a policy which does not. If the per capita income level below which utility is negative is indicated on the figure by K, the iso-social welfare curves will have a negative slope to the right of this point and a positive slope to the left of it, as drawn here. In the portion of the figure to the right of K, the "indifference curves" or iso-welfare curves would be linear if the marginal product of income is constant and equal for everyone, (or more specifically equal between existing population and new population as one moves up and to the left along the curve); it would be convex down if marginal utility of income is increasing and concave down in the opposite case. It may well be that the marginal utility has a more complicated form; in that case the iso-welfare curves would have a more complicated form.⁵

We do not pursue here these psychological issues; the only objective is to note that the nature of the choice involved in population policy is roughly speaking that indicated in Figure 1, and that in order to make the decisions intelligently it is clearly necessary for someone to have his own subjective judgments with respect to the nature of the iso-social welfare curves.

It is useful, before proceeding to narrower issues of population policy, to categorize briefly some of the major threads in the literature on this issue, in terms of

⁵ This highly oversimplified and stylized version obviously does not take into account any interactions among people in consumption; it might strike most people as plausible to assume that with a very low population level something is lost from simply not having many people to interact with; this may be true, although it must be borne in mind that the absence of economies of scale in production should show up in the measured income per capita itself. Economies of scale in consumption would still have to be allowed for.

how they have dealt with the issues just raised and in particular with (a) the need for an implicit assumption as to the level of income at which, if a new person is added to the population, total social welfare is increased, and (b) the question of whether marginal utility of income for the representative person tends to be rising or falling. Issue here is somewhat akin to the question of whether the members of a rich country have responsibility for the welfare of members of poorer countries when e.g. the latter wish to migrate to the richer countries and for some reason their so doing would lower the welfare level of the current residents of those countries. Most economics pre-supposes that the obligation of policymakers in a country is exclusively to maximize the welfare of the members of that country, but there is no particular moral or philosophical basis for such a judgment. It is rather one of convenience and adequate description of reality.

In ascending order of what might be called "completeness of framework" we distinguish the following types of discussion, none of them "wrong" per se but some potentially misleading if the conclusions are interpreted as being complete ones, something author's frequently do imply.

1. Analyses of the relationship between (a) size of population or its rate of growth and (b) per capita income levels and/or the rate of growth of that variable. This sort of analysis is of course a necessary component to any overall judgment on population policy, but it is important to remember that it is only a component and not the full story. Thus the empirical studies of this relationship on over time or cross-sectional bases are important. Those which conclude that a negative correlation between the two variables is per se a sufficient argument against population growth

are open to criticism.

2. The benefit cost studies of population control. Per se, of course, the use of benefit cost terminology is simply a way of describing the results, and does not imply anything about the objective function used (i. e., how the benefits and costs were measured). In fact however, much of this literature can be categorized together since it has tended to use a specific implicit manner of defining benefits which is inconsistent with the above discussion. One tendency has been to refer to relative effectiveness of investment in output increasing and in population reducing directions, where equal effectiveness is defined by the achievement of a given income per capita figure.⁶ The use of such a criterion obviously biases the results in favor of population control if the utility of the representative person at the average per capita income of the country in question is positive. It presumes that total welfare is the same for two populations with the same per capita income, regardless of the total population.

Other benefit cost analyses compare the present value of a person's expected future contribution total output (his marginal production) with the present value of his expected future consumption. The underlying welfare function is ambiguous, but the focus seems frequently to be on the impact of the additional person on the welfare of the rest (per se an implausible criterion as just discussed) or on the impact of that person on the system's savings potential--also per se unsatisfactory.

3. Over life utility analysis of a country's existing population.⁷ This

⁶ An example of this approach is Stephen Enke, "The Economic Aspects of slowing Population Growth" Economic Journal, Vol. LXXVI, March 1966.

⁷ Examples of this type of analysis include E. Phelps, op. cit.

analysis has clear advantages over both the preceding categories, the goal is an overall appraisal of the situation; it permits, for example, taking into account the fact that while children may lower per capita consumption and income in the short run they may have over-lifetime benefits for their parents associated with the increases in the rate of return to capital which the higher L/K ratio implies; but the analysis does not deal with comparisons of welfare across different population sizes; it manages to hold population size constant by appraising exclusively the welfare of the existing population and focussing on what population growth rate is, for them, the optimal. It could be argued--and it would be a valid parallel with the nature of "national economics"--that this is the relevant question. But it is clear that many of the people involved in the discussion of population feel that the issue should not be so circumscribed.⁸ The many discussions of the appropriate level of the social rate of discount--and a basic component of this discussion is philosophical--cannot be avoided.⁹

⁸ This is not to deny that under certain special conditions it may be the case that maximization of one generation or one group's income is consistent with maximization of another group's, and that it therefore becomes irrelevant what their relative marginal utility of income is; but these are strikingly unlikely conditions.

⁹ It is both a strength and a weakness of some examples of this form of analysis that children are treated as objects producing utility for the parents. Failure to allow for this presumably positive contribution to parental welfare is a weakness in much of the other analysis (which implicitly assumes it to be zero) but the implicit assumption that the utility level of the children is per se to be disregarded obviously represents an incompleteness in the analysis. But, as in other types of analysis, each of the approaches makes contributions to the overall question, and the only danger is in assuming that any one can contribute the full answer.

4. A complete analysis must take into account the total cardinal utility or social welfare over time corresponding to different combinations of population size and income per capita at different points of time; the analysis must make some presumption about whether and where, in terms of consumption levels, the zero utility level is reached, and about the over time social rate of discount--which is necessarily equal to the interest rate.

The benefit cost analysis has focussed very much on comparisons of specific population programs versus other forms of investment.

And, as ~~reserved~~, one implicit value judgment in most benefit cost analysis of population programs is that social welfare is a function exclusively of income per capita and not of population size, a dubious presumption, and one almost inconsistent with the general presumption of economics that "people matter"; but this strange assumption by no means precludes one's drawing ~~useful~~ results from this form of analysis, if only because it is usually fairly simple to make the adjustment which the reader feels necessary to such analysis to convert it to his own different framework. A second adjustment typically necessary is for the failure to assume any direct utility derived by parents from children. Finally, of course, such calculations do not go beyond the analysis in terms of income per capita to consider, for example, the long run positive effects ^{for} the current generation of high population growth leading to a high rate of return to capital. The implicit presumption, one might say, is that if income per capita can be moved to a higher level at a given point in time, that will raise the probability that it will ~~subsequently~~ be higher for all age cohorts. ¹⁰

¹⁰ In Enke, *op. cit.* parental utility from children was implicitly taken into account when he indicated that the effectiveness comparison he was making between investment in a population program and investment in dams, steel plants, etc., pertained only to the policy of aiding and permitting parents to limit families to the

When actual benefit calculations are made, necessary to compare with cost figures or to generate internal rates of return,) the frequent assumption is that the benefits are composed of the present value of consumption "released" by not having the child.^{10.1} where the analysis goes beyond the childhood period, the marginal productivity of the person in the labor force for the rest of his/life may be discounted and subtracted from the consumption costs. When the analysis is in the context of a labor surplus economy, the difference between consumption and marginal productivity may be negative through the individual's whole life, so negative value must therefore be calculated. In the opposite case a positive value would usually emerge; in non-labor surplus economies the discount rate becomes a key factor.^{10.2} Harvey Leibenstein, in criticizing some aspects of the benefit/cost analysis, refers to the ambiguity and the unsatisfactory nature of the welfare analysis involved in assuming that avoiding consumption is a benefit to an economy.^{10.3} He argues that we cannot handle such

size they really prefer. In other words the marginal children to whom the calculation refers implicitly produced negative utility for the parents. In relation to this goal of maximizing income of the present generation, his ratios underestimate the average productivity of the population program. But the analysis was still not complete in the sense mentioned earlier.

^{10.1} See Enke, op. cit.; . . . Note that it might not be appropriate to both treat this as a benefit and to treat "disutility of parents avoided" as a benefit, since presumably the consumption the child would undertake is one of the determinants of that parental disutility which the birth would avoid.

^{10.2} Note that the implicit welfare assumption in the analysis which compares benefits (as defined by the consumption foregone of the individual) and costs is that direct utility of the person whose birth is prevented is either zero or irrelevant to the consideration.

^{10.3} Harvey Leibenstein, "Pitfalls in the Benefit Costs Analysis of Birth Prevention" Population Studies . . .

ideas without initially having some social welfare criterion which includes children as such, as well as the consumption goods, as variables in the objective function. ^{10.4}

He disapproves of the frequent failure to distinguish in benefit cost analysis between the 6th or 7th child, frequently unwanted by the family, and the first or second. To the extent that the issue is what the family's utility is from the child, it is satisfactorily taken care of in the Phelps type analysis of the present value of the over life income or welfare stream of the existing generation. To the extent that, regardless of parental utility, a society should presumably be interested in the income of a child who might be born, it is not taken into account by the Phelps' analysis. Leibenstein notes also "the mere fact that a birth is not wanted does not make it socially undesirable without some initial criterion which leads to this conclusion."

Leibenstein also disputes the implicit assumption that the prevented birth is of a person who, if born, would be a marginal worker^{10.5}, especially since the effects of a

^{10.4} In later dynamic models Enke defines the benefit in any year as "the difference in GNP per head with and without birth control multiplied by the population with contraception." (Presumably the studies referred to include S. Enke and R. G. Zind, "The Effect of Fewer Births on Average Income", Journal of Biosocial Science, No. 1, 1, January 1969, p. 41 and "Birth Control for Economic Development", Science, May 16, 1969.) He notes that with these dynamic models, where for example the effect on savings is taken into account, benefit cost ratios of 80 or so are not uncommon over 30 years.

In his reply, Leibenstein notes specifically that "the existing population must be considered, as well as intra and intergenerational preferences. It is difficult to see why there should be any special significance in maximizing GNP per head of the existing population unless we view all future additions to that population as slaves." Adding the money value of the psychic value of children does not patch up the situation. "It seems to me that the entire analysis has to be carried out in terms of psychic values or utilities and not in terms of the monetary value of the "psychic value" of children."

Leibenstein presents a diagram (page 118) very similar to mine although his context is the discussion of when the BC ratio will and will not favor a smaller population size.

^{10.5} Ibid, p. 165.

Table 1

Labor Share and Income Equality in Large Population Compared with Small Population
(Equal Capital Stock in Each Case)

Elasticity of Substitution Between Labor and Capital

Concentration of Capital in Large Population Case Compared with Small Population Case	∞	1	0
Same	Wage Rate - Same Labor Share - Greater Distribution - Better	Wage Rate - Lower Labor Share - Same Distribution - Same	Wage Rate - Lower Labor Share - Zero, unless there was a capital surplus before Distribution - Worse
Less Even	Wage Rate - Same Labor Share - Greater Distribution - Better or worse depending on how much less even capital concentration becomes	Wage Rate - Lower Labor Share - Same Distribution - Worse	Wage Rate - Lower Labor Share - As above Distribution - Worse
More Even	Wage Rate - Same Labor Share - Greater Distribution - Better	Wage Rate - Lower Labor Share - Same Distribution - Better	Wage Rate - Lower Labor Share - As above Distribution - Better

planning program might fall much more readily on middle class workers than marginal ones.^{10.6} Leibenstein argues further, that the cost of acceptance and achieving a prevented birth are very much understated in the analyses carried out thus far; substitutability among techniques of population control is one factor leading to underestimates of the cost of acceptance. In his rejoinder, Enke suggests strongly that it is the poorest who are in need of assistance if they are to use contraceptives, so that any income redistribution is from the better off to the worse off.^{10.7}

Even in terms of the level of discussion corresponding to point (1) above, we are surprisingly in the dark. Few empirical studies have tried to relate, either in a sophisticated econometric fashion or otherwise, the rate of growth population and the rate of growth of product or its distribution.^{10.8} Among the few which have attacked the problem directly is one by

^{10.6} Correspondingly, a family planning program financed out of general taxes could benefit the responsive middle class families at the expense to some extent of the poor.

^{10.7} S. Enke, "Leibenstein on the Benefits and Costs of Birth Control Programs".

^{10.8} Simon Kuznets in a 1966 study, questioned the by then more or less conventional wisdom that population growth deters economic development by pointing out that an over time analysis of a cross section of 11 now developed countries did not suggest this; with respect to the half century prior to World War I he observed no relationship between the population growth rate and the rate of growth of income per capita. (Simon Kuznets, "Quantitative Aspects of Economic Growth of Nations, Part I: Levels and Variability of Rates of Growth", Economic Development and Cultural Change, Vol. 5, No. 1 (October 1956), p. 30. But it is not surprising (for a variety of reasons) that there be no apparent relationship for the new developed countries. Kuznet's analysis was partial since it did not distinguish countries according to their original man/land ratios nor consider other possibly important factors. Since the period in question witnessed substantial migration from the high population density countries to the low ones, there are serious identification problems which mean that these data tell us little or nothing about the implications of population growth in the individual countries; other things were too far from being equal. Countries with rapid growth in income per capita both pulled migrants to them and generated little pressure to keep family size down.

More recent evidence limited to the underdeveloped countries, where migration is not an important phenomenon are presumably more relevant. Easterlin (op. cit.) looking at 37 countries in the period 1957-58 to 1963-64 found no relation between real per capita income growth and rate of population growth. But a number of these countries

trade

suffered considerable terms of effects during this period so that the rate of growth of their per capita output and per capita income may have been substantially different; the population hypotheses relate to output.

Views as to the effects of population growth over the long sweep of history are very disparate, not surprisingly in view of the limited information with which judgments can be made. Hagen (E. E. Hagen, "Population and Economic Growth," American Economic Review, June 1959, No. 49, p. 310-27.), at the one extreme, argues that income induced population growth has nowhere prevented even a moderate increase in aggregate income from leading to an increase in income per capita. The present day relevance of such a comment seems open to question, since it is doubtful that prior to the 20th century conditions would have permitted the population growth rate to accelerate very fast even in cases of fairly rapid growth of income per capita; even in the period 1900-World War II the model rate of population growth for peasant societies was only 0.5 to 1.0 percent; with a relatively rigid population growth rate Hagen's conclusion would be more or less a foregone one. But this is not to say that the gains from a burst of growth during one period might not be wiped out if population growth then accelerated and retained that higher (but still not rapid) rate of growth over a longer period of time.

At the other end of the spectrum Spengler (Joseph A. Spengler, "Demographic Factors in Early Modern Economic Development," Daedalus, Spring 1968, p. 433.) implies that the speedup in the rate of growth of income per capita in Western Europe in the early modern period may have been the result of the relatively low birth rate which followed on the development of a pattern of later marriage there (sometime between the 14th and 17th centuries) than that found in Eastern Europe or outside Europe. It appears that Western European birth rates were rarely over 38 even before the spread of birth control. Higher birth rates in other regions such as Asia between 1650 and 1900, did not imply a faster population growth than in Europe, but rather higher birth and death rates and therefore higher dependency rates.

Perhaps more work has been placed on analyzing the impact of economic development on population growth than vice versa. The fact that both relations may be rather strong creates a severe identification problem. One recent attempt to relate socioeconomic development to population growth is that of Irma Adelman. (Irma Adelman, "An Econometric Analysis of Population Growth," American Economic Review, Vol. LIII, June 1963, p. 314.) This cross country study relates age specific birth rates to income, level of industrialization (associated with the level of urbanization), an index of education, and population density; it relates age specific death rates to income, rate of change, industrialization, and health. The multiple regressions indicate that age specific birth rates tend to vary directly with per capita income in the long run, negatively with the socioeconomic phenomena associated with the urbanization process and with education and negatively with population density. Death rates bear a negative long run relation with economic conditions, also with urbanization and industrialization, and with health care. Putting these results together the author concludes that the influence of socioeconomic variables on the demographic features of a society is much smaller than the effect of population growth upon economic development; thus one would not expect population increase to wipe out gains from increased income per capital. Unfortunately it must be borne in mind that the cross country information on which any such study is based is still quite rough.

Kuznets.¹¹ He found a positive rank correlation between population growth and economic growth among 21 countries of Asia and Africa (excluding the more developed countries of Israel and South Africa), among 19 countries of Latin America, and among the 40 countries treated as a single group. The correlations are not statistically significant, but Hagen considers that the absence of negative correlation is significant. (Here it must be ascertained whether Kuznets used total income or per capita terms). While empirical research may eventually throw new light on the relationships, the number of other factors affecting output growth and distribution is impressive and it would be optimistic to assume that they could all be appropriately allowed for in a statistical analysis. At present the empirical studies on the relationship still suffer too many such problems to furnish convincing conclusions on the nature of the population growth-economic performance links. Correspondingly, careful theorizing, and empirical work which throws light on specific (possible) links in the chains of causation between demographic and economic variables may be useful.

In this paper we effect a simple (perhaps superficial) classification of the ways in which population growth would be expected to affect growth of output, distribution of income, and employment in three familiar economic models, i. e., the neoclassical model (defined here to refer to a model with perfect factor and product markets and the resulting absence of unemployment)¹², the Keynesian model, and the labor surplus

¹¹ Simon Kuznets, "Population and Economic Growth", Proceedings of the American Philosophical Society, No. 3, (June 1967), p.170.

¹² At various points in the discussion we note how the results are affected by market imperfections (monopoly, etc.) of the type which do not prevent market clearing; "Keynesian" type imperfections which lead to involuntary unemployment are dealt with separately.

model. The discussion of the first two is in part designed to lead up to the labor surplus case, since that model or something akin to it appears relevant for many underdeveloped countries (especially some of the densely populated ones). In the context of each model static and dynamic implications of population growth¹³ are distinguished. Finally, summary comments are made on the state of empirical knowledge with respect to the relevant coefficients.

Most of the discussion is, therefore, at the level of No. 1 above, i. e., simply trying to appraise the relationship between population growth and income per capita^{13.5}

¹³ It may be assumed that the once familiar concept of the "optimum population" is not now considered very relevant in discussions of the population question in underdeveloped countries; the rate of population growth appears to have substantially more relevance than the absolute population. The optimum population concept is a static one; objections to and limitations of this and related concepts are well presented in United Nations, Determinants and Consequences of Population Trends, New York: United Nations, 1953, pp. 233-38.

Although the "optimum population" theory in its simplest version is not very relevant--it essentially assumed that capital and technology were fixed--the basic idea of the possibility of increasing returns to scale must not be neglected. A handy synthesis of this concept and the possible relationships between rate of growth of population and of capital is presented by Ohlin. (Goran Ohlin, Population Control and Economic Development, Development Center of the Organization for Economic Cooperation and Development, Paris 1967, p. 61.) (He does not, however, analyze in detail the determinants of this relationship.)

One suggested index of overpopulation, though not necessarily a measure of the negative effects of overpopulation, is the total dependency ratio, i. e., number of people under 20 and over 65 relative to the number of people of 20-64 years. It is suggested by David R. Kamerschen, ("On An Operational Index of Overpopulation", Economic Development and Cultural Change, January 1965, p. 169) that a country is overpopulated if this ratio is greater than 100. Kamerschen's position seems to represent an invalid line of thought: that because the variable suggested may be correlated with overpopulation as appropriately defined in some more basic sense, it is a good one to use. This latter contention could, of course, have interest, but it needs to be demonstrated before such a rule of thumb approach should be taken.

^{13.5} One of the earlier quantifiers of the implications of population growth was Stephen Enke, e. g., "The Economic Aspects of Slowing Population Growth," Economic Journal, March 1966.

and its distribution. It could be quickly broadened to include the implications of total population

The relevance of the direct utility deriving from children is taken into account and discussed.

A. (1) Demographic and Economic Variables in the Neoclassical Model: Static Analysis

Since in the neoclassical model with freely working markets there is no unemployment problem, the economic variables of primary interest are per capita income and distribution of income. If constant or decreasing returns to scale prevail, then decreasing marginal productivity of each factor characterizes the equilibrium state for a firm, an industry, or the economy as a whole; under such conditions a higher population would, at a given point in time, imply a lower average income per capita since it would imply a lower "other factors/labor" ratio.¹⁴ Increasing marginal productivity of labor for the economy can only occur when there are increasing returns to scale (except under the rather implausible circumstance where the marginal productivity of some other factor is negative); they are consistent with a purely competitive system

¹⁴ The frequently mentioned relationship between adequate consumption levels and the productivity of labor is formally rather similar to the existence of decreasing returns to scale; i. e. an increase in the labor force provokes, along with whatever decrease in the marginal productivity of labor would occur if the labor quality were exogenously fixed, a further decrease associated with the decreased consumption which results from the direct decrease in marginal productivity and presumably in wages. It would be possible, as a first approximation, to take this factor into account in the definition of the production function; since the stock of capital and labor determine the total output the corresponding consumption levels may be implicit--assuming a specified pattern of distribution; the quality of labor is thus implicit also. The possibility of such a simple definition of the situation are limited by the need for the specific income distribution assumptions.

For discussions of this consumption-production relationship see Harvey Leibenstein, Economic Backwardness and Economic Growth, New York, 1957; Paul

only if the economies of scale are external to the firms; otherwise they would imply widespread monopoly. #The above discussion abstracts from the question of whether "income per capita" is an appropriate measure of welfare. In fact an important weakness is its failure to reflect the present value of future and past streams; assuming, as seems fairly plausible, that a society's objective function involves maximization of the discounted future welfare streams of individuals, it is possible for income per capita to be higher at each point of time in one system but for each individual's over

Wonnacott, "Disguised and Overt Unemployment in Underdeveloped Economies," Quarterly Journal of Economics, May 1962; Edgar O. Edwards, "Work Effort, Investible Surplus and the Inferiority of Competition," Southern Economic Journal, Vol. XXXVIII, No. 2, October 1971.

Another possibly important consideration brushed over in such a simple analysis is the fact that a high birth rate has the effect of reducing feminine participation in the labor force; the extent of this effect depends on the economic structure, and whether continuity of job is particularly important either for reasons of productivity or for more artificial ones.

Still another qualification relates to the fact that the rate of population growth may affect the distribution of investment as well as the total. Where certain social expenditures tend to be given first priority a government may have more investment flexibility when fertility is not so high, particularly important if the rate of return is higher on other forms of investment than ones such as education. On the other hand, of course, educational expenditures may be more distribution equalizing than many others. But if lower fertility permits a higher proportion of children to go to school, likely both because on the private side individuals can afford to send more children to school, and on the public side because the investment does not have to be stretched so far, the advantage lies in any case with the low population growth situation.

15 The question of returns to scale in an economic system as a whole has been long discussed but little quantified. It does appear that economies are likely at the industry level wherever special labor and division of labor are important, or indivisibility marks the production process. Some of these economies may be reopened via specialization in certain industries cum international trade, and more could be if there were not substantial barriers to trade. But, on balance, it seems conceivable that a small country may still be in the stage of increasing returns to scale. It is much less likely that the conditions of increasing marginal productivity of labor of economy will be fulfilled.

life income (welfare) to be higher in an other. Phelps, using the broader and presumably more appropriate concept of income, comes to the conclusion that there is no general theoretical presumption that population growth should lower welfare. (Edmund S. Phelps, "Population Increase", The Canadian Journal of Economics, August 1968, p. 497.) He notes that if two golden age growth patterns are compared, one involving more rapid population growth than the other, the rate of interest (rate of return to capital) will be higher in the case of more rapid growth, implying that the typical individual would receive less wages than in the alternative case, but during his dissaving years would earn a higher rate of interest on his accumulated capital. He concludes that, if it be assumed that the direct positive effect of the last child in a given family (i. e., the marginal direct enjoyment effect) is equal to the marginal cost of that child, then the overall effect of more rapid population growth is positive, zero, or negative according to whether the rate of interest is smaller than, equal to, or larger than the population growth rate, assuming throughout that the comparison is between golden age states. In other words, this factor price effect of faster population growth, taken alone, reduces lifetime parental utility if and only if the capital intensity of the economy is smaller than the golden rule capital intensity.

Though it is highly unlikely that the set of conditions which would imply a neutral or positive welfare effect of population growth be fulfilled in L. D. C. 's, it is certainly necessary, in order to come to valid conclusions on the issue, to take account of the direct utility effect of children (often neglected) and of the advantage (other things being equal) attaching to the higher rate of return to capital caused by the population growth. The fact that current per capita productivity is lowered by a

larger population does not imply that an individual's lifetime consumption need decline, since if he takes advantage of the higher interest rate by redirecting more of his consumption to the future, the former (negative) effect could conceivably be overcome.¹⁶ This useful categorization of the effects of population growth into direct and indirect (via the impact on factor prices) provides the framework for the next paragraphs.

The Welfare Effect of (Population-Growth Stimulated) Changes in Factor Prices

If the representative family in underdeveloped countries has more children than would equate marginal direct social benefit with marginal direct social cost, this implies that the indirect effect on welfare via the factor price ratio would have to be discretely positive to provide an overall argument in favor of rapid population growth. But underdeveloped countries are far from a golden age state with a golden rule capital intensity and population growth equal to the interest rate; the indirect effect would be clearly negative in a country with a population growth at 3 percent and a rate of return to capital somewhere between 10 and 30 percent. As always, other external diseconomies associated with the existence of factors in fixed supply (living space, etc.) and the positive implications of any increasing returns to scale of economy must be allowed for as well, but it seems highly unlikely that they would be sufficient to offset both a negative "direct" effect (as defined above) and a negative indirect effect.

In any case the issue is not closed by this highly abstract analysis; the assumptions of perfect foresight savings exclusively designed for subsequent running down, etc. are not convincing as a "full story". In the "dynamic" discussion below

¹⁶ Phelps notes also the need to consider "true externalities" associated with shortage of living space, etc., i. e. with the fixed supply of some factors.

of some aspects of the population question, more general savings functions are considered, and their implications for the question at hand drawn out.

Some Direct Effects of Population Growth on Welfare

In many underdeveloped countries it seems clear that actual family size is above desired family size, in other words that the "direct" effect of the marginal child is negative.¹⁷ This is suggested, among other things, by the extensive use of contraceptive devices when they become available, the high levels of induced abortions, and the "masked infanticide" (deliberately allowing an unwanted child to die when he becomes sick)¹⁸, and the outright statements of women that they have more children than desired.¹⁹ Provoked abortion rises with urbanization, presumably because the disadvantages of a larger family size are more obvious, the children being at home more, creating housing congestion, and being a bigger economic burden.²⁰ These

¹⁷ See, for example, Ronald Freedman, "Norms for Family Size in Underdeveloped Areas," Proceeding of the Royal Society, B, Vol. 159, 1963, p. 222.

¹⁸ Doctors also point to a related but more unconscious effect, attributed to the (usually subconscious) wish on the part of mothers that their younger children will die, an effect which shows up in much higher infant mortality rates for later children than for earlier ones. See Dr. Benjamin Viel, "The Social Consequence of Population Growth", Population Reference Bureau, No. 30, October 1969.

¹⁹ This response was frequent in the CELADE surveys in several Latin American capitals, e. g. Rafael Prieto Duran and Roberto Cuca Tolosa, Analisis de la Encuesta de Fecundidad, Informe Preliminar, Cuadros Estadisticos, Centro de Estudios Sobre el Desarrollo Economico (Universidad de Los Andes), Bogota, Sept. 1965. It is interesting to note that even in the United States at present it has been estimated that 13 to 18 percent of all births are unwanted. See J. J. Spengler, "Economic Growth in a Stationary Population," Population Reference Bureau Selection No. 38, Population Reference Bureau Inc., Washington, D. C., July 1971.

²⁰ See *ibid.* Celade's studies in seven cities of Latin America indicated abortion rates and the percentage of women using contraceptives; in Colombia the rate

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various manifestations of family size greater than desired occur primarily in the lower income groups. The hospital cases resulting from illegal abortions are primarily in the lower social economic classes.²¹ Masked infanticide follows the same pattern. In general it is true that upper income groups match desires to reality better than the lower income groups.

There are other reasons to question the assumption that direct social benefits and direct social costs of a family's last child are typically equal. When society provides certain social services like education, free or at subsidized rates, the family calculus does not take into account these social costs. (See, for example, Harold J. Barnett, "Population Problems--Myths and Realities", Economic Development and Cultural Change, Vol. 19, No. 4, July 1971).

Along different lines, it may be pointed out that one of the benefits of children is the "security effect" they provide--assuring one's old age. This is an unquestioned benefit but the fact that it can be relatively easily and successfully substituted for by old age welfare schemes implies that under slightly different "rules of the game" families would choose smaller family sizes. And the "benefits" in question are not

really contributions ^{of} the children, but rather unfortunate problems which their presence

of induced abortion was 16 per 100 pregnancies in Bogota, 20 or more in other cities, and about 8 in rural communities. It may be presumed that any bias in these figures would be downward. The existence of abortion (which prevents the birth of unwanted children) is of course not a proof that unwanted children are born. But given the surrounding evidence, the best guess is that the abortions are matched but many more unwanted births not so prevented.

²¹ Abortion is resorted to primarily by married women, much less so by single women. It is more frequent among women with primary or no education than those at the secondary level.

may prevent. The something which substitutes for quantity of children may be quality of children; statistical evidence of this phenomenon has been adduced by DeTray.²²

The fact that the marginal direct private effects of children are frequently negative obviously calls for policies to facilitate control of family size and that fact that desired family size is sensitive to the supply conditions of substitutes implies that these conditions should normally be manipulated, and that in the general policy approach to population, desired size should not be treated as an exogenous variable. Some theoretical considerations suggest that rapid population growth worsens the distribution of income but the issue is not clearcut (see below). The proposition is unfortunately particularly difficult to test empirically, both because of the usual (serious) identification problems involved and also because the impact would not be expected to be quick, but rather to build up over a substantial period of time. On the first count, it is clear, for example, that low population growth accompanies higher income levels and that improvements in distribution do too²³, but that these improvements

²² Dennis DeTray, paper presented at The Economic Growth Center, Yale University, February 1972.

²³Controversy still surrounds this issue, with a number of observers doubting that, when all appropriate factors are taken into account, there has been significant improvement in income distribution in the developed countries. That the personal distribution of income generated in the current production process has improved is little questioned, but it has been argued that the more relevant family distribution has improved less and that when income from asset appreciation is taken into account the improvement is still less. An example of this sort of critique of the generally accepted figures is Richard M. Titmuss, Income Distribution and Social Change, London, George Allen and Unwin Ltd., 1962.

may be explained by factors unrelated to demographic developments. On the second, rapid population growth at one point of time would not be expected to affect income distribution until say 20 or so years later. Since differences in the rate of population growth were less in the developing world of 20 or 30 years ago than they are now, the small range of that independent variable would make statistical analysis very difficult.²⁴

As suggested above, the relationship between population growth and income distribution cannot be simply analyzed from a theoretical viewpoint, among other reasons because it involves specification of the distribution of the capital stock among two populations of different size. Referring to the smaller population (which results from slower growth) as \underline{S} and the larger one as \underline{L} , and assuming (a) both labor and capital are homogeneous (b) constant returns to scale and (c) the same total capital stock in both cases, Table I summarizes some of the interesting possibilities. The effect of a larger labor force is to decrease average product of labor and increase that of capital. With elasticity of substitution equal to one it implies a better distribution of income whenever that of capital is better;²⁵ with elasticity greater than one, a population increase improves income distribution if capital distribution is unchanged or even somewhat more concentrated; with elasticity of substitution less than one, the larger population implies a worsened distribution, unless capital distribution is better by some threshold

²⁴ It might be of interest to analyse the income distribution of different age cohorts as a function of the rate of population growth at the time each was entering the labor force, but the results would be difficult to interpret.

²⁵ The top X% of the population has the same percent of income as before, for any X.

amount. In short, the elasticity of factor substitutions in the aggregate production function is a key variable, so the empirical evidence on it is important; a second key variable is the relationship between rate of population growth and the distribution of capital. Before turning to these questions, however, it is worthwhile referring to the extensive benefit cost literature referring to population programs with a view to seeing what relation it bears to the above discussion.

Empirical Evidence on the Elasticity of Factor Substitution

Once again, while there have been innumerable studies estimating cross country, one country, one industry, etc., production functions with corresponding deductions about the elasticity of substitution, most of these are, for one reason or another, not directly applicable to the issue at hand, though taken together they at least provide some guidelines. Empirical estimates of substitution elasticities are cross section, time series, or some combination. In all cases it is exceedingly difficult to know what marginal rate of substitution, if any, is really being measured. In cross section studies, problems are least when a homogeneous product is considered, but it is necessary to assume that (a) each firm faces the same production function and (b) the observed differences in factor proportions are due to factor market imperfections (i.e. different factor prices facing the different firms). If in fact the production functions were different from each firm, the true average elasticity of factor substitution (this variable would presumably vary across firms) might bear no relation to the observed one--it could be much higher or much lower. While careful statistical

analysis can give hints as to what is really being measured, so that the seriousness of this problem should perhaps not be exaggerated, neither should it be disregarded.

Within a given economy, the seriousness of this "identification" problem is aggravated when the estimation refers to many products. Relatively few analyses implicitly assume the same production function for entirely different industries, but most involve some degree of product homogeneity.

In cross country studies it is more plausible to assume that the different factor proportions of the different observations are "generated" by different factor price ratios, but the validity of the assumption of the same production function is much more dubious. (For a discussion of this point see Richard R. Nelson, "A Diffusion Model of International Productivity Differences in Manufacturing Industry," American Economic Review, Vol. LVIII, No. 5, Part I, December 1968.)

Over time studies face the difficult task of sorting out non-neutral technical change and the response of factor proportions to factor prices. Many studies have failed to introduce independent evidence on changing factor prices, further reducing the level of confidence which can be placed in them.

In short, no obvious methodology can provide a reasonable level of confidence in the absence of good independent evidence on the nature of production functions, interfirm differences, factor markets, technological change, etc.

Rate of Population Growth and the Distribution of Capital

It is usually assumed that a fast population growth implies greater inequality in the distribution of capital, since the overall rate of population growth basically

reflects that of the lower income groups. This view could be oversimplified, however, and a careful analysis of the relation is called for. To predict the effect of population growth on family or personal income distribution, (the real issue of interest) it is necessary to know not only how functional distribution is affected but also (a) whether and how the vegetative rate of population increase is related to income level, (b) to the extent that some of the population increase comes from families with capital, in what proportions this capital is divided up among the expanding family,³³ and (c) whether people who earn income from capital also participate in the labor force and if so how their labor service differs (if it does) from that of the proletariat. Probably as plausible a combination of assumptions ~~as any~~ in the prediction of the income distribution impact of fast population growth would be an elasticity of substitution in the neighborhood of 0.5 - 1.0³⁴ and a less equal distribution of wealth the larger the population.³⁵ Given

³³ As a plausible description of an historical process, there seems little use in assuming that wealth will be distributed to anyone but the heirs of the wealthy.

³⁴ Among the studies of interest in this connection the following may be cited.

³⁵ The purpose of this simple comparative static analysis is to compare two (or more) populations which could exist at some future time, according to demographic events in the interim period. We abstract from the fact that other conditions than the size of the population might be expected to differ at that future date, and attempt to isolate the effect of population size differences ceteris paribus. A more complete analysis would take into account, for example, the fact that lower income groups usually have more children and even larger completed families; this would suggest that the larger populations would correspond to less equal wealth distributions.

constant returns to scale, this would imply (as indicated in Table 1) that the faster population growth would lead to a more concentrated distribution of income. Since distribution depends only on the marginal rates of factor substitution (and not on their average productivity levels), cases where the marginal productivity of labor is rising in the relevant range do not differ in this respect from the constant returns to scale case as long as the production function is homogeneous of any degree; in these cases (homogeneous of degree greater than one) the effect of a given percent difference in the labor force on relative factor incomes is the same as with constant returns to scale; total output does, of course differ according to the degree of the function. Only if the ratio MP_L/MP_k (marginal productivity of labor to marginal productivity of capital) rises as the labor force increases can the labor share be an increasing function of population.³⁶

The strongest disequalizing effect of larger population on capital distribution would occur when a laboring class with no capital generates all of the population increase; given the expected result that wages fall, the redistribution is likely to be quite negative. At the other (unlikely) extreme, if the group which derives most of its

³⁶ If there are constant returns to scale and MP_L is higher the greater the labor force in the relevant range, then average income per capita will be a decreasing function of population but distribution will be better the larger the population (since income per unit of capital is a sharply decreasing function of population.) It is impossible for the production function to have constant returns in all factor combinations, since it is non homogeneous. But there could be constant returns for a particular factor proportion. If there are increasing returns to scale and MP_L/MP_k is a positive function of L in the relevant range, then the population increase can both increase income per capita and improve its distribution. This combination of circumstances sounds rather unlikely. A final possibility is that MP_L/MP_k is an increasing function of L , but not a sufficiently positive function to imply a rising MP_L , given the returns to scale characteristic of the production function. Then a larger population could imply a lower average wage (and a fortiori, a lower average income) but a better distribution. This somewhat quixotic case can probably also be dropped as of little interest.

income from capital generated all of the population increase, and also divided the capital evenly among the new larger capitalist group then as long as the capital share does not rise the distribution would be made more even at the top³⁷, and left unchanged at the bottom.³⁸

Note

that if capitalists did not earn labor income, population growth would not lead to any increase in the labor force, nor change the wage rate nor total income. It would lead to a lower average income and a better distribution.

More likely than non-participation of capitalists in the labor force is the non-homogeneity of their labor service with that of the laboring class. It is useful to think of the different types of labor in the real world (with differences being due to education level, basic skill, experience, etc.) as different factors; this framework permits a variety of assumptions as to their substitutionability or complementarity with each other.³⁹

³⁷ Specifically, for some X (perhaps small) the share of total income accruing to the top X percent would fall.

³⁸ Specifically, the share of total income accruing to any Y% who had no capital would be unchanged--as long as the labor share was unchanged.

³⁹ The alternative is to lump human capital together with physical capital, and assume perforce that capital and labor are complimentary factors. In this context, a capitalist who works contributes one unit to the total supply of labor; in this framework one would conclude that an increase in the number of capitalists, all having some job, with the total amount of physical plus human capital held constant, would lower the wage rate.

Clearly the "different factors" approach is the better one, since it allows more flexibility of assumptions about substitutability and complementarity. The issue is whether information requirements and needs for more complicated production function specification permit the approach.

The existence of three factors increases the range of possible results if the elasticities of substitution are different from one.⁴⁰ For example, wages could be an increasing function of the capitalist population and of the corresponding supply of "skilled" labor, if unskilled labor had a complementarity relation with both physical and human capital, such that when the ratio between human and physical capital rises the marginal productivity of unskilled labor also rises.

While no general prediction as to the net effect of population growth on income distribution can be made, a negative effect seems more likely than a positive one. In underdeveloped countries all income groups are normally more than self-sustaining population-wise, but, as observed above, growth is likely to be faster in the lower income groups. Usually there is some division of capital among the children of a wealthy person, but not necessarily a very equal one.

Thus, unless unskilled labor is a substitute for the two forms of capital--and there seems little evidence to support this possibility--population growth may be expected to worsen distribution. This worsening will be faster (a) the greater the difference in rate of population growth by income level, (b) the less equally the capitalists divide their wealth among offspring, and (c) the more complementary is unskilled labor with each of physical capital and skilled labor. Worsening can only be avoided if either (a) unskilled labor is a perfect or almost perfect substitute for the other factors, and capital distribution is not a significantly negative function of population size or (b) unskilled labor is not a very close substitute for the other factors but capital

⁴⁰ High cross elasticities are more frequent the more factors are separately specified.

distribution is more equal the larger the population. If a large population somehow generated a preference for that form of capital (as between physical and human) which is more complementary with unskilled labor than the other, an improvement could also result.

A (ii) Neoclassical Model: Dynamic Analysis

The above comparative statics analysis involves the economic implications of different levels of population, all other things being equal; its results could only be directly relevant in the case of a once and for all increase in population, given constant amounts of other factors. But the comparative statics question "how would income and its distribution differ if the country had a larger population, but the amount of capital and the technological possibilities were the same?"⁴¹ is a hypothetical one with no dynamic or over-time element; almost by definition it cannot be directly relevant in any economic system. When a policy is effected which makes the rate of population growth lower than it would otherwise have been, it only gradually causes the actual population to diverge from what it would otherwise have been, and in the process it alters other demographic variables such as the age structure and the dependency ratio. Thus measurement of the policy's effects involves comparing incomes over time (theoretically over all future time) rather than simply^{42, 43} at one

⁴¹ In asking this question above it was implicitly assumed that the labor force differed between any two cases by the same percent as population, and more generally that the two populations were identical in the distribution of all characteristics like age, sex, training, etc; they differed only in size.

⁴² Evaluation of the benefits of any policy which has effects over more than one point of time technically requires this treatment. But where the effect is constant over time, it may not be necessary to introduce time into the analysis.

⁴³ An interesting and different form of dynamic analysis involves comparisons

specific future date.

A second sense in which comparative statics analysis is unsatisfactory is its failure to allow for the fact that demographic variables may be determinants of the growth paths of other inputs. It is plausible to hypothesize that population growth affects savings rates and thus the capital stock; the rate of technological change depends on the amount of research and development expenditures, and is in this way likely to be related to savings--it is one form of investment.

Both the rate and the nature of technological change could be related to the rate of population growth, though it is not obvious exactly how.

In drawing out some of these dynamic questions, we will consider the possibly special characteristics of what may be called the "transition period" i.e. the period after a change in the rate of population growth and before the various demographic variables (like age structure) have moved to the new long run equilibrium states corresponding to the new growth rate (See the discussion, p.). Before doing so, however, it is useful to begin with a comparison (not far removed from the comparative statics one) of the over time income patterns in two systems where different (constant) population growth rates prevail and which have the same rates of technological change and of savings (implying that both are independent of the population growth rate over the relevant range). Suppose that previous growth paths have brought both economies to between alternative rates of population growth--each maintained over a long period--in terms of their impacts on growth of income per capita and its distribution. The question is different from that involving the effect on the path of the income variables of a change--either at a given point of time or occurring gradually over a period of time--from one rate of population growth to another. It tends to be simpler than the analysis of interest here, so will be used as a first step in the discussion below.

the same factor proportions, and that one has a population and labor force growing at X% (say 3%) per year and the other at Y% (say 0%). (Past capital/labor ratios must have been different for them to be equal at present.) Then, under most assumptions about the production function, income per capita will grow faster in the second economy, and distribution will be more even; the exceptions parallel those discussed in the comparative statics context, e. g. , where there are strongly increasing returns to scale, income per capita may grow faster in the first economy, and where the production function is non-homogeneous with MP_L/MP_K an increasing function of the input of labor distribution may be better in it, etc. (See the discussion above, p. .) With a linear homogeneous production function the difference in growth rate of average income is less than X-Y and depends on the elasticity of substitution between the two factors. If the only source of increasing income per capita is an increase in capital/labor ratio (i. e. there is no technological change) then with infinite elasticity of substitution the difference in the two income per capita growth rates would be $(X-Y) \cdot \frac{L}{L+K}$ where the units of labor and capital are each defined as having a marginal productivity of one.⁴⁴

⁴⁴ Thus, a 1% increase in the labor force leads to an increase in income of $(\frac{L}{L+K})$ percent, i. e. , a percent increase equal to the ratio of units of labor to units of labor and capital combined, the term $\frac{L}{L+K}$ representing the elasticity of output with respect to labor and the labor share.

Note that for this particular case the conclusion that income per capita grows more slowly in the economy with faster population growth is deceptive in one sense; no one would necessarily be made worse off by the population growth; the wage rate, for example would not fall; there would simply be less capital per person and either the capitalist group as a whole would have a lower average (if population growth occurred there and capital was not divided among the now larger group) or the laboring group would be numerically greater relative to the capitalists than before, but with the same average income, or both. If the capital is now divided up more ways, a subgroup which would be present in either case would be worse off in the fast population growth case.

The greater the labor share the smaller the effect of the different population growth rates on per capita income growth.⁴⁵

When, at the other extreme, production requires fixed proportions between labor and capital, then if an economy has initially neither unemployment of labor nor of capital, population and capital must henceforth grow at the same rate to imply full employment of both factors. As a result there is no possibility of faster population growth leading to higher output per capita, unless (a) there was previously unemployment of capital or (b) technological change occurs. If, beginning with no unemployment, labor grows faster than the capital stock, then unemployment of labor arises and average income falls continually; if there is originally an excess of capital, then income per capita remains constant until that excess is used up--then unemployment of labor appears and per capita income begins to fall. In this case, the income per person corresponding to the fixed labor/capital ratio at which the factors must be used constitutes an upper ceiling income in the absence of technological change.⁴⁶

⁴⁵ The limiting case, where labor is responsible for all of the output is a one factor economy where population growth has no implications unless there are non-constant returns to scale.

⁴⁶ Introducing such change is not relevant since its impact is simple; our interest here is exclusively to compare growth rates of per capita income in cases which differ only with respect to their population growth rates; and within a model which is kept as simple as possible.

Note that the phenomenon of the upper limit occurs in all cases where the savings rate is high enough to assure faster growth of capital than of labor, except where the factors are perfect substitutes. The limit is reached abruptly in the fixed proportion model (i. e., MPK drops suddenly to zero), and is approached gradually in the case of a variable proportion's model. The same income per capita is eventually reached regardless of the population growth rate, so a comparison of final equilibrium is of no interest--the only interest lies in comparing growth paths; income per capita in an economy with slower population growth would begin to rise above that of one with faster growth--then

Income per capita is the same in two models with different population growth and its rate of change is the same (zero). If labor is in excess supply, income per capita falls faster by X-Y percent in the economy whose population is growing faster. This limiting fixed proportions case is not of interest per se, but as being suggestive of the results for low factor substitutability cases.

Cases between the extremes of perfect substitutability and perfect complementarity produce results, as expected, between those of the two extremes, and one can think of a continuum of possible negative effects of--assuming a linear homogeneous production function--population growth rate on the growth of income per capita, the effect being an inverse function of the relative importance of labor and (as measured by the labor share) the elasticity of substitution. The range of this continuum is between 0 and the rate of population growth. With high but not perfect complementarity of factors, the negative impact approaches the rate of population growth and there is something close to what, in the case of fixed coefficients, was referred to as excess supply of labor, i. e., the marginal productivity of labor is quite low.

The above paragraphs constitute simply the rephrasing of the comparative statics results in an over-time context, without analysis of the specifically dynamic aspects of the situation. To be complete, as noted earlier, allowance must be made for the fact that the savings rate may be a function of the rate of return to capital, the rate of growth as the capital/labor ratio increased and capital became less and less productive, the gap would narrow until finally the two trajectories approached each other asymptotically. In such a model, therefore, the negative effects of population growth would depend on how long it took the two economies to reach the income ceiling, and on the rate of discount. In the real world, of course, technical change has normally been rapid enough and of a type to keep the marginal product of capital high, so the two time paths would never really approach each other.

of income, the distribution of income, and family size; all of these factors may be affected by the population growth rate as may technological change, especially change which responds to factor proportions and relative factor payments. If the savings rate is an increasing function either of per capita income or its rate of growth, the above "first-step" analysis would underestimate the negative effects of the population growth.⁴⁷

Thus X-Y, the difference in two population growth rates, is by no means the maximum difference between the corresponding growth rates of income per capita, *mutatis mutandis*;⁴⁸ if savings were very responsive to the rate of growth of per capita income, this difference could be considerably greater than X-Y. On the other hand, some theories suggest a higher savings rate the faster the population growth, due to the latter's tendency to cause a more unequal income distribution. Thus, even if it were accepted that for a given economic entity (e. g. family) the savings rate was an increasing function of the income level and/or the rate of growth of income over the recent

⁴⁷ Whatever would be the "real" net effect of population growth rate on a country's average savings rate, it seems unlikely that by itself it could be positive enough to outweigh the negative effects typically resulting from the less favorable factor proportions (lower K/L ratio). As observed above, if the savings rate were unaffected by population growth, then income per capita could be expected to grow somewhere between zero and X percent faster in a system where population grows X percent slower; where the savings rate is positively affected by fast population growth, this effect might have to be strong to outweigh the other one. Consider an economy with population growing at 3 percent; then, assuming a fairly optimistic marginal rate of return to capital/33%, it would require a savings rate higher by 9 percent for income per capita to grow as fast as it would with zero population growth. In other words, a 6 percent savings rate without population growth would generate the same growth of per capita income as a 15 percent savings rate with 3 percent annual population growth.

The objective here is not to ask whether consideration of savings could lead to a reversal of the earlier results, but rather to see in general which way it works and how strongly.

⁴⁸ i. e. holding constant all variables determined independently of the rate of population growth.

past (both these factors tending to suggest that the savings ratio would be a negative function of the rate of population growth), no conclusions could be drawn without analysis of how population growth affects income distribution and how distribution affects the aggregate savings rate. If all savings were carried out by families, the requisite analysis would involve (a) the relation between average size of the family and the savings rate, with the logical hypothesis being an inverse one due to the need for higher levels of certain consumer expenditures when family size is larger, and (b) the impact of population growth on distribution of income by families. But savings are also done by incorporated businesses and the government. It is probably plausible to assume for each of these groups that the savings rate is a positive function of both income level and its growth, but there is further the question of how faster population growth affects the distribution of income among families, government and business, and what their relative marginal savings proposition are.

The thesis that unequal distribution implies higher savings rates depends on a marginal propensity to save which rises with income; most of the formulations of the argument seem to have been couched in the context of family incomes.⁴⁹ In fact,

⁴⁹ In one attempt to calculate a trade-off between improved distribution and rapid growth, Cline used household budget surveys in four Latin countries, concluding that the growth rate cost of improving the equality of distribution to the level found in England would be between zero and 1%, according to the country. (See William R. Cline, "The Potential Effect of Income Redistribution on Economic Growth in Six Latin American Countries," The Woodrow Wilson School, Princeton University Discussion Paper No. 13, August 1970). In one country (Brazil) Cline was able to test for the significance of whether income was "entrepreneurial" or labor; he concluded that this variable was not significant, a conclusion contradicting some earlier work (e.g. Hendrik Houthakker, "On Some Determinants of Saving in Developed and Underdeveloped Countries" in E. A. G. Robinson (editor) Problems in Economic Development, McMillan & Co. Ltd, London, 1965), although as Cline notes Houthakker was vague as to whether his conclusions referred to a

however, it appears that in many developing economies a rather small share of all saving out of current income is done directly by families, a substantial proportion being done by the government and by incorporated businesses.⁵⁰ Both of these entities are likely to have higher average savings rates than families (although this would depend on the distribution of disposable income among families). How the rate of population growth is likely to affect, via its impact on factor proportions, the distribution of income among these three sectors is less clear; with an elasticity of substitution below (above) one, it would be expected that a higher labor/capital ratio would lead to a greater (smaller) share of income going both to privately owned capital and to corporate capital; assuming an elasticity below one is more probable, both these shares

difference net of income levels. In any case this is a different issue from the one mentioned in the text, since it dealt with factors determining the savings rate out of personal income, not the "business savings" rate. It seems likely that most of the methodological biases in this study and others like it are towards overestimating the growth rate cost of income redistribution via the "savings effect", in particular (a) the implicit assumption that if family savings fall as a result of redistribution, all other forms of savings will fall in the same proportion and (b) the use of budget survey data which is very likely to overestimate the marginal propensity to save of the permanent savings function, and very possibly the first derivative of the marginal propensity as well. The former assumption does receive some support from studies showing substitution among forms of savings, e. g., as between family and corporate savings. (See Franco Modigliani, "The Life Cycle Hypothesis of Saving, The Demand for Wealth and the Supply of Capital," paper presented to the Rome Congress of the Econometric Society, 1965.) Such substitutability would a priori be expected to be stronger in the long than in the short run, since it must require some time for some people to evolve their interpretations of the substitutability, e. g. between private savings and social security contributions. It seems likely that the value of the latter, for example, might be underestimated at first.

⁵⁰ Foreign savings may also be important but this phenomenon is ignored here since the issues raised are much more complex than those surrounding the other forms of saving. One might note, however, that a reasonable hypothesis would be that the higher the labor/capital ratio the more attractive would be the country for foreign investors and the higher the savings which would come from abroad. The effect of these

would be expected to increase. But the impact on the aggregate savings rate would be hard to predict.⁵¹

The factors affecting the share of income going to the government have not been studied in the detail necessary to permit judgments as to how it might be related to population developments.⁵² One could hypothesize (in broad accord with observed reality in many underdeveloped countries) that an uneven distribution of income helps to create an uneven distribution of social and political power which may in turn imply relatively few social services, relatively little investment in education, and a relatively small government sector. Even when the system has enough inherent democracy to make the government subject to lower income groups demands for such services, inequality of power tends to make a high average tax rate difficult or impossible politically. But this conclusion that inequality is likely to be associated with a small government sector does not imply directly that it will be associated with lower government savings.

savings on national income constitutes a more complicated question than in the case of domestic savings since at least part of the return to them is taken out of the country and there are situations (e.g., where the foreign capital achieves a certain type of monopoly position) where the costs may even be greater than the contribution of the capital to gross domestic product.

⁵¹ In some empirical studies of savings it has been hypothesized that the major determinant of the savings rate is the distribution of income between labor and capital, the implication being that it does not matter much whether capital income accrues to corporations or to individuals. If this were the case there would be no need to distinguish whether an increasing capital share leads to a more unequal distribution of personal income or to a greater share of private sector income going to corporations.

⁵² Studies of relevance here are Richard S. Thorn, "The Evolution of Public Finance during Economic Development", *Manchester School of Economic and Social Studies* 35, No. 1, January 1967; Harley Hinrichs, A General Theory of Tax Structure Change During Economic Development, Cambridge, Mass., Harvard Law School, 1966; Richard A. Musgrave, Fiscal Systems, Yale University Press, New Haven, 1969.

Since governments unquestionably do have savings potential in one sense, it could be argued that the weakness and lack of independence of the government in a system marked by inequality constitutes a loss of that potential.

Many other determinants of the income distribution-savings relation would have to be introduced for a full treatment. For example, a system with a small upper class and corresponding unequal distribution of income is more likely to have a monopolistic (industrial) structure, partly because the reduced number of potential entrepreneurs decreases the likelihood of competition, and partly because government policy is more likely to favor large firms (against small or medium sized ones) when power is concentrated. The existence of a monopolistic structure may lead to a higher savings rate by generating a higher capital share than would have characterized pure competition. Some theorists (e.g., Schumpeter) have also argued that it creates a greater tendency to innovate, but this is unclear; monopolistic firms frequently give evidence (in many underdeveloped countries) of being sluggish and inefficient, and relatively unconcerned with innovation. Possibly a monopolistic structure has positive effects in a production oriented society or possibly the effects of monopoly in this regard are positive as long as the position is not too secure.

Empirical Evidence on the Savings Function

In the discussion of the overall relation between savings and demographic variables, two ties have been singled out as of special importance, the direct effect of family size on family savings, and the impact of the probably greater income inequality resulting from fast population growth on the average savings ratio. In this section empirical evidence bearing on each of these relations is summarized; this evidence comes from cross country studies, family budget surveys, and one country-overtime studies. Unfortunately, all of these have severe limitations. Comparisons among countries at different income levels, family budget surveys, and studies of savings functions or savings rates over time in a given country suffer from the basic difficulty of the multicollinearity of

the hypothesized independent variable with so many other variables which might plausibly be argued to affect savings so as to make a reasonably accurate specification of the function extremely difficult, and leave the ever present worry that correlation implies little or nothing about causation i.e. that the higher savings ratio that goes with a higher income level may be due to some other factor correlated with income. Since high income may result from a high propensity to save, it would in any case be difficult to specify the direction of causation, if the variables were causally related. In general, regardless of the variables missing in the specification of the savings function, it seems probable that both cross country studies and budget surveys tend to overestimate the marginal propensity to save.

Explanations of why savings rates differ across countries may be more or less grouped around three basic determining factors--the level of income, the age structure (with associated dependency ratios, etc.) and the rate of return to investment (or "investment opportunities" or some other variant). The by now conventional "income level" explanations tend implicitly to interpret savings as a residual after consumption, and to assume that the desired or "institutionalized" consumption level rises less than proportionately with the income level. The dependency theories, which relate savings behavior to the age structure of the population, have hypothesized both positive and negative savings effects of population growth. Cassel early suggested that a growing population would have a higher savings rate than a stationary one since it would have a higher ratio of the young (i.e., savers) to the older (i.e., dissavers); he was employing a life cycle theory of savings behavior.¹ An obvious doubt attaching to this explanation gives rise to the opposite predictions: although the younger age groups are savers and the older ones dissavers, the former may save less the larger their families (i.e., the faster the growth of population).

¹Gustav Cassel, The Theory of Social Economy, trans. from 5th edition (New York, 1932).

The argument that dependency lowers the savings rate has been most recently presented and supported with cross country evidence by Nathaniel Leff.¹ Leff's cross country regressions (on 74 countries) suggested a strong relation between the dependency ratio and the savings rate, and greater explanatory power for that variable than for the income level. While Leff's results did not imply that income per capita is not a relevant variable in the determination of savings² they raised important questions about the nature of that relationship.³

¹Nathaniel E. Leff, "Dependency Rates and Savings Rates", The American Economic Review, December 1969, p. 86. Leff notes that Eizenga and Modigliani's work has also supported a connection between dependency rates and savings.

²Prior work on this relation had, of course, tended to indicate a fairly strong positive tie as well. A strong positive relationship exists if the LDC's are grouped together and the developed countries together; Kuznets estimated an income elasticity of savings of 1.48 between selected but fairly large sets of those two types of countries. Within the less developed countries the relationship is clearly positive.

³For the 47 underdeveloped countries, the implied income elasticity of savings was in the range of 1.1 to 1.15; it was about 1.0 for the Western developed countries where the rate of income growth was more important and the dependency effect of young children much less important, although still quite significant. In the regression including all countries the income variable was somewhat more important, partly due to the presence of the LDC's and partly a spurious result of the pooling of two samples which, according to the Chow test, came from different universes (see p. 891).

Multicorrelation between income and the dependency variables naturally raises uncertainties as to the confidence to be placed in these results.¹ The least that can be said, however, until more completely specified relations can be tested, is that it is at least as likely that these demographic variables are important causal factors in the determination of savings rates as that the income variable is.²

¹The simple correlation of log (income per capita) with the logs of child-dependency, aged-dependency and overall dependency were $-.74$, $.80$, and $-.67$ respectively.

²One difficulty in interpretation of Leff's results lies in his failure to use adult equivalents or consumer equivalents to measure population. The "population/adult equivalent" ratio is highest where the dependency ratio (especially the child dependency ratio) is high; thus if the population were measured in adult equivalents, income per "capita" would be raised in high dependency countries vis a vis low dependency ones. The nature of the statistical bias resulting from the use of unadjusted population figures is not clear. On the one hand, it could lead to an overestimate of the significance of the income variable as a determinant of savings and an underestimate of the effect of the dependency variables since the former, closely correlated with the dependency variable, would "pick up" more of the explanation of differences in savings rates than when its variance was correctly measured (and hence is smaller). This is, in other words, a purely statistical phenomenon of a variable whose explanatory power may be misestimated due to its multicollinearity with another explanatory variable, and where an upward bias in its significance is made more likely by the artificially high dispersion of its values - the high dispersion makes it less likely that random noise will erase its estimated significance.

By this interpretation, it would be concluded that the failure to work in terms of adult equivalents biased down Leff's estimates of the importance of income. A high dependency country really has higher income per adult equivalent than do the others at the same income per capita level, so it should have a higher savings ratio if in fact savings is dependent either on income per capita properly defined or factors associated therewith. How significant this effect would be is not clear. But, there could, on the other hand, be a downward bias in the income coefficient of the savings function when the population variable is unadjusted. Suppose there is, in reality, a positive relationship between S/Y and Y/A (income per adult equivalent); then the coefficient of income would be lowered by the fact that the income level is overestimated in the low dependency countries and underestimated in the high dependency countries. This mismeasurement of the income per capita variable would not necessarily lower the estimated significance of the income variable, but rather the size of the coefficient. Another query worthy of consideration is the extent to which the exclusion of foreign savings affects the results. It is not intuitively clear that it should lead to any bias, however. Another difficulty in interpreting Leff's results lies in knowing the extent to which dependency ratios are strictly a function of income. Before being in a position to quantify well the possible impact of dependency ratios on growth through savings, one would have to consider the above issues, and also to include investment in human capital as a form of savings. Probably the ratio "investment in human capital/investment in physical capital" would be higher in countries with high dependency ratios, and the overall impact of the dependency ratio would thus appear smaller. In a country like Colombia (as of 1966), the cited ratio appeared to be in the neighborhood of 25 to 30 per cent.

The tautological equivalence of savings and investment implies that any theory which claims to be explaining cross country differences in savings rates may in fact be explaining cross country differences in investment rates. The "investment opportunities" theories of savings may be interpreted in this sense; they suggest in varying degrees according to the author that in fact savings are relatively elastic vis a vis the rate of return. Theodore Schultz, while noting that traditional economies are likely to be efficient in an allocative sense, argues that growth does not occur because the new investment opportunities are limited.¹ Arthur Lewis² might also fit in this category; he implies that when modern sector investment opportunities are perceived, the savings are generated out of profits in a rather straight forward, unequivocal way. Hirschman's argument that investment opportunities generate their own savings is clearly of this ilk³, and the whole "two gap" discussion of recent times has essentially suggested that savings either will not occur or will not be productive (and the latter may well in part imply the former) unless they can be coupled with imports of capital goods—in other words the possibility of importing is a requisite for a high rate of return to capital.⁴

The implication of this last interpretation of overall savings behaviour for the impact of demographic variables on savings is of interest. The gist of the emphasis placed by Alvin Hansen and others on the importance of population growth in stimulating recovery from the great depression in the U.S.A. was that it implied certain minimum demands by new families for housing, consumer durables, etc.; it therefore buoyed aggregate demand. Since underdeveloped economies are not normally Keynesian in any general sense, such an argument cannot be applied directly (see below). But an interesting related question does arise as to whether population growth might be associated with "investment opportunities;"

¹Theodore Schultz, Transforming Traditional Agriculture, New Haven, Yale University Press, 1966.

²Arthur Lewis, "Development with Unlimited Supplies of Labor," The Manchester School, May, 1954

³Albert Hirschman, The Strategy of Economic Development, New Haven, Yale University Press, 1958

⁴e.g. Hollis Chenery and Alan Strout, "Foreign Assistance and Economic Development," American Economic Review, Sept. 1966.

this could occur if, for whatever reasons, greater growth in total income and smaller growth in per capita income - the presumed concomitants of such population growth - implied better opportunities for investors. This question might provoke the following hypothesis: at income levels where much (or even the majority of) speculative consumption is met by own production and relatively small amounts by purchase, an increase in total income which does not correspond to an increase in per capita income is unlikely to change either the total quantity or the composition of goods demanded in the market as much as the same increase in income per capita; this latter should permit more division of labor, and more threshold breaking investment opportunities.

At higher income levels, where most goods are in any case purchased in the market, slow population growth and rapid growth of income per capita might prevent the achievement of certain economies of scale in mass markets by implying small increases in demand for many products rather than large increases in demand for a few; then the argument would go in the opposite direction.

Intra-country savings studies also shed some limited light on the issues at hand, though their precise implications for the issue under discussion are frequently less than obvious and sometimes non-existent. The question to be answered is "If policy could affect the rate of population growth (presumably by affecting the birth rate) without changing any other economic variables, what would be the impact on the subsequent path of income per capita and the distribution of income?" It can only be given a convincing test when a very complete understanding of an economic system permits an accurate specification of that system. For example, the parameters of a consumption function based on a budget survey would only be directly applicable to the prediction of the over time implications for savings of increased income inequality due to population growth. It could be assumed (a) that the aggregate consumption function would remain unchanged over time; this would probably require that those of specific income groups also remain unchanged, (b) that the survey estimated function would be thought of as a "long

run" function i.e., it did not suffer from biases related to transitory income¹ and (c) that the specification of the consumption function was correct; of particular interest in this connection would be the correct specification of relevant demographic variables--if in fact these variables are important in the cross country savings function then they must also be incorporated in any single country function which purports to predict savings under different demographic conditions from those currently prevailing. As discussed earlier, a family savings function does not describe total savings behavior, unless (through indirect process) total savings were to depend on total income in the same way as family savings depend on family income.² That all these conditions be satisfied is unlikely.

There is probably little doubt that budget studies overstate the positive relationship between the savings rate and income; there remains the question of whether there is a long run positive relation between the two; if there is not then the long run marginal propensity to save is also unrelated to income--this is the relation of relevance in the present discussion.

Over time studies for individual countries have, as is well known, frequently shown constant savings rates or fluctuations without trend.³ The complexities involved in reconciling budget studies of savings with over time studies suggest caution in facile interpretations of the applicability of either type of "savings function."⁴ It is clear for various reasons, that one cannot predict the future average savings rate on the basis of a budget study. Variables which provide a statistical reconciliation of "over time" and "moment of time" studies include wealth levels, transitional income, distribution of income by size of locality, new products and the relative income hypothesis, etc. All of these interpretations tend to be consistent with

¹Of the type discussed by Milton Friedman in his A Theory of the Consumption Function, Princeton, Princeton University Press, 1957.

²Although improbable, this is not impossible, since other forms of savings are likely to be substitute for family savings. See the discussion on p. .

³As in the U. S.

⁴Friend made interesting observations on the joint use of time series and cross-section data. See Irwin Friend, "Techniques of Projecting Saving," Chapter in National Council of Applied Economic Research, Measurement and Analysis of Saving, papers of a seminar held in December 1960 (New Delhi 1962), p. 98.

the evidence, i.e. little statistical evidence helping to rule out some of them seems yet to have been provided. Those developed country theories designed to reconcile increasing APS in budget studies with constant APS over time are not directly relevant to the situation of the LDC's since (a) their APS's do tend to be below that of the DC's, so, if it be hypothesized that both groups come from the same universe (in a broad sense) then it must be allowed that APS can rise in the LDC's and (b) an increase in APS has been observed in a small number of LDC's over a period sufficiently long as to argue that it was not a purely transitory phenomenon.

Only if all of the positive relationships between average propensity to save and income were due to the high marginal propensity to save out of transitory income would one be very pessimistic about the long run possibilities of raising the average savings rate.¹ With something like the relative income hypothesis there is obviously a strong pressure against large and long sustained increases in the average savings ratio, but one might suppose some rigidity in consumption patterns. Overall it seems not implausible to assume a positively sloped permanent savings function. This could be based on a desire to bequest or a "residual" attitude to savings. This function may be assumed to shift over time in response to many different factors.

¹The "long run" in this instance is defined by how long it takes individuals to redefine unexpected income increases as part of their permanent income. In the pure versions of life cycle savings theory -- i.e., where there is no presumed desire for bequest, the increase cannot be long run. Where such a bequest is present, and has an income elastic demand, then the savings ratio may be expected to rise in the long run. Otherwise any rise which would occur -- and one would be expected during the process of peoples' becoming conscious of their new higher permanent incomes, and especially given the fact that the income accrues disproportionately to people in the savings stages of their lives -- would be a transitory increase in the average propensity.

It seems not improbable, for example, even though average savings rates do not change over time, that the point of time savings functions does involve a positive relation between permanent savings rate and permanent income, with age, etc. held constant.

There is nothing in the empirical evidence, to my knowledge, which would contradict either the hypothesis that a system with a permanently more unequal distribution would generate higher savings rate on average, through time, or that it would generate a lower one. The issue, in short, of whether a redistribution of income related to changing demographic variables would tend to increase or decrease savings is quite unresolved. The evidence on the marginal rate of savings generated from budget studies is presumably of some relevance to the issue; a budget study MPS which is strongly increasing presumably implies a greater likelihood that the "permanent savings function" has that characteristic than an MPS which is decreasing; but that is about all that can be said.¹

Budget studies invariably indicate that the savings rate is a positive function of family income.² Although the evidence naturally varies

¹If some information of an empirical sort were available on the relative magnitude of transitory and permanent income, one could test the sensitivity of the "permanent" savings function and the observed one but I am not aware of such an analysis having been performed.

²Cline (op.cit.), using observations which were averages for income categories, observed very high marginal propensities in the linear estimating equation ($C=a+bY$, where C is consumption and Y is income), ranging from .29 to .49. (See p. 56) In three of the four countries (Brazil, Argentina and Mexico) he found a significant curvilinear character to the function, i.e., the marginal savings rate did rise with increasing income; in Venezuela this tendency was not significant. In India Friend (Irwin Friend, chapter on "The Propensity to Save in India" in Economic Development Issues -- Dr P.S. Lokanathan Seventy-Second Birthday Commemoration Volume (Vora and Co., Bombay, 1966) used cross-section data and found an all India MPS out of normal personal disposable income of around 0.167. Choudhry used time series data and found an MPS out of total income of 0.1244 and an MPS out of per capita income of 0.2259 [Uma Datta Roy Choudhury, "Income, Consumption and Saving in Urban and Rural India" in Review of Income and Wealth, Series 14, No. 1, March 1968.] One of the most complete surveys of savings information in across developing countries appears to be that of U Tun Wai. [U Tun Wai, "Financial Intermediation and National Savings in Developing Countries," Economic Growth Center Discussion Paper No. 126, August 1971.] His over time regressions indicated MPS normally above APS in both DC's

from country to country, it is typical to find the bottom few deciles engaged in net dissaving while the top decile (earning, say, 35-50% of income) has a savings rate of, say, 10-20% and the top 5% a savings rate of 15-25%. Biases in the data may well be substantial, though it is not clear in which direction they run. There is likely to be greater underestimation of high incomes than of the consumption expenditures corresponding to them. But low income savings are also likely to be underestimated, especially in traditional economies.¹

²(cont'd. from previous page) and LDC's, with median values of MPS in the same range in both cases of around 0.4; the variance was much higher among the LDC's, from -.3 in Ecuador (probably reflecting problems in the national accounts) to 0.9 in Panama (probably suffering from the same problem). Since average propensities tend to be lower in the less developed countries, the difference between marginal and average tended to be somewhat higher. (Tun Wai used linear equations, included a time trend in all the equations and variables for price change, real interest, and rate of growth of real per capita income in various of his alternatives; inclusion or exclusion of the last three variables had some but normally not dramatic effects on the results. The savings variable was total gross national savings and the income variable is gross national product per capita.) Household savings rates derived from national accounts are sometimes below those implicit in budget studies, though not always. (The former suffer, of course, from the high possible error implicit in the residual methodology usually used to estimate such savings. Tun Wai found that over the period 1950-65 (roughly), almost half of the LDC's had household savings rates of less than 5 percent. In two-thirds of the LDC's the personal savings ratio has either fallen or remained almost unchanged over the period; in one-third, significant increases occurred. Meanwhile half of the DC's had savings rates above 12.5.

¹Thus Paniker estimated that around 1950-51 the proportion of savings occurring in kind in rural India was about 40 percent. He argued that the typical savings of the small poor Indian farmers was considerably higher than might have been expected -- the net savings rate could easily be 10 percent, 15 percent, or even higher over a several year average (the rates being quite volatile according to the situation of a given year). (See P.G.K. Panikar, "Rural Savings in India," Economic Development and Cultural Change, October 1961.

Regardless of the general agreement that the marginal savings propensity estimated in a budget survey is above the corresponding parameter of a permanent savings function, few would disagree with the hypothesis that it is positive, though conceivably not very large.¹

Intra-country studies of the direct effects of family size on the savings rate² are less helpful than the cross country studies, to date at least, in part due to the

¹Reasons to expect it to be positive include the facts that (a) some people are involved in a continuous upward adjustment of expected lifetime incomes, and others are not or are adjusting to downward change, and due to habit formation in consumption patterns, the former group, who may be expected to have higher average income than the latter, have higher savings rates; they also have higher savings rates at given income levels; (b) there are real constraints against people having highly different consumption expenditures, based on economies of scale in production and distribution of particular types of goods, working against the provision of relatively low cost goods for people at either end of the income distribution; (c) the rate of return to capital is higher for high income people, and present and future consumption levels (or bequests) are substitutable.

²Family savings appear to provide a rather small share of total savings in some LDC; so demographic effects here might be argued to be of less than overwhelming importance. But data for less developed countries in Asia show that households account for half or more of gross domestic savings--in some countries as much as two-thirds. About one-half of these are in the form of tangible assets, much more than in developed countries. Business savings were between one-eighth and one-quarter and government savings between 20 and 40 percent of gross domestic savings for these countries. In many nations of Latin America business savings account for up to half or more of gross domestic savings.

With respect to the share of government in total savings the developed countries are much more homogeneous, with over half of them in the 25-35 percent range, while for the developing countries 41 percent had less than 15 percent and 26 percent more than 55 percent. Twenty percent (or seven countries) had less than 5 percent. (Gavin W. Jones, The Economic Effect of Declining Fertility in Less Developed Countries, an occasional paper of the Population Council, Feb. 1969, p. 11.)

difficulties of and failure to sort out income and demographic variables. Large family size implies directly a lower average income per capita and per adult equivalent; unless this factor is taken into account explicitly in a budget study, the results will be difficult to interpret³. The logical hypothesis is that savings decrease for a given family income or adult income per capita the larger the family size, because certain consumption expenditures almost inevitably increase. But there has been relatively little empirical testing of this hypothesis.⁴ Studies from LDC's do suggest negative relations between family size and the savings ratio, with family income held constant. A study of middle income workers in Nairobi found higher savings rates for smaller families, which had, on average, somewhat smaller incomes. (see Kenya Ministry of Economic Planning and Develop-

³If family income is the income variable, family size could play a role in the variables which correspond to income; income might provide a fully satisfactory explanation for savings, with demographic factors entering only in their role as direct determinants of per capita income variables. Probably a simpler-though not perfect-methodology is that which separates, as independent variables, income per adult assuming no children and number of children.

⁴One study, based on U.S. data, showed some relation between family size and savings rates, though the results were difficult to interpret. (See W. Eizzenga, Demographic Factors and Savings, Amsterdam, North Holland, 1961.)

ment, Statistics Division, Statistical Abstract, 1969). The results are not unambiguous, however, since age and sex structure of families were not given, so it is not possible to normalize satisfactorily for the income variable. Colombian data show the same relation but are likewise not presented in a form which permits appropriate normalization of the income (and other) variables. (See Rafael Prieto, *op. cit.*)

Observed marginal propensities to save tend to fall in the range of 0.15 to 0.60 (See Tun Wai, *op. cit.*) Gross average national savings almost all lie between 10 and 20 in LDC's (See Tun Wai, p. 118).

Summary

It may be useful here to recapitulate the arguments discussed so far. The impact of demographic variables on output was felt to depend primarily on return to scale and other characteristics of the production function and on savings. The hypothesis that large family size has a negative direct effect on savings appears to be more or less borne out in the studies referred to. The second relevant issue, the indirect impact on savings of a changed degree of income inequality is clarified much less by empirical work; the lack of any persuasive evidence that the relevant "permanent" savings function demonstrates increasing marginal propensity to save argues for the conclusion that the income redistribution effect on savings is not very large. Since most of the other effects are likely to be negative, the probable overall effect seems clearly to be negative.

The impact on distribution, despite considerable ambiguity as to some of the component effects, seems very probably to be negative. It depends, as discussed earlier, on how capital is redistributed over time and on the elasticity of substitution between labor and capital, and on savings behavior. One of the most plausible sets of assumptions, *i.e.*, (a) an elasticity of factor substitution not far from one -- and certainly

not much above one -- so that a substantial decrease in the equilibrium wage rate and an increase in the rate of return to capital may be anticipated to result from a larger population and (b) a permanent average propensity to save which increases with income (even if the marginal propensity does not), implies that short and longer run effects of the population growth work together to provide a strong disequalizing force.¹

The savings -- and hence the future capital stock -- of people toward the bottom of the distribution are lowered by the change in the wage/rental ratio, while those of higher income people are raised; this effect is stronger the greater the positive relation between average savings rates and income levels.^{2,3}

Effects of Population Growth on Income Per Capita Paths When the Alternatives Are A Constant Population Growth Over Time and a Decrease in Growth Over Time

The demographic policy decision which may face an individual country is not the one analyzed above (e.g. a choice between, say, a 3% population growth over past, present and future and a 0% over past, present and future), but rather a choice between 3%, present and future as opposed to 3% past and present but a gradual (or quick) lowering in the future. The two comparisons are quite different, since a country's age structure depends on the past as well as the current rate of population growth. When

¹If to this is added the conclusion of some empirical studies that the rate of return to capital is higher for richer people than for poorer people, the case becomes even stronger, e.g., James E. Meade, Efficiency, Equity, and the Ownership of Capital, London, George Allen and Unwin, 1964.

²These various relations are treated jointly in an interesting model of the interaction between the demographic and economic characteristics of different classes outlined by Herman Daly. Herman Daly, "A Marxian-Malthusian View of Poverty and Exploitation with a Corresponding Typology of Social Classes," Economic Growth Center Discussion Paper 80, November 1969.

³Regardless of the much more difficult question of how marginal propensity to save changes with income levels, there seems less doubt (see above) that average rates do rise.

birth and death rates are stable over a considerable period, age composition also stabilizes; it is then particularly meaningful to talk of over time changes in income per capita, etc., since that variable changes in the same degree as such more directly meaningful variables as income per adult equivalent, average family income, etc.¹

When the rate of population growth is changing, careful attention must be given to the implications of the lag between the birth of a child and his entrance into the labor force, a lag which ranges between 10 and 20 years according to the system in question. It implies that, during the first 10 to 20 years after a fall in the rate of population growth (assuming that the fall is due largely or wholly to changes either in fertility or infant mortality rates -- not too far from the truth in most LDC's -- there is no short run effect on the rate of growth

¹Comparisons between two different systems with population growing at constant but different rates can be dangerous since the different rates imply, for example, different child/adult ratios. The ratio of the average income per capita figures would thus be different from the ratio of the average family income figures. But at least over time, changes in income per person would be relevant measures of changes in the relative development of the two economies.

of the labor force, i.e., a slowdown of population growth does not affect the rate of growth of output during this period through the mechanism of a smaller labor force (though, of course, it may through other mechanisms).

The second important implication of the fact that the age structure and the dependency ratio change during this transition period is, as suggested above, that the concept of income per capita is a dubious one by which to measure economic success. Its uniform validity requires the assumption that the same level of income is required for an individual to achieve a certain level of satisfaction, regardless of his age, regardless of how individuals are organized into families., etc. In fact, it is obvious that a child of one year old consumes less than an adult; there may also be economies of scale in housing and certain other expenditures (e.g., the cost of six people who live under one roof and achieve a given level of satisfaction per person may be less than 50% higher than the cost for four). Both of these factors suggest the need to use the concept of "consumed equivalent" in this analysis.

The implications of adding these two transition period considerations to the prior discussion can be seen easily in the context of the "benchmark" set of assumptions used above (linear homogeneous production function, savings rate independent of population growth and no technological change). In the comparison between two constant different population growth rates, it was observed that a system with population growth $Z\%$ lower would experience a growth of per capita income less than $Z\%$ greater; with the present assumption of independence of the growth of the labor force from the growth of population, a population growth lower by $Z\%$ does imply a per capita income growth faster by exactly Z percent, since both the capital stock and the labor force are growing independently of popu-

lation, and the only difference between the two cases is the number of people among whom the total income is to be distributed. In other words, the disadvantage of population growth seems to become greater with the addition of this realistic assumption. But allowance for the fact that the ratio "consumer equivalents/population" is lower in the faster growing population partially offsets this feature; the difference between the two rates of growth of income per consumer equivalent is less than the difference between the two rates of growth of per person income. The importance of this latter consideration depends on the weights applied to people of different ages in calculating consumer equivalents. If, to take an arbitrary example, the "adult equivalent" coefficient for children of one year old was .1, that for children of two years old .2, and so on up to 10 at which they were assumed to be adults, then a sudden drop in population growth rate from 3% to 0% would in the first year after the change imply a rate of growth of income per adult equivalent only a little over 0.3% higher than it would have been with no change in population growth (instead of the full 3% increase in the growth rate of income per capita)¹ and in the

¹The percent of total population which is in the age group 0-1 when population is growing at 3% is $3+x$, where x is the percent of the year-end population which died during the year (perhaps between one and two per cent). If X is the absolute number who died, then

$$x = \frac{X}{P_3}$$

where P_3 is the year-end population in the system growing at 3% per year. If we assume the only source of the difference in the growth rates of the two populations is their birth and infant mortality (less than one year) death rates, then the per cent of total population in the age group 0-1 in the system with no growth is

$$\frac{X}{P_0} \quad \text{or} \quad \frac{(1.03)X}{P_3} = 1.03x$$

The per cent of all adult equivalents in the 0-1 age range depends on length of life and the weightings of different age groups. If $x = .01$ this per cent would be about 0.48. For the population whose growth just dropped to 0% it would be about 0.12. Thus since the growth rate of adult equivalents differs only by about .036 between the two cases, so does the growth rate of income per adult equivalent.

second year of a little over 0.6%; by the 10th year the adult equivalent growth rates are different by the full 3% or a little more.¹ Around this time or soon thereafter, the labor forces of the two systems begin to differ so the difference in the rate of growth of income per adult equivalent will soon be pushed below 3% again. This issue can be an important one in the short run.²

Demographic and Economic Variables in a Keynesian System

Perhaps the only two very serious arguments which have ever been put forward in favor of population growth are (1) the increasing returns to scale argument already referred to, which may be of some validity in a small economy which faces severe barriers to international trade and as a result cannot take full advantage of specialization through trade, and (2) the argument that in an economy suffering from a lack of aggregate demand, a growing

¹Since a sudden change in growth rate from 3 to 0 creates a sudden discontinuity in the number of people in contiguous age cohorts, beginning about 10 years hence there will be a period when the absolute number of consumer equivalents falls briefly; it will then oscillate before reaching its final level, that corresponding to a zero population growth and the given death rates,

²Some information is available to provide a basis for estimating these consumer equivalents. If one is willing to assume that within a family, food, clothing and so on are distributed so as more or less to equate the satisfaction of parents and children, relative amounts consumed then constitute an interesting measure of consumer equivalents. It appears from some empirical studies that the "adult equivalent" of children is not as low as one might think, at least after the first two or three years; children around 10 to 15, for example, tend to consume more food than adults and they are frequently receiving education whose private and public cost can loom large. In defining the consumption of children, however, one should try to separate out that part of educational expenditures which corresponds to consumption and that part which is investment; if it was all felt to be investment, the adult equivalence of children would be smaller. (Investment is appropriately separated on the grounds that we allow for it in the analysis of how K/L changes.) Some other questions of technical interest also depend on how education is viewed, e.g., the relationship between the savings rate and population growth would clearly depend on the extent to which education is defined as investment. If all of it were so defined, the savings rate could turn out to be an increasing function of population growth, and if none were the opposite. Probably the best criterion to decide how it should be handled is its payoff, not how it is viewed by the various participants in the drama. If a society has a certain minimum amount of education (e.g., provided by law) it might not lead to errors of analysis to consider this to be consumption, while treating further expenditures as investment. But this is clearly a fuzzy area.

population may stimulate a multiplier effect, via the creation of a higher demand for new housing and other basic items whose demand is more a function of population growth rates than population size. The demand for items like housing (long life) reflects the accelerator principle, i.e., a small percent increase in the demand for the service provided by the good leads to a much larger increase in demand for its production. In a situation of insufficient aggregate demand, the accelerator-multiplier interaction can be a powerful mechanism. This argument can be especially valid if, as is likely to be the case with housing, the increased demand associated with faster population growth implies a large increase in ex ante investment minus ex ante savings. Although new families acquiring houses are likely to try to increase their savings rates, this increase is likely to be much smaller, at least in the first few years, than the investment involved.

The strength of this possible positive effect of population growth on income would depend on the amount of investment demand generated, and the smallness of any associated increase in ex ante savings, as well, of course, as on the multiplier. The main forms of investment would presumably be housing, certain types of social infrastructure such as roads and education where requirements tend to be a function of population. With further specification of the production process and of the relative unemployment of various factors in the underemployment equilibrium, it would be possible also to determine the impact of the population growth on distribution of income along with that on output and employment.

Economic and Demographic Factors in a Labor Surplus Model

It seems probable, intuitively, that the negative effects of population growth will be strongest in a labor surplus situation,¹ more spec-

¹This has been pointed out, among other, by Richard Easterlin, op.cit.

ificantly, in that labor surplus case where $MPL = 0$,¹ since of the two usual effects of population growth (i.e., increase in output and increase in the number of people among whom that output or income is divided) the positive one is removed; a population increase generates no increase in output, even in the long run. Other things being equal, the relation between average per capita income and population size is a precise one; with $x\%$ more people, income per capita is $x\%$ lower.

The case of fixed proportions between labor and capital (analyzed above) is one example of a labor surplus situation; other cases are outlined in the extensive literature on the labor surplus economy. The reasons for the presence of labor surplus do not concern us here; it seems probable that some such phenomenon does exist in many countries.

With $MPL = 0$ the conditions which in the context of the neoclassical model imply a positive effect of higher population on income per capita no longer do so; the existence of increasing returns to scale is "irrelevant;"² and by the definition of labor surplus, a rise in $\frac{MPL}{MPK}$ as L rises could not easily lead to an improved distribution.³

¹The labor surplus condition is usually defined by the existence of a sector of the economy in which the income level (or wage rate, depending on how it is viewed) of labor is above its marginal productivity; that marginal productivity may or may not be zero; results for cases where it is positive but low would be less extreme than the ones discussed here.

²Since taking advantage of them depends solely on an increased capital stock and is not furthered by a larger labor force.

³ $\frac{MPL}{MPK}$ originally at zero, would have to increase substantially before MPL would equal wages, since labor surplus theory postulates a wage well above zero. Rising MPL could still push wages up, but probably less rapidly than in a neoclassical setting. So a positive income redistribution seems almost impossible as a result of higher population; the opposite is almost assured.

The only remaining issue to be discussed is the impact of population growth on the savings rate. On the dynamic side, the same questions as discussed for the neoclassical case are relevant here; overall, they make the result generally indeterminate, though there is an even stronger presumption in this case that the effect of population growth on average income will be negative and that distribution will be worsened.