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POPULATION GROWTH AND SAVINGS IN LDC'S: A SURVEY ARTICLE

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Abstract

This paper surveys the theoretical and empirical literature concerning the possible effects of population growth on the aggregate savings rate. The effect is examined from three perspectives: 1) macroeconomic effects of variations in the age structure of the population, 2) choice theoretic models of family decision-making and 3) market level interactions of variables which determine individual decisions.

Population Growth and Savings in LDC's

Both population growth and savings have traditionally taken a certain pride of place among models of growth and development. In the earliest neoclassical models, the savings rate, in interaction with the rate of labor force growth, determined the rate of per capita income growth. The general conclusion was that for a given rate of savings, the faster was the rate of population growth, the lower was the level of steady state capital stock and the slower was the approach to that level (Solow (1956), Coale and Hoover (1958), Enke (1971) and Nelson (1956) inter alia). This effect led to the general feeling that faster population growth was an unambiguous drag on growth and development.

The purpose of this paper is to examine the literature concerning the hypothesis that the savings rate itself is a function of the population growth rate and this effect exacerbates the negative effect of population on economic growth.

The plan of the paper is to examine this evidence from three perspectives. The first looks at demographic models of the age distribution of a population. In conjunction with life cycle characteristics of income and consumption, these models can lead to predictions of the effect of population growth and savings. The empirical evidence on the aggregate level on this subject is also reviewed.

The second part of the paper takes a closer look at the microeconomic behavior underlying the demographic models. The variables of income and savings for which the age structure models provide a convenient aggregation scheme are determined at the household level. The joint determination of fertility decisions and savings decisions are examined.

The third section returns to the aggregate level. When the individual decisions relevant to the joint problem discussed in the second part are aggregated, market determination leads to a number of problems of simultaneity. Variables which are exogenous to households (wage structures, relative prices and interest rates for example) are endogenously determined at the market level and further interactions between population growth and national savings can be discerned.

The principal conclusions of the paper are, by necessity, quite ambiguous. While there is much evidence to indicate that these two aspects of development are intertwined in many ways, no simple generalizations are justified. The net effect on an economy will depend on factors which are specific to the country in question.

I. Macroeconomics: Age Structure and Savings

Formal demographic models allow for the examination of the effect of population growth on changes in the age structure of the population. The usual cause of the population growth examined is an increase in fertility, however, the models are sufficiently general to allow for decreases in mortality as well. Given a change in the age distribution, the effect on any variable which has a distinctive age specific component can be calculated. If the age specific component is essential to the behavior of the variable, the age structure can be an important determinant. Therefore, for the analysis of pension fund demands, proportion of the population which is retired or the need for high schools, the demographic models obviously have a great deal to say. Drawing on a separate body of the economics literature, the life-cycle savings hypothesis, the presumption is that population growth should have substantial effects on savings.

The life-cycle savings hypothesis, originated by Modigliani and various co-authors (Modigliani and Brumberg (1954), Modigliani and Ando (1957)) is in general use in the economics profession. The essential feature for our purposes is that savings, the difference between current earnings and consumption, should take on a general age specific form. Individuals are assumed to maximize total lifetime utility subject to a lifetime wealth constraint. Capital markets are assumed perfect so that borrowing and lending are allowed to separate income from consumption decisions freely. Under this formulation, standard instantaneous utility functions (concave in consumption) will generate relatively flat consumption demands over the life-cycle. People will want to avoid large swings in consumption and, so, would prefer relatively smooth consumption patterns. On the other hand, the income earned as a function of age does not follow the same pattern. Earnings profiles generally rise in early years of entry into the labor force, peak and are reduced (possibly to zero) in retirement. If the horizon of analysis for the intertemporal decision problem is an individual's whole life, the earnings are near zero for most of childhood, are positive in the middle years and drop off again in old age. This inverse U shape in income, when combined with the relatively flat consumption function (in age), yields a similar inverse U shape for savings over the life-cycle. If the horizon of analysis is the adult life, the increase in earnings in the beginning of the life is more modest (and depends on the productivity of different aged workers or wage ladders) but the reduction in later years remains. The shape in this case is basically downward sloping with the young working and the old retired. As it turns out, the choice of units of analysis, individuals over their whole lives or households over the life of the head, is a crucial distinction in the subsequent analysis.

From the demography literature we obtain a characterization of the age distribution of the population. The concept is of the stable age distribution which reflects the position in long run equilibrium of constant age specific birth and death rates. Using standard notation (Arthur and McNicoll (1977, 1978):

$$c(a) = \frac{\rho(a)e^{-na}}{\int_o^w \rho(a)e^{-na}da}$$

where p(a) is the probability of survival to age a, c(a) is the proportion of the population of age a, n is the population growth rate and w is the maximum age attainable.

The savings rate of the economy can then be described by:

$$S = \int_o^w s(a)y(a)c(a)da$$

where S is aggregate (or private) savings, s(a) is the age specific savings rate as described by the lifecycle theory of savings and y(a) is the fraction of national (or private) income accruing to people in age group a.

This model is best suited for the analysis of private savings of individuals. The theory of the life cycle savings relation is based on the individual utility maximization problem. However, as formulated above, the problem can be extended to any arbitrary function s(a). If, somehow, the government sector's savings can be attributed to the population as a function of age, the above formulation can capture governmental effects as well.

Under the assumption that a change in the population growth rate does not effect the intergenerational distribution of income, the effect of an

increase in the population growth rate due to an increase in fertility can be shown to be:

$$\frac{d\ln S}{dn} = A_p - A_s$$

where A_p is the average age of the population and A_s is the weighted average age of savings (weighted by population proportions). More intuitive, perhaps, is to separate the components of savings into earnings and consumption so that:

$$\frac{d\ln [Y/C]}{dn} = A_c - A_E$$

where C and Y are aggregate consumption and income respectively and A_E is the average age of earnings. This result states that an increase in the population growth rate will decrease savings if the average age of earning income is larger than the average age of consuming income. Given the inverse U shape of the life-cycle savings function, the relative size of these averages may be ambiguous. However, in poor countries, the young greatly outnumber the very old, the average age of consumption is likely to be smaller than the average age of earnings. At least, this is true when the unit of analysis is the individual.

This is the essential conclusion of the simple demographic model of savings: an increase in the growth rate of the population due to an increase in the rate of fertility reduces aggregate savings. A similar conclusion follows from a change in the mortality rate, though the effect is, in general, smaller (Arthur (1981), Hammer (1980)). A rapidly growing population has a large number of young people. Young people tend to consume more than they

produce. If there is no countervailing increase in the income of adults or decrease in the consumption of adults, the effect will be to reduce aggregate savings. The added burden of dependents reduces available investible resources.

Before examining the empirical evidence on the subject, a number of qualifications to the above analysis must be made. Criticisms can be levelled at the above analysis on the basis of the simplifications of constant savings rates and income earning capabilities. Secondly, the life-cycle theory of savings is open to doubt both on its empirical relevance in the developed world (its home turf) as well as its relevance, theoretical as well as empirical, for explaining aggregate savings in LDC's.

As mentioned above, the results are sensitive to the definition of the unit of analysis. The alternative to the approach based on individuals is one based on the household. In the above structure, life would begin at the time of household formation, say age 20. In this case, children are not independent decision makers. Their consumption patterns are set by their parents for whom they are, in effect, consumer durables. Under this change in assumption, the presumption of the above results is much less firm. For individuals, it is obvious that children will consume more than they produce and their weight in the calculation of average age of consumption will be important. In the earliest examples of the household based approach, the consumption of children was entirely ignored (Samuelson (1958), (1975)) and the results were exactly the reverse. Here, since the younger generation (ignoring children) unambiguously produce more than it consumes while the older generation (retirees) dissave, faster population growth increases savings. Neither extreme is likely to be correct. Children are a claim on resources but they do not make their own consumption plans. The household

head can reduce his or her own consumption as a result of extra children, treating the necessary consumption of the children as a reduction of available resources in the life-cycle utility maximization problem. The inclusion of the children in this way appears to dampen the original results substantially. Using some stylized facts concerning the relevant variables, Lee (1980) calculated numerical examples to the effects of population growth on the different versions of the model. The different values of the expression $d\ln(Y/C)/dn$ were -5,5,-.8 for the cases where the unit of analysis was the individual planning from birth (the first case above), the individual planning from age of household formation (with children ignored) and the household model with children's consumption as a fixed proportion of adults'. Plainly, the entire flavor of the results depends on the version employed. Furthermore, the results with children's consumption included in the household model are very sensitive to the assumed value given to the fixed proportion of children's consumption. In Lee's example, children were assumed to consume 15.4% of the household's total consumption. If this number were lower than 13.3%, the net effect of population growth on savings would have been positive. The degree of sensitivity of the results to the parameters of the model which are likely to differ across countries undercuts the ability to make broad, cross-national conclusions, even at this level of abstraction.

A second assumption which might be relaxed is that of a fixed distribution of income across age groups. That changes in the age distribution can effect the distribution of income by age is well documented in the literature (Welch (1975), Easterlin (1968)). Most of the important effects of supply of labor on relative wages will be discussed in the last section. However, changes in income can be incorporated into the above model in a simple way. Papers by Mason (1977, 1980) incorporate a rate of growth effect of income on savings in a model essentially like the one above. He

notes that savings function frequently include the rate of growth of the economy as one of its arguments (Mikesell and Zinsser (1973)). The rate of growth of the economy is directly influenced by the rate of growth of the labor force (multiplied by the marginal product of labor). To the extent that faster growing income increases savings, there is this second effect of the growth of population. This consideration also serves to undercut the conclusion of the dependency based models of savings. His conclusion, based on empirical estimation of both effects, is that for slow growing economies, the rate of growth effect (increasing savings rates) will dominate the dependency effect. Only in economies which are growing very fast will the dependency effect dominate. Thus, in countries such as Korea or Japan, the change in age structure from slowing population growth may have given an important boost to savings. In general, the net effect is likely to be quite small.

An entirely different line of criticism stems from questions concerning the adequacy of the life-cycle model of saving in explaining savings behavior. Recent work (White (1978), Kotlikoff and Summers (1981)) has called into question the explanatory power of the model in the United States. On the theoretical level, the model ignores motives for saving other than smoothing consumption within a person's lifetime. A significant amount of personal savings may stem from the desire to leave a bequest to one's children. If this is true, the life-cycle savings function need not be of the assumed inverse U shape. Recent work seems to show substantial savings among older people (Menchik and David (1983)). Whatever the cause, attempts have been made to measure directly the age specific shape of the savings function. Using cross section evidence on earnings functions and consumption patterns from survey sources, Kotlikoff and Summers find only a very flat

relationship between savings and age. The U has little depth in the U.S.. As such it was able to explain less than 20% of total private savings.

In the context of the less developed countries, the life-cycle hypothesis may be even less well equipped to explain aggregate savings rates. As for the assumptions of the model, the credit markets in many LDC's are frequently poorly organized. The ability to obtain consumption loans through organized markets may be tightly circumscribed. Therefore, the timing of consumption may be, by necessity, more closely tied to the income stream than is allowed in the stylized optimization problem of the individual. Some of this effect can be offset by intrafamily transfers within an extended family (Kotlikoff and Spivak (1981)) but this can be done only imperfectly. A second concern is that children in agricultural households come to contribute to the family income at a much earlier age than households in urban, industrial areas (Rosenzweig and Evenson (1977), Mueller (1976)). Given the proportions of agricultural households in most LDC's this would tend to decrease the earnings differential between children and adults. While the above two arguments do not affect the logic of the life-cycle model, they do tend to argue for relatively smaller differentials in savings rates by age groups. This would undercut the effect of changing age distributions as an important determinant of total savings.

Finally, the importance of family savings averaged over age groups may be of limited relevance to total personal savings rates or to total national savings. A possibility pointed out by Gupta (1971) is that in poor countries, personal savings are acquired by a very small number of people. The very poor, indeed, the majority of the population, do not generate much of the total supply of investible resources. The analysis of private savings, then should center on the behavior of only the well-off segment of society.

The connection with the overall age distribution may be remote and largely irrelevent. Fertility is a "democratic" concept. All families enter into the population growth statistics equally. Savings in poor countries, on the other hand, may be concentrated in relatively few hands. Models relevant to the whole population may have little relevance to aggregate savings rates.

On a more general level, the assumptions of the models examined which propose that savings rates, by age group, are exogenously determined and are independent of fertility decisions is quite suspect. The microeconomic aspects of the problem, which view the savings and fertility decisions of the household as simultaneous are left for the following section of the paper.

Empirical Evidence

Since the theoretical relation between the age distribution and the savings rate can be of either sign, the final arbiter must be empirical work. Unfortunately, more controversies are generated by the available studies than are answered. Most of the studies rely on a cross section of countries, often at very different levels of development. This type of analysis is subject to a variety of criticisms. Problems of data comparability and quality are substantial. In many countries, numbers reported for savings are computed as a residual between figures on aggregate income (often suspect) and aggregate consumption (also suspect). Commenting on the principal paper in the field, Goldberger (1973) notes that the data set is not internally consistent (savings per capita did not equal the savings rate multiplied by income per capita even in the data). Furthermore, estimation of a cross national savings function assumes that all observations are drawn from the same savings function. The variety of economic conditions and local factors which may effect savings behavior are numerous and this

assumption is probably not very good. These factors may explain the notable instability of estimates in savings functions using this type of data (Mikesell and Zinsser, (1973), Snyder (1974)). Preferable data would be time series for a particular country. This would control for the country specific variables which determine savings. However, since age distributions change slowly and population censuses are conducted relatively infrequently, data restrictions for such studies are severe.

The first test of the relation between the age distribution and savings rates was conducted by Leff (1969). This study generated a great deal of controversy. (see the comments by Adams (1971), Gupta (1971), Goldberger (1973), Bilsborrow (1980), Ram (1982) and the replies by Leff (1971, 1973, 1980)). The original study examined the effect of the proportion of dependents on the aggregate savings rates. Dependency ratios (the proportion of the population under 15 and over 65) were used as the explanatory variables along with per capita income and the growth rate of income. In this paper, each of the dependency ratios were found to decrease savings significantly.

In response to that paper, many authors have criticized the work on the basis of its lack of robustness to possible omitted variables and with respect to the particular countries included in the original sample. Adams (1971) reported results similar in explanatory power to Leff's with a dummy for LDC's substituted for dependency rates. It is unfortunately true that many variables of interest in the development process are highly colinear. As extra variables are added to an equation such as savings rates, the multicollinearity problem should prevent precise estimation of regression coefficients. It is difficult to obtain results in cross country studies which are robust to possible alternative specifications. For this reason, the

theoretical foundation of the study is important. In this case, the ambiguity of theory is not of great help.

Others, such as Bilsborrow and Ram, contend that the original results are not robust to changes in data sets. The final word on this subject is not yet in. The following table presents the results of a number of authors' studies which have a bearing on this case. In general the data sets vary considerably from one study to another as do the other variables included in the regression.

Estimates of the effect vary considerably between specifications of the model and data sets. If generalizations are necessary, the results appear to be weakest for the poor countries and stronger in the developed world. This is consistent with the argument that the assumptions of the theory are less well net in the LDC case. As a guide to the countries of most interest in regard to population policies, the results of the empirical work are as ambiguous as the theory.

It should be noted that these studies examine the effect of age distributions on the savings function and not the effect of population growth. It is usually thought that higher rates of population growth are associated with higher dependency rates. However, as Kelley (1973) points out, older dependents may be a larger drain on resources that younger ones. As population growth rates increase (from increases in fertility) the number of young dependents rises but the number of older dependents falls. Using different weights for the consumption of older and younger dependents, he shows that increased population growth can have either a positive or a negative impact on the aggregate savings rate. Mason (1980) includes the rate of growth of population in the calculation of the rate of growth of output (included in the savings regression of Leff) and finds that while the

ELASTICITIES OF SAVING WITH RESPECT TO DEPENDENCY RATES

Author	Sample	Dependency Measure 1/ D1 2/	D2 3/	D3 4/	Comments
Leff (1969)	74 countries	-1.35*	-.40*		
				-1.49*	
	47 LDC's	-1.23*	-.44*		
				-1.49*	
Gupta (1971)	Poor Countries	-.77	-.65		Data from Leff Study
	Middle Income	-.62	-.04		
	Rich Countries	-2.70*	-.89*		
	Total Sample	-1.84*	-.54*		See Note 5
Adams (1971)	47 LDC's	-.46			Data from Leff Study
			-.67		
				-.80*	See Note 6
Leff (1971)	74 Countries	-.97*	-.39*		Included Dummy for LDC's
	67 Countries	-.99*	-.38*		Excludes socialist countries
Gupta (1975)	40 LDC's	-.63*			See Note 7
Singh (1975)	70 Countries			-.13*	Data averaged over five years See Note 8
Ram (1982)	110 Countries	-.004	-.375		Data averaged over ten years
	66 LDC's	1.32	.207		Includes foreign Capital flows
	31 DC's	-1.08	-.96*		
	70 LDC's	.08	-2.48		Estimated with instrumental variables

* - Significant at 10% level

Notes to Table

1. Coefficients presented on the same line indicate that variables were included in the same regression equation.

2. Proportion of population less than 15 years of age

3. Proportion of population more than 65 years of age

4. D1 + D2

5. Results show no significant effect for poorer countries; overall effect captures rich countries' influence only.

6. Results were to show that effect is spurious if neither young nor old dependents had effects individually.

7. Equation was estimated in a simultaneous equation framework. Both savings and dependency rates were endogenous. Reported effect is the intercept of multiplier of dependency rate on saving.

8. Dependent variable is the labor force participation rate, not the dependency rate. The sign of the coefficient was reversed to be conformable to the rest of the table. Coefficient combines age effects and sex effects.

dependency effect of population growth retards savings, the direct effect on income growth increases savings and the net effect is ambiguous.

Other studies, using different sorts of data that are not directly comparable to the studies in table 1 are relevant to the issue. In a recent paper, Lewis (1983) simulates the impact of life-cycle savings in the American economy in the nineteenth century. He finds that age distribution changes could account for one quarter of the rise in savings rates over that period. In a different sort of cross national study, Simon (1975) found population density on agricultural land was a good predictor of investment in irrigation. While not directly comparable to the other studies, this work illustrates that national financial savings rates do not capture the whole story of savings. Many other aspects of savings such as direct investments of farm households (perhaps more important than financial savings in agricultural societies) and investments in human capital are not considered in the above studies. Unless the effects on these alternative savings instruments are explained, the aggregate results may be far off the mark.

Finally, most of the studies mentioned above use as the dependent variable gross national savings. The life-cycle theory which underlies the hypothesis is best applied to personal savings. Admittedly, the substitution possibilities between various sorts of savings instruments should be taken into effect, yet little explanation is provided as to the determinants of the other components of savings. The reaction of government expenditures to the relative size of different age groups should be investigated.

II. Microeconomics: Fertility, Savings and Family Choice

Since both the theoretical studies and the empirical analysis done at the aggregate level are ambiguous, it is useful to look at possible

microeconomic foundations for a connection between population growth and savings. One aspect of the question which is immediate at the micro level is that it is not legitimate to specify the usual single equation models with demographic variables exogenously determining savings. The above models implicitly have fixed, age specific, savings rates which the exogenous changes in age distribution manipulate into aggregate values. Much work in recent years has dealt with attempts to explain fertility of households endogenously (see articles in Schultz (1974)). Similarly, savings are a matter of household choice. The imputation of causality running from fertility to savings is misleading since both are simultaneously determined by family conditions and opportunity sets. In an extreme form, this argument would be that one item in a demand system cannot be used to explain another, the mutual determinants are the relative "prices" of the commodities.

The second kind of criticism of the mechanistic age structure models is that there are many alternative ways of accomodating extra children besides reducing savings (Kelley (1976), Bilsborrow (1979)). Other variables can adjust to the extra burden. Income can increase as parents work harder to support the family. In this case it is leisure, not savings, which adjusts. Alternatively, parents may reduce their own consumption of market goods. This reduction may be contemporaneous with having children or it may come in later life. Children may work, at least in agricultural societies, so that their leisure may adjust. Finally, if children are planned, parents may save more in anticipation of the extra consumption needs. In this case, any cross section study will show children as having a negative effect on savings, but no real effect over the lifecycle. Indeed, in the case of saving for children (reduced consumption before childbearing), the aggregate effect of population growth would be to increase total savings as the average age of consumption

would be increased. In any event, more than just household saving can be used to accomodate children's consumption needs. Once again, the theoretical possibilities include either effect of population growth on savings and the issue must be resolved empirically.

There are a few caveats to be mentioned in connection with the empirical work. First, the work done on developing countries is scanty. Very few careful studies of both fertility and savings have been carried out at the household level. Even in the industrial countries, the amount of work is small. Second, the definition of savings is problematic at the household level and not always easy to compare to the national accounts. Gold, land or any capital gain investment is hard to measure. While relevant to the household, these savings and investments are hard to aggregate. In agricultural societies, direct investment on the farm is also savings but similarly hard to mesh with aggregate figures. This measurement problem underscores the difficulty in interpreting the aggregate studies. Third, much of the research on savings is not tied to demographic composition of households. With these warnings in mind, the few related studies can be discussed.

The studies that deal with direct effects of family size on savings provide limited information with ambiguous results. Using data from the U.S., a few studies have looked at the relation between number of children and changes in assets. The main effect common in a few studies is that the timing of childbearing and the age of the children and the parents is more important than size of the family per se. Freedman and Coombs (1966) found that having many children early in the marriage interferes with asset accumulation. Espenshade (1975) finds that the age of the child is an important variable in explaining savings though the number of children is not. Young children were

found to reduce savings but older children appeared to increase savings (though this result may be an artifact of the functional form used in the study). The explanation given was that people may begin saving for higher education as the child gets older. Thus, children may be influencing the timing of savings rather than its overall level.

In the most careful study of this type, Smith and Ward (1980) examine the various adjustments families make to children with data from a panel study of U.S. households. They find that families do reallocate their time and expenditures to accomodate added children. They find that the duration of the marriage is an important consideration in the effect on savings. Young families tend to reduce their financial assets in the early years of childbearing. Interestingly, the effect of young children is to reduce total family consumption, not to increase it. Parents consumption takes some of the burden of reduced resources. The parents substitute more time in the home for consumption of market goods. Family income is reduced more than this, though, as women leave the labor force and the family loses the wife's earnings. All of these effects disappear for marriages of longer duration. The reason is that much of the reduction in savings in young families was to finance consumption of durables (housing in particular), which are already in place in marriages of longer standing. In all, the effect of children on savings was quite modest, affecting the composition of assets more than their level.

The evidence from these studies is that children may have little impact on the amount of savings done by the household but may affect the timing of that savings. The timing of the savings can affect the aggregate effects of population growth but the size and the direction of this effect is not clear.

Exploiting the simultaneous aspect of saving and fertility decisions Kelley (1976) analyzed data from an 1889 survey of American iron, steel and coal workers. Both savings and number of children were endogenous variables. Therefore, the connection between the two depends on changes in the exogenous variables that determine them mutually. He found that the direction of the relationship between the two variables depended on the particular exogenous variable which caused the change. In general, the relationship was ambiguous.

In one of the few studies to be done in the developing world, Kelley (1980) reports on a survey conducted in urban areas of Kenya. His main findings are that children have no effect on financial savings. If, however, investments in human capital (education expenditures in this case) are included, the children increase the overall savings rates. The inclusion of education in this case points out another gap between household savings models and aggregate savings rates as conventionally measured. Further discussion on this point is left for later.

Since so little work has been done in LDC's it is hard to assess the relevance of the above studies. The evidence, in any case, is quite ambiguous. This ambiguity, however, does not mean that the two variables, population growth and savings are unrelated. Since they are both important decisions of the household, they may be linked in many ways. As endogenous decisions, though, they should be discussed in terms of the effect which the exogenous variables and constraints facing the family might have on them. This way we can see if there is a general tendency for the two to move together or in opposition depending on what causes the change. Since so little work has been done in this field, the proposed effects are little more than speculation. However, it is interesting to trace possible mutual determinants of population growth and savings in the LDC context.

Wage rates

Wage rates, particularly for women, are frequently cited as a measure of the opportunity cost of time spent in the home at child rearing activities. The hypothesized relation is that higher wages for women are likely to increase labor force participation by women and decrease fertility. Increased money incomes from women's work may plausibly be expected to increase financial savings. Therefore, there may be an expected negative correlation between fertility and savings due to changes in the wages facing the household. Labor force participation is itself a jointly determined variable. In this case, then, we might be interested in the effects of wages (the exogenous component of the decision) on all three. While the first effect, wages on labor force participation, has been identified in a number of studies (though mostly in the industrial countries) the second effect, on fertility, remains problematic. In the developing countries, in particular, the link between women working outside the home and fertility rates is difficult to identify empirically (Standing (1981)). So, while a plausible story for the developed economies, the link is tenuous for the developing world.

The connection between female labor force participation and savings is similarly hard to find. While the study of Smith and Ward shows a reduction in saving due to younger women leaving the work force to have children, this effect is reversed for older women. Older children may help in the house or take care of younger siblings freeing the mother for work. Alternatively, the prospect of financing college education may require increased market earnings and savings from the secondary earner (Turchi (1978)). Empirical evidence from the LDC's is fragmentary. As mentioned

above, Singh (1975) finds the overall labor force participation rate is a significant determinant of aggregate savings in a cross section of countries. He interprets this to be a measure of the dependency rate and as capturing age distribution effects. On the other hand, a large part of the variance in labor force participation rates in aggregate data is due to variations in female participation. His results, then, may have less bearing on the age structure debate than on the question of the role of women's earnings on savings. This is, admittedly, very slim evidence. Hammer (1981) included female labor force participation in a savings equation and found the coefficient to be positive but not significant.

In any case, while the argument that high wages for women increases labor force participation, increases savings and decreases fertility sounds plausible, direct evidence on the subject is still to be found.

Urbanization

The urban/rural status of a household can influence both fertility and the savings decision. As economies experience a shift in activities from agriculture to industry, the value of children as producers declines (Mueller (1976), Rosenzweig and Evenson (1977)). Costs of raising children are also higher in urban contexts. On the savings side, the story is more difficult. While financial savings, the monetized component of aggregate savings, may very well increase in an urbanized, or nonagricultural society, direct investments by households may decline. It is the monetized savings which are recorded in national accounts and may show increased savings with urbanization (though, again, the evidence is scanty). However, the direct improvements in agricultural land which are not measured are no less important for development. Agricultural status, then, decreases measured savings but has an

ambiguous effect on total savings. In rural regions, the availability of investment opportunities may increase the demand for children and direct savings and investment (Bhalla (1978).

Institutional structure

Various institutional constraints that parents face can influence both the savings and fertility decisions. These effects will, necessarily be country specific.

Recent work has suggested that there may be a connection between the operation of capital markets and fertility. The old age security hypothesis has long been proposed as a motive for having children in LDC's (Willis (1981)). It seems a natural extension of this line of thinking that institutional features of the economy which affect the ability to provide for retirement years may change the perception of the value of children. In a very cautious, exploratory study, Nugent and Gillaspy (1983) present evidence from rural Mexico in which the provision of pensions and social security payments by the government was shown to decrease the number of children born to women. Children are no longer needed to provide for old age. A substantial debate has developed over the effect of social security systems and aggregate savings (Feldstein (1974, 1977, Kotlikoff (1979)), and final judgement on the subject is not available. If savings is best described by the life-cycle theory, the effect of social security should be to reduce private savings as government replace private funds. If bequests are more important, this effect is reduced or eliminated. Thus, social security may tend to reduce both fertility and savings, though both effects are far from certain. However, this shows a case in which savings and fertility may move together.

In a similar vein, Hammer (1981), provided some evidence of a similar effect operating through private credit markets. Using cross country aggregate data, this paper shows an inverse relationship between the "quality" of the private credit system and fertility rates. As the ability of the banking system to provide safe channels for saving improves, the security motive for children declines. The presumption would be that improved credit markets would also increase savings. However, this effect was not significant in that study (casting some doubt on the reliability of the results). If the main effect is through the change in the real interest rate, though, the effect on savings should be ambiguous. The interest elasticity of savings is a difficult parameter to estimate (Giovannini (1983), Chamley (1983)). Assuming that it is positive, this line of research suggests that improved credit conditions induces an inverse relation between fertility levels and savings.

Different financing arrangements for education may also condition the effect of children on savings. In the study of Kenya mentioned above, Kelley (1980) showed that the desire to educate children (due to large earnings differentials) led to higher savings. The fact that educational expenses were privately borne led to an increase in financial savings in order to purchase human capital investment. If the educational system were publicly financed, this positive impact of children on savings would likely disappear.

Life Expectancy

Up to this point, discussion of increased population growth rates concentrated on increased fertility rates. In the early stages of the demographic transition, however, the acceleration of population growth is usually generated by reductions in mortality rates. These reductions, while greatest for infants and children, seem to occur at all ages (Ram and Schultz

(1979)). These reductions, by themselves, will increase the pace of population growth. Decreases in infant and child mortality are likely to be followed by reductions in births as well, making the net effect on population growth ambiguous. Assuming an increase in the growth rate, we can see how mortality declines affect savings.

The principal point made by Ram and Schultz is that longer life expectancy leads to greater incentives for human capital accumulation. They also argue that human capital is a substantial component of total capital. Their estimates indicate that total expenditure on human capital accumulation amounted to 55% of physical capital accumulation in India in the 1970's (Ram and Schultz (1979), Sharma and Ram (1974)). Therefore, the increase in life expectancy should be expected to have substantial positive effects on total savings, suitably redefined to include human capital formation. The longer life increases the "payback period" of the investment and increases the return to parents for educating their children. Their evidence was from India, where substantial reductions in mortality at all ages have been accompanied by increased educational expenditures. The same kind of reasoning should apply to financial savings as well. The evidence on this point, however, is scanty. Hammer (1981) includes the life expectancy at age 1 in the savings equation and finds a signficant effect. The evidence in this case points to a positive association of population growth and savings when the initiating cause is the reduction of mortality.

In summary, population growth and savings are determined jointly at the household level. Different constraints and exogenous factors can influence this simultaneous decision. The net relation between the change in population growth and the change in savings depends on the factor initiating

the change. Therefore, the direction of that effect is likely to depend on conditions specific to a country.

III. Macroeconomics Revisited: Aggregation of Household Behavior

Returning to the national level, two further kinds of links can be identified. The first looks at the market determination of variables which are exogenous to the household. The second looks of changes in the composition of income in the economy as populations grow which can affect aggregate savings.

Decisions made by individuals on savings and fertility have further impact when aggregated to market level. Variables which are exogenous to the household are endogenously determined in the economy as a whole. This further complicates the attribution of causality as it becomes increasingly difficult to identify any exogenous variables at all. Some of the effects (of population growth particularly) operate with long lags. This should help identify directions of causality in a time series framework of an individual country. When comparing countries at different levels of development, though, the effects cannot be ignored. As the discussion of the microeconomic effects has a large speculative component, so, too, does this one. All of the effects are embedded in the seamless web of development.

A case can be made that each of the variable discussed in the preceding section which are factors in household decisions are themselves functions of population growth and capital accumulation, perhaps with a lag. In any model of an economy with an underlying production function, faster increases in population growth should have a depressing effect on wages. This has been illustrated empirically in the U.S. context by looking at earnings of the baby boom generation (Welch (1975), Easterlin (1968)). Similarly, capital

accumulation should increase the marginal productivity of labor, and hence wages. An exogenous increase in the labor supply will increase the return on capital and, to the extent that savings respond to that return, will increase them as well (Solow (1956)). An exogenous increase in savings will increase wages and, to the extent wages effect women's wages and child bearing, decrease fertility. These are, admittedly, long and tenuous chains of causality. They illustrate, however, the complexity of interactions possible at the market level.

The age distribution discussed in the first part of the paper is a convenient aggregation scheme for determining changes in total personal savings rates. However, population growth affects the distribution of other variables as well which can influence savings indirectly. The first of these is the size distribution of income. Recent studies have identified the growth rate of the population as a contributing factor to increasing inequality in some developing nations (Kuznets (1976, 1980), Winegarden (1978)). The reason for this effect may be related to the argument above in which factor population growth led to a reduction of wages relative to the return to capital. This dispersion in the income distribution can have secondary effects on both savings and fertility rates. It is a common position in the literature that savings is a convex function of income, that is, the savings rate increases with income (Bhalla (1980), Landau (1971)). If the savings function is convex, then increases in inequality in income (for the same mean income) would increase the savings rate. Income would be transferred from low to high marginal savers. All else held equal, the increase in population growth would increase inequality and savings.

From the other direction, Repetto (1979) has argued that increased inequality of income is positively correlated with fertility rates. This may

argue for a second round increase, a multiplier effect, of population growth. The relations described here, however, are still subject to verification and these conclusions speculative.

The inclusion of human capital in the measurement of savings leads to another compositional effect of faster population growth. If a "vintage capital" framework is considered, the faster the growth in the labor force with improved education, the faster is the aggregate investment in human capital (Leibenstein (1971)). A possible qualification of this improvement in human capital accumulation is sounded by Stone (1974) and Bilsborrow (1978) who note a reduction in the quality of schooling as more demands are placed upon the educational system. Rapid population growth, then, improves the possibility of accelerating human capital formation but may reduce the quality of the education in the process.

The final compositional effect involves the impact of shifts in private savings and age structure on savings in other forms such as corporate and government savings. Unfortunately, little is known about the response of these variables to the concerns of this paper. Bilsborrow (1979) assumes that corporate savings would be reduced by the combined impact of increased food consumption by children and reduced non-food consumption by adults (only non-food producers were assumed to save). This implies that the dependency arguments from the first section apply to corporate savings as well. Needless to say, direct evidence of this is hard to come by.

Government expenditures may be affected in various ways by increased population growth and the associated age structure. However, insofar as the impact is on education and health expenditures, it is not clear whether extra expenditures should be classified as consumption or savings. The effect depends entirely on the definition of savings. As for the general level of

government expenditure, Kelley (1976) finds no connection between government budgets and population growth. Effects may be important but are likely to be country specific and of any sign.

Summary and Conclusions

This paper has taken three approaches to the question of how population growth affects savings rates in LDC's. The first examined the effect of changing age distributions on the level of aggregate savings. The interaction of age specific savings rates suggested by the life cycle theory with the changes in age distributions was examined. In general, the theory is ambiguous. Results are sensitive to assumptions regarding children's consumption and the precise shape of the function relating savings to age. The net effect is likely to be small in any case. Empirical studies are similarly ambiguous. Evidence is weakest, both theoretical and empirical for the poorest countries.

The second approach examined the joint decision of households regarding savings and fertility. Since both are endogenously determined, it is difficult to impute causality from population growth to savings. The effect should depend on the particular exogenous factors giving rise to the population and savings changes. Various possible effects were discussed. A correlation of either sign was possible. The final approach returned to the aggregate level and showed possible indirect connections between the variables at the market level.

Both population growth and savings rates are inextricably tied up in the process of economic development. While there are many ways in which the two variables may interact in any one country, no generalizations can be safely made across countries. The question must be answered with careful work modelling the institutional structure of individual countries. To date, little such work has been done.

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