DEMOGRAPHIC LINKS TO SAVINGS IN LIFE CYCLE MODELS: IDENTIFICATION OF ISSUES FOR LDCs

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1. Introduction

A comparison of saving rates over time and across countries reveals that after World War II, the less developed countries (LDCs) have experienced an unprecedented pattern of changes in saving rates. While in the U.S. and Japan, the saving rates have been falling rapidly, in most developing countries the pattern is opposite. Another striking feature of most post-world war II LDCs is their present demographic transition from high fertility and mortality rates to rapidly falling mortality and slowly falling fertility rates. While the literature is well surveyed on other determinants of savings such as the effects of liquidity constraints [Fumio Hayashi (1985)], and endogenous labour supply [Marvyn King (1983)], very little is known about the relationships between demographic factors and savings. Could there be any link between the recent pattern of demographic transition and intertemporal and inter-country variations in savings rate.

Various demographic factors such as fertility, infant mortality, life expectancy, female and child labour force participation, affect saving rate of a nation in mainly three ways: (i) through their effects on the age structure; (ii) through their effects on age specific individual savings behaviour; (iii) and through their general equilibrium effects on the interest rate, wage rates and income distribution.

In section 2, I set up a simple discrete time life cycle framework, In section 3, I explain the issues related to age structure; in section 4, I discuss the effect of age specific savings function; in section 5, I discuss the general equilibrium effects of demographic factors, in section 6,I discuss the effects of life expectancies and child mortalities. In section 7, I discuss the nature of social security overages in LDCs, and the issues that are especially important for LDCs. In section 8, based on our discussions in the previous sections, I conclude the paper with a new approach to evaluation of demographic policies.

2. Household Savings

The literature on savings theory has been divided mainly along two lines surrounding the household's motive for savings*. One line of research of more recent vintage postulates that agents are altruistic towards their children and part of the motive for their savings is for the purpose of bequest. These models use altruistic utility functions to model savings for the purpose of bequest [Razin and Ben-Zion (1975), Nerlove, Razin and Sadka (1984),Barro (1974),Bernheim and Ray (1987) and Leinenger (1986)]. In this framework not much have been done to study the effects of demographic factors on savings, only exception being the theoretical investigations by Barro and Becker (1989), Becker and Barro (1988). Moreover, no empirical analysis has been carried out to test this theory, and hence we will not pursue this here.

The other widely studied line of research is the life cycle-permanent income theory which we discuss in more details here. The main hypothesis of the life cycle theory of savings [proposed originally by Fisher (1930)] and later refined and given empirical content by Modigliani and Brumberg (1954) and Friedman (1957)] is that each individual fully consumes his life time income. Over the individual's lifetime, his consumption is spread evenly, whereas his income is earned during pre-retirement years. He therefore saves, then dissaves in such a way that his net worth is never negative. In a stationary economy where the population and productivity are not growing there will be zero aggregate savings. Whereas, in a growing economy in each time period, with the number of retired dissavers being less than the young savers, the economy will have positive aggregate savings. Before we fully discuss the models, it will be useful to formulate the problem more formally. We discuss the issues using a discrete time life-cycle model.

2.1 Life Cycle Theory of Savings

Assume for simplicity of exposition that the only source of uncertainty is the timing of death. Let C_t = consumption of an individual in period t, P_t = perceived survival probability at age t, σ = subjective rate of time preference, r = rate of interest, assumed to be constant over time, Y_t = labour earnings in period t, L = maximum age at death, U = expected life time utility.

An individual's decision problem is to

$$\text{Maximize } U = \sum_{t=0}^{L} P_t \frac{U(C_t)}{(1+\sigma)^t} \qquad \text{..... (1)}$$

* For an account of the controversy see, Kurz (1984), Bernheim, Shleifer and Summers (1984),Cox (1986), Menchik and David (1983).

subject to

$$\sum_{t=0}^{L} \frac{C_t}{(1+r)^t} \leq \sum_{t=0}^{L} \frac{Y_t}{(1+r)^t}$$

The underlying assumption behind having a single budget constraint is that the capital markets are perfect. The first-order conditions for an interior solution yields

$$\frac{\frac{\partial U(C_t)}{\partial C_t}}{\frac{\partial U(C_{t+1})}{\partial C_{t+1}}} = \frac{1+\sigma}{1+r} \frac{p_{t+1}}{p_t} \qquad \text{..... (2)}$$

This together with the budget constraint give us the optimal age profile of consumption C_t from which we get the individual age specific savings function

$$S*(t) = Y_t - C_t \qquad \text{..... (3)}$$

The life cycle hypothesis states that the age profile of earnings Y_t, is generally bell shaped but the age profile of consumption is flat; as a result, the age profile of savings will be negative during early years, positive during working years and again negative during retirement years.

Let

S = aggregate savings
P = total population
p(a) = survival probability at age a
Y = national income
N(a) = population of age a
n(a) = N(a)/P
Y(a) = share of national income of the households of age group, a.
h(a) = Y(a)/Y
s(a) = S*(a)/Y(a) = savings rate of the households in age group a
s = national savings rate.

By aggregating the age specific savings of the individuals in different age groups in period t, we have

$$S = \sum_{a=0}^{L} N(a)S*(a)$$

$$= P \sum_{a=0}^{L} n(a)S*(a)$$

From the above we get the aggregate household savings rate as

$$S = \frac{S}{Y} = P \sum_{a=0}^{L} n(a)h(a)s(a) \qquad \text{..... (4)}$$

It is clear from (4) that the sources of variation in aggregate household saving rate are:

- the age structure of the population n(a);
- the individual age-specific savings function;
- the distribution of national income among different age groups, h(a);
- the survival probabilities or the life expectancies.

Various demographic factors that affect above three are rate of growth in per capita income or productivity growth, number of children, investment in human capital of children, family structure, life expectancies, rate of female and child labour force participation, and various public policies such as social security, investment in health, nutrition and education. In what follows, we will discuss these effects and the empirical findings regarding these effects whenever available.

3. Age structure

I begin with a description of the pattern of age structure that has been faced by various countries over time and then argue that much variations in the saving rate among countries can be explained by variations in the age structure.

The simplest way to understand the effects of age structure are the dependency ratios defined as proportion of those of young age and old age to those of working age within the life cycle framework. The age profile of savings is generally hump-shaped, with the young and old dissaving, and adults saving positively. Therefore, the higher these dependency ratios are, the lower will be the aggregate saving rate. For instance, in the U.S., the savers [households aged between 35 to 65] which made up 60 percent of all households immediately after the World War II, now constitute only 45 percent of all households. For expositional ease, if we assume that the dependent groups do not save at all, and that all household incomes are equal then the changing age structure may constitute as much as 25 percent fall in the aggregate saving rate*.

A comparison of age structures of DCs and LDCs in 1980 shows that the percentage distribution of population among the age groups 0-14, 15-44, 45-64, and 65 + are respectively 23:45:21:11 in DCs, and 39:44:13:4 in LDCs **. It is interesting to note that the DCs have a lower young-age dependency ratio, by about 60 percent and

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* However, as we will see later that the actual reduction will be much smaller in some cases, and the effect on savings could be ambiguous

** United Nations (1982, 60-63)

a higher old-age ratio by about 40 percent. Even more striking is the difference between the rates at which the young age population in the two regions are growing. While during 1960-80, the growth rates were 3 and 2.3 percent per year for DCs and LDCs respectively, the corresponding rates in 1980-2000 are respectively - 1 and 1 *. As has been pointed out earlier, depending on the nature of the age specific saving function, the change in the age structure can have substantial effect on the saving rate. It could, in fact, provide a major explanation to why saving rates in DCs are slowing down and in LDCs the saving rates are increasing over the past two decades.

Even among developing countries, the age structures vary widely. For example, Kenya and Sri Lanka have very similar per capita income and widely differing population growth rate and saving rate. More specifically, fertility rates in Kenya and Sri Lanka are respectively 8 and 3.4, and their saving rates are respectively around 20 and 11 percents in the seventies and early eighties. However, the difference is consistent with the above remarks regarding the possible links between population growth rate and saving rate.

Much of the earlier empirical studies have examined the effects of two dependency ratios on the saving rate. Regressing the two dependency ratios, together with per capita income, and growth rate in GNP on saving rates of 74 LDCs, Leff(1969) found that the both dependency ratios have negative effects on saving rate. Ram (1982,1984), observed that the earlier results critically suffer from specification errors, selectivity and simultaneity biases, and also sometimes form multi-collinearity problems. Using improved econometric techniques to rectify some of these problems on the similar cross country data, he found that dependency ratios do not have negative effects on saving rate; he found insignificant effects in some cases and significantly positive effects in some cases.

While dependency ratios are useful, they capture only the partial life-cycle effects of the demographic variables on saving rate. Direct use of life cycle theory to empirically examine these effects are limited and carried out mainly in three different ways: First, Tobin (1967) used the life cycle hypothesis to study the impact of a change in population growth rate on saving rate. He used a steady state balanced growth approach in which he assumed that the population is growing at a rate n and the productivity is growing at a rate λ. Both rates are assumed exogenously given. The balanced growth assumption implies that along a balanced growth path, the wealth of the economy grows at the natural rate, $n + \lambda$,

$$\dot{W} = (n + \lambda)W$$

where, W = stock of wealth at any moment in the economy. Notice that $\dot{W}$ can be viewed as aggregate savings. He argues that a higher population growth entails a highersaving rate. With the purpose of examining whether the life-cycle prediction

* Demeny (1983, Table 2)

explains the wealth holding of the U.S., while he tried to make "more realistic calculations" for consumption and earnings profiles using survey data and taking explicit account of dependent children, age-sex distinction,he did not, however, carry on his analysis to examine the effect of a change in population growth rate or dependency ratios on the aggregate saving rate.

Mueller (1976) refined Tobin's (1967) framework by incorporating children's earnings and consumption in the construction of the earnings and consumption profiles which were more appropriate for developing countries. She concluded that a higher population growth leads to a lower saving rate.

The second approach is that of Modigliani and Sterling (1983) who extended the life cycle model to study the extent to which the inter-country variations in saving rates among industrialized countries could be explained by the rate of growth of per capita income, length of retirement and dependency ratios. For a non-stationary economy in steady state, they derive the following relatic ship

$$S = \left(1 - \frac{Z}{\lambda L} n_1 \sigma\right)\left[1 - \frac{W}{Z}\left(1 + \lambda \cdot \frac{r}{\omega} + \lambda_d \cdot \frac{d}{\omega}\right) + \alpha\varsigma\rho\right] \qquad \text{.....(5)}$$

where

n_1 = proportion of population covered in the Social Security Scheme
σ = SST/LY
SST = total social security benefits
Y = average annual disposable income
L = R + W
R = Years of retirement span
W = Years of working span of an adult
ω = working population
r = retired population
d = actual number of dependents
λ = the fraction of the working age consumption (assumed to be constant) that is consumed during the retirement
λ_d = the average yearly rate of consumption expenditure per minor relative to the rate of expenditure per working adult
$Z = W + \lambda R + \lambda_d D$
D = average years of minor years attached to a household over his life cycle.
ρ = growth rate in productivity

It is important to note that they derived the above aggregate relationship by aggregating the individual decisions.

Modigliani and Sterling (1983) estimated equation (5) on cross country data and found that both dependency ratios, r/ω and d/ω, have significantly negative effect and that the rate of productivity growth has significantly positive effect on saving rate. So their study suggests that a higher rate of population growth reduces the saving rate.

The third approach, also known as *variable rate of growth effects*, was poineered by the work of Mason (1981). This is an extension of Tobin's (1967) framework.

He formulated our basic life-cycle optimization problem (1) in continuous time as follows:

$$\text{Maximize } U = \int_0^L e^{-\alpha a} p(a)u(C(a))da \qquad \ldots\ldots\ldots (6)$$

subject to

$$\int_0^L e^{-ra} C(a)d(a) \leq \int_0^L e^{-ra} Y(a)d(a)$$

Let

$$c(a) \equiv \frac{C(a)}{V}$$

and

$$y(a) \equiv \frac{Y(a)}{V}$$

where, C(a) is a solution to (6), and V is the lifetime wealth of the individual.

Let us define,

$$A_c = \int_0^L ac(a)da$$

$\equiv$ average age of consumption

and

$$A_y = \int_0^L ay(a)da$$

$\equiv$ average age of earnings

Assuming that both per capita income and population grow at a steady state rate, g, it could be shown that

$$1 - s = \frac{\int_0^L e^{-ga} c(a)\, da}{\int_0^L e^{-ga} y(a)\, da}$$

Taking the logarithm on both sides and using the Taylor's series approximation for the integrals, one obtains the following:

$$\log(1 - s) = a_o + (A_y - A_c)g \quad \text{.....(7)}$$

where, $a_o = \log \int c(a)da + e$, e is the error term associated with Taylor's series approximation, and $A_y - A_c$ is the consumption lag, i.e., the difference between average age of earnings and average age of consumption.

These models predict that growth in population will affect aggregate savings in two ways. First, it will induce a growth in national income which in turn will affect the capita income. So this will affect the aggregate saving rate through g in equation (7). Second, a growth in population will tilt the age structure which will affect the consumption lag, $A_y - A_c$, in (7).

The empirical specifications of these models use instrumental variables approach for the consumption lag, $A_y - A_c$. For example, they have used variables like dependency ratios, childbearing, interest rates, and other factors that affect the life cycle pattern of consumption or earnings [See Mason (1981), Fry and Mason (1982), Mason (1984)].

The main conclusions of these studies are as follows:

"(1) reducing population growth raises the saving rate and, hence, the rate of growth in per capita income; (2) raising institutional interest rates to market equilibrium levels, lowering capital taxation, and/or reducing taxation of financial intermediation, e.g., through reserve requirements, accelerate the rate of economic growth by stimulating savings; (3) increasing foreign aid, i.e., foreign saving, lowers the national saving rate directly but can raise it indirectly by increasing the rate of economic growth; (4) increasing per capita income growth by whatever means may enable countries, except those with high population growth rates, to leap into the vicious circle:"high growth increases the saving rate which frees more resources for investment which, in turn, produces higher economic growth". Fry and Mason (1982, p.440).

Mason (1985) extends these models by introducing the childbearing and other household activities into his model, and he finds that the impact on savings of a decline in childbearing depends on the rate of growth of income. For zero growth in income, rates of savings are independent of the dependency ratio. In contrast, for the countries with the annual growth rate in income is ten percent, a decline in the dependency ratio from 0.9 to 0.3 generates an additional 11 percentage points of savings. For the sample countries with five percent annual growth in income, a decline from a high childbearing to a low childbearing regime produces an increase in the saving rate by about five percentage points - roughly a fifty percent increase. Thus, the population dependency ratio has a significant effect on savings for countries with a medium to high rate of growth in national income. [See,Mason (1985, 25-26)].

He later refined his model to include such other demographic variables as percentage of labour force in agriculture, adult literacy rate, dummy variable for

capturing the pro-natalist cultures or religions, together with the dependency ratio. [For details, see Mason (1984, 26-33)].

I would like to make three important remarks regarding the above studies. First, it is not so much the rate of growth in population that is relevant for isolating the effects of demographic factors on saving rate; it is rather the age structure which is important. The reason is that since the age structure is the result of fertility and mortality rates of the past few decades a given population growth rate may correspond to several age structures. For instance, using the stable population theory, it can be easily shown that two age structures of 43:43, 11:3, 37:43, 14:6 in the age groups 0-14, 15-44, 45-64 and 65+ are consistent with the pairs of birth and death rates (45,20) and (30,5) per thousand respectively. Both age structures, however, yield a population growth rate of 2.5 percent. It is obvious that the above two age structures have different implications for aggregate saving rate.

Second, what is more important for empirical purposes is to relate a change in the mortality, fertility and immigration rates to changes in the age structure, or at least to the dependency ratios. This will allow one to estimate the effect of exogenous shocks in the above demographic factors on the aggregate saving rate. Two effects should, however, be distinguished in this regard: the short run and the long run effects, depending on whether the shocks are temporary or permanent. This exercise will be very useful for evaluating for public policies related to demographic factors.

Third, a shock in the age structure can have a substantial effect on the intergeneration (wage) income distribution that may counteract the pure age structural effect on saving. For instance, when the baby boom generation reaches its prime saving age, although the dependency ratio might become smaller, which will have the effect of increasing the aggregate saving rate, their income share might also be depressed as result of the boom in the labour supply. The net effect is to be determined empirically.

4. Age Specific Savings Function

Since fertility and savings are jointly determined in maximizing utility, they will be related. Household survey data will be useful to examine the inter-action between them. Empirical studies, however, have ignored such inter-action. Lewis (1983) attempted to link declining child-bearing in the U.S. to its saving rate at the house hold level using the U.S. household survey data. He found that the fall in fertility contributed about 25 percent increase in the saving rate in the U.S. during the period 1830 to 1900. However, he did not consider the impact of fertility decline on the subsequent age structure of the adult population.

Studies on the relationship between family size and household savings, have shown mixed results although most of them found the relationship to be negative. Analyzing the U.S. Household Survey Data of 1961, Eizenger (1961) found that savings

first declined with family size at an increasing rate, then after family size reached 3 it declined at a decreasing rate. The other studies on developed countries by Somermeyer and Bannik (1973), Espen-shade (1975), Mason (1975), also support a negative relationship. However, the relationship is not robust for LDCs. While Kim (1974) found the relationship to be negative for both rural and urban households in Korea, Peek (1974)[for Philippines], Kelley and Williamson (1968) [for Indonesia], and Kelley (1980) [for Kenya] found no significant relationship.

One main shortcoming of these household studies is that they do not examine the interaction between fertility and savings. However, Hammer (1986) gives a life cycle model in which both savings and fertility are jointly decided within the framework of maximizing utility subject to budget constraint. He estimates the reduced form birth rate and savings rate equations, postulating both as functions of fraction of agricultural labour force, female labour force participation rate, in fact mortality, life expectancy, and some measures of financial development. He finds that, "financial development was to decrease the birth rate and, if its effect on births was negative, infant mortality was to increase the savings rate". Rate of female labour force participation, and the life expectancy, on the other hand, have negative impact on birth rate, however their effects are not significant on saving rate.

A common problem with above household survey analysis is that they are all based on completed family size. Fertility decisions are made sequenctially by a couple over their life-cycle and thus are affected by the changes in socio economic variables over the life-cycle. The perception about the degree of old-age insecurity, preference for son/daughter, and the occurrence of an infant or child death may depend at any time upon the number of surviving children, earnings profile of husband and wife, stock of assets and therefore will vary over the life-cycle of a couple. Fertility decisions will also interact with the labour supply and savings decisions over the life-cycle of a couple. Empirical analysis that are based on completed fertility will not be able to capture these dynamic effects, and also will have cohort biases in the parameter estimates since the young women who have not completed their reproductive periods will be dropped out of the sample and thus the sample will represent only those old women who survived until the survey date. Sequential econometric techniques are more appropriate in this situation.

Empirical studies that have incorporated sequential nature of fertility decisions are Heckman and Willis (1975), Newman and McCulloch (1984), Olsen and Wolpin (1982), Wolpin (1984) and Hotz and Miller (1988), Ben Porath and Welch (1976) and Raut (1992). The first two papers considered the hazard rate approach to fertility choice. In this framework, parents choose a contraception method in order to realize a feasible desired probability of live-birth in subsequent periods. Hotz and Mealier studied the interaction between fertility and savings decisions over the discrete time life-cycle periods using longitudinal household data on Panel Survey of Income Dynamics for the US. Wolpin formulated a simple life-cycle fertility decisions

mechanism as a discrete time dynamic programming problem and estimated the structural parameters, Olsen and Wolpin used waiting time regression framework to study the replacement effect. Ben-Porath and Welch used a regression analysis to estimate the effect of number of son on the subsequent birth intervals for Bangladesh families. Raut (1992) uses the duration framework to test the old-age security hypothesis, replacement effect, and sex preference hypothesis. This framework has the advantages that it takes into account the sequential nature of the fertility decisions, stochastic nature of the reproductive process, right censoring and the effects of measured and unmeasured heterogeneity. There is no empirical study that examines the interaction between fertility and savings decisions over the life-cycle. Research along these lines are very much needed.

5. General Equilibrium Effects

There are also general equilibrium effects through which the aggregate savings rate will respond to changes in demographic factors. One line of research, based on the Samuelson-Diamond's overlapping generations growth framework studies the interaction between savings and fertility [Neher (1971), Willis (1984)], later extended to include savings on physical capital [Raut (1985,1990,1992b), Eckstein and Wolpin (1985), and investment in quality of children [Raut (1985)]. In these models motive for saving, children, and investment in human capital are life-cycle. Or in other words, the amount of expenditure on children's education and the amount of savings in physical capital are decided by agents by comparing the returns from these assets. The alternative approach is based on altruism motive for having children [Becker and Barro (1988), Nerlove, Razin and Sadka (1987)] and they also study the interaction between fertility and savings within the growth framework. I will explain some of the general effects using the former framework. However the latter framework also yield very similar results.

5.1 Income Distribution and Interest Rate Effects

A higher population growth rate will have general equilibrium effects on aggregate saving rate at least in two ways. First, Samuelson (1958) has pointed out that an exogenous permanent increase in population leads to a higher rate of [general equilibrium] interest, which he terms as the biological rate of interest. In other words, a smaller amount of savings can now provide the same amount of old-age consumption, the higher is the fertility level. This new after shock interest rate, will, in turn, affect the age profile of savings decisions of different individuals. Second, it has been argued that by changing the wages of different types of skill labours [Raut (1985,1990)] or income shares of base-period income groups (Morley 1981, an exogenous increase in fertility may increase income inequality; and since the savings propensity varies across income groups, it will affect the aggregate saving rate both in the short-run equilibrium, and in the long-run equilibrium [Raut (1985,1990)].

5.2 Effects On Corporate and Public Savings

By stimulating the demand side of the product market and depressing the wage-rental ratio, a higher population growth may generate a higher rate of profit ; thus, a higher population growth may increase corporate savings. On the other hand, a higher rate of population growth will require a larger proportion of government expenditures on public health and education, which will have an adverse effect on government savings. We do not know the net effect and needs to be determined empirically.

There has been no empirical studies regarding these effects. A computable general equilibrium approach to these problems can shed useful light on these issues.

6. Life Expectancies

The uncertainty of age at death affect the age profile of savings in mainly two ways. First, a change in the age at death - causing a change in the planning horizon - has two opposing effects on the life cycle consumption profiles. A longer life span makes the retirement period longer than the working age, and hence provision for the longer retirement period requires a reduction in the working age consumption [Champernowne (1969)]. On the other hand, if the agent is risk averse, a reduction in the risk of life will induce him to consume more during his younger age this has the same effect as increasing the discount factor. [This was originally conjectured by Fisher (1930,216-17) and rigorously proved later by Yaari (1965)]. An increase in life uncertainty, however, as pointed out by Levhari and Mirman (1977), involves both effects and the direction of the net effect will depend on the choice of utility functions, the rate of return from investment, and also on the subjective discount rate; risk aversion, however, in this model is not a crucial factor [See also Levhari and Srinivasan (1969)].

Second, the infant mortality rate or more generally young age mortality rates of the children will make children a risky asset. So an increase in the infant mortality rate, by increasing the riskiness of children as assets, will change the optimal portfolio of assets held by parents. In general, the net effect of infant mortality and life expectancy on the age profile of savings is indeterminate. Empirical studies using household survey data are needed to determine the strength of these effects.

What is more important for empirical purpose is to relate a change in the mortality rates [or survival rates] to changes in the old age and young age dependency ratios in order to study its impact on aggregate saving rate. This has not drawn much attention in the literature.

An empirical issue regarding the subjective survival probabilities is raised by Hammermesh (1985). Recall from (2), an optimal life cycle consumption profile of an individual depends on his/her subjective survival probabilities in the utility function.

Then questions arise: How do individuals perceive these subjective survival distributions? Are these subjective survival probabilities consistent with the actuarial survival probabilities in the life table? Or in other words, do their expectations about life expectancies form rational expectations? Would an agent be able to reproduce future survival probabilities using all the information available in a life table today?

Hammermesh (1985) conducts a questionnaire survey on a sample of American economists on these issues. He finds that "people to extrapolate changing life tables when they determine their subjective horizons,and they are aware of levels of and improvements within current life table. The existence of demographic and expectational consistency in the formation of subjective horizons suggests the use of current life expectancies in cross-section studies of aggregate savings [as in such studies as Feldstein (1976)] is not correct. Time-series studies of savings and labour supply must also account for increasing life expectancy and its effects on the subjective horizon that determines individual consumption behaviour.[Hammermesh (1985,404-405)].

7. Policies Affecting Fertility and Savings: Social Security

In the development literature much emphasis have been put on the effectiveness of such social developments as education, health and nutrition, and women's labour force participation in reducing fertility rates, very little is known about the effectiveness of introducing social security programs in reducing fertility and saving rates. Therefore, in this paper we will focus only on the social security.

By the early eighties, 22 developed countries have established full fledged social security programs and 12 less developed countries have established formal social security schemes, the majority of which cover old age, invalidity and survivors benefits*. During the late seventies and early eighties, while in most developed countries, the percentage of government expenditures on social security was quite high, ranging from around 25 percent in Australia and U.K., and around 35 percent in the U.S.,Norway, Italy and the Netherlands, to as high as more than 50 percent in Spain, West Germany, Sweden. While most of the LDCs do not have formal social security programs, quite a few LDCs introduced formal social security programs although the coverage in most of these countries are not high but significant. For instance, among the lower income countries, Sri Lanka and Togo spent respectively 12.8 and 11 percent; among the middle income countries, Egypt, Costa Rica and Paraguay's expenditures amounted to 14, 27 and 32 percent respectively and among the upper middle income countries,expenditures of Argentina, Mexico, Uruguay, Yugoslavia, Greece, Chile and Brazil, amounted to 30, 25, 54, 36, 33, 45 and 36 respectively. Some of these figures, especially those in the middle and upper middle income countries, are very close to the figures in the developed countries ; in some countries, when taken as a percentage of

* The U.S. Department of Health, Education and Welfare, Social Security Administration, Social Security Programs throughout the world, 1977, Government Printing Office, Washington, D.C., 1977.

GNP, the figures turn out to be even larger than those of the DCs. It is also important to note that out of these 12 LDCs, seven are Latin American.

While the figures on the coverage of beneficiaries are not readily available for most LDCs, figures for 20 Latin American countries* [show that the coverage varies from as low as 6 to 11 percent of total population in Honduras, E1 Salvador, Ecuador, Nicaragua and Colombia, to as high as about 96 percent in Brazil, and above 70 percent in Argentina, Costa Rica, Chile, Mexico, Panama, Uruguay. [Moreover, the latter countries also have high percentages of government expenditures on social security, as mentioned earlier]. However, other than in Mexico, the social security benefits are restricted to the urban organized sector in most LDCs.

An important empirical stylized fact is that the LDCs that have formal social security programs also have lower total fertility rates are generally low. For example, the total fertility rates in 1983 are as low as around 2 in Greece, Yugoslavia, around 3 to 4 in Brazil, Chile, Uruguay, Argentina, Costa Rica and Sri Lanka, and within 4 to 5 in Mexico, Paraguay, Egypt etc. Interestingly, for all these countries, the fertility rates are predicted to be as low as 2 to 2.5 by the turn of this century. Although, the social security scheme may not be the only factor which might have reduced demand for children for old age support, it could be one of the major factors.

We now indicate how social security may affect aggregate saving rate. The relationship is complex both on theoretical and empirical grounds. First we sketch very briefly the theoretical debate on this linkage.

Depending on the motives for saving, the type of funding, degree of imperfection in the capital markets, and the rules regarding the disbursement of social security benefits net of taxes to different income groups, a social security scheme may affect the saving rate of a national at least in four ways. First, the effects of a social security scheme will depend on whether the motive for saving is to smooth one's consumption over lifetime or whether it is for bequest. [See Kotlikoff and Summers (1982)]. When the motive is bequest, Barro (1984,1978) has shown that social security has no effect on savings. However, for expositional ease, we will assume the life cycle motive.

In this framework, people save or accumulate wealth for their old age consumption, as they would not be able to earn enough in their old age. Under the assumption that the capital markets are perfect, if social security taxes and benefits of an individual [or household] do not change his life time wealth position, then savings during the working years will be reduced exactly by the amount of social security taxes. This would be the prediction of household saving behaviour by the life cycle theory. However, what effect will a social security system have on the net wealth position of a nation will depend upon the type of funding and also upon the reference period during its inception and when it is operating in full swing. Let us first look at the effects during

* United Nations (1982).

the initial periods. If the system is fully funded, then it will have no effect on the aggregate wealth position of an economy, although the composition of wealth will be affected in the sense that government savings will replace private saving, one-for-one. The same effects will hold for later years. If the system is a pay-as-you-go one, then initially, the reduction in household savings will not be offset by any increase in the government's wealth position. The effects in later periods are ambiguous.

Second, if capital markets are imperfect, and households are liquidity constrained, then the neutrality of the social security tax may not hold; it will indeed increase the aggregate savings, since the liquidity constrained households will not be able to borrow against their future social security wealth. Introduction of a social security system in an economy with imperfect capital markets will affect savings rate through its interaction with fertility rate. In the absence of insurance markets for old-age pension, parents rely on their children for old age support. Many empirical studies on LDCs support this "old-age security hypothesis*. So, once a social security system is introduced, it will interact with aggregate savings in two ways: First, demand for children as means of old-age support will decline, and hence it will increase the investment in other assets, and hence will increase individual savings. Second, decline in fertility will tilt the age structure which in turn will affect the aggregate savings rate. The net effect is to be determined empirically. Raut (1985,1990,1992b) and Raut and Srinivasan (1990) thoretically investigate the general equilibrium effect of social security program on population growth rate and capital accumulation.

Third, Feldstein (1974) extended the life cycle model of Modigliani and Brumberg in which he treated the retirement decision as endogenous [more specifically labour supply in both pre-retirement and post-retirement periods as endogenous]. He showed that "if the labour supply is fixed in both periods, the introduction of a Social Security program reduces personal saving even if there are positive second period earnings. When the labour supply in the second period is endogenous, social security benefits reduce second period labour supply but the effect on savings is ambiguous".

Assuming no uncertainty in life, perfect capital markets, actuarial fairness in setting benefits, Kotlikoff(1979) Blinder, Gordon and Wise (1978) developed life cycle models with endogenous retirement decisions, they found that pension coverage does not affect the incentive to retire. On the other hand, Crawford and Lilien (1981), Hubbard (1985) found that dropping one of these assumptions leads to the opposite result regarding early retirement.

Fourth, to the extent that social security scheme redistributes income, it will affect aggregate household savings if the marginal propensity to save vary across income groups.

* See for instance, Bollen and Entwisal (1981), Gillapsy and Nugent (1983), Ridker (1980) and Nugent (1985) for other references.

In sum, at the theoretical level, the effects of social security programs on aggregate household savings and government savings are ambiguous, and the strength and direction of these effects will depend much on the type of funding, structure of the capital markets, interaction of savings with fertility, and the distribution of social security benefits net of taxes.

While the U.S. literature is very useful to understand these interactions,an important issue, namely, how social security can have an impact on personal savings through its effects on demand for children, has not been addressed in that literature. This is particularly important for LDCs having underdeveloped capital markets and virtually no market for old-age pension. Raut (1985,1990,1992b) in an extended life-cycle framework found that effect of social security on fertility is generally negative, and the effect on savings is ambiguous.

We report the findings of a few U.S.studies on social security based on macro time series data and household survey data.

Feldstein extended the life cycle model by adding a social security wealth variable to Ando and Modigliani's (1963) macro econometric specification of the life cycle model and employing it on aggregate U.S. time series data. The coeffeicient of the social security wealth variable in his formulation captured both the asset substitution effect and the inducement to retire effect of the social security program. He found that the U.S. social security program approximately reduces the personal saving rate by one half. Together with the theoretical controversy, this empirical finding generated a tremendous amount of empirical effort to refute Feldstein's result. Improved definitions of savings, social security wealth, changes in the time span of the data sets, and correction of the programming errors of Feldstein's original computations of social security wealth, have not resolved the controversy. [See the following table, which summarizes these findings] So, the relationship between savings and the social security tax does not appear to be robust. More research on other countries particularly LDCs is called for.

I now discuss the studies that examine the effect of social security on savings using household survey data. A proper testing of the life cycle model using household survey data and throwing light on the issue of whether the social security tax reduces savings would require extensive information on household assets of all types, including the individual's perceptions of the expected return from the accumulated social security benefits and private pensions, portfolio of securities and real estate properties, education, health, sex, occupation that will make estimation of the expected age profile of earnings for each individual possible. These data are simply hard to come by.

The first, and the only major, cross sectional study in the area is by Feldstein and Pellechio (1979). They used very extensive information on asset holdings in this study. They found that each dollar of social security wealth replaces roughly one dollar of other assets. Whereas, decomposing the social security wealth into an actuarially fair

component and a capital gain component, and using a different data set, Kotlikoff (1979) found that contrary to the life cycle prediction, the first component reduced savings by $.67, but not dollar-for-dollar, and the second component increased savings by $.24. The net effect is an insignificant fall in savings of only $.13. Diamond and Hausman (1983) using the same dataset found the fall to be $.57. See table 2 below for summary results of these studies. As in the time series analyses reported above, the relationship between saving and social security tax turns out to be not robust in the household survey data analyses as well.

TABLE 1

Macro time Series Studies on Social Security and Savings

Authors	Data Set	Social Security Variables	Findings
Barro (1978)	Macro time Series 1919-1940, 1947-1974	Gross Social Security wealth; benefits per recipient times proportion of labour force covered	No effects
Boskin and Robinson (1980)	Macro time Series 1929-1940, 1947-1974	Gross and net social security wealth; benefits per recipient times ratio of covered workers to total labour force.	Significat negative effect
Darby (1979)	Macro time Series 1929-1940, 1947-1974	Gross and net security benefits per recipient times proportion of labour force covered times population ; OASI taxes	Negative or zero
Feldstein (1974)	Macro time Series 1929-1940, 1947-1971	Gross and net social security wealth	Significantly negative effect
Feldstein (1979a)	Macro time Series 1929-1940, 1947-1974	Gross social security wealth	Significantly negative effect
Feldstein (1980)	Macro time Series 1930-1940, 1947-1977	Social security wealth	Significantly negative effect
Leimer and Lesnoy	Macro time series 1930-1940, 1947-1974 on Feldstein and Leimer - Lesnoy algorithms for post-war periods	10 variants of gross, and 11 variants net social security wealth based	No significant negative effects Some signifi-cance positive effects
Munnell (1974)	Macro time series 1900-1971	Social security wealth Employee and employer taxes	Support for extended life cycle model

Source : Break (1981, Table 2.5)

While the studies of social security in developed countries focused on measuring its effects on private savings, the studies in the less developed countries mainly focused on estimating the impact of social security coverage on fertility [Bollen and Entwisal (1981), Entwisal (1980), Gillaspy and Nugent (1983)]. Empirical studies of social security in less developed countries should incorporate the interaction between fertility and saving at the household level; and then compute the effect of social security on aggregate saving rate and population growth rate taking proper account of this interaction and its effect on age structure.

TABLE 2
Household Survey Studies on Social Security and Savings

Authors	Data Set	Social Security Variables	Findings
Feldstein and Pellechio (1979)	Federal Reserve Board Survey of Financial Characterstics of Consumers, 1963: Households headed by insured males, 55-64.	Net Social Security Wealth	Significant negative effect
Kotlikofff(1979)	1966 National Longitudinal Survey of men, aged 45-59	Lifetime social security wealth increments	No effect
		Accumulated value of employee & employer taxes paid per household	Negative effect

Source : Break, (1981, Table 2.5)

8. A New Approach to Evaluate Demographic Policies

Summarizing our discussion so far, we propose a new strategy to empirically evaluate demographic policies. From the household survey data one can estimate the age profile of earnings, saving and fertility rates, and then using the life tables one can compute the aggregate saving rate and population size. Any demographic policy that affects fertlity rate, life expctancy, and investment in quality of children will change the aggregate saving rate and population growth rate. These two aggregate effects could indeed be compared to evaluate demographic policies.

It should, however, be pointed out that changes in different demographic factors will have different short-run and long run effects on the saving rate and these will also depend upon whether such changes are transitory or permanent. For instance, a transitory increase in fertility rate will immediately [in the short run] increase the young age dependency ratio, and thus will reduce national saving. In the next .bp generation,

however, the dependency ratio diminishes, and saving increases; in the thir generation the dependency ratio increases leaving no effect afterwards. However, fo a permanent increase in fertility, the first period effect is the same as above; secon period saving is larger and old age dependency ratio smaller. Thus, the net effect o aggregate saving is ambiguous. In a similar manner, one can study the short-run an long-run effects of changes in other demographic factors on aggregate savings rat This way, one can evaluate the short-run and long-run -effects of any demographi policy.

This strategy could also be used to check the consistency between the offici data on aggregate saving rate and the rate predicted by our aggregation procedur Similarly for the level of population. This can also provide an alternative criterion f testing the life cycle hypothesis of saving.

REFERENCES

Ando, Albert, and Modigliani, D.(1963)	"The Life Cycle Hypothesis of Saving: Aggregate Implications and Test Amer. Econ. Rev., Vol. 53, 55 - 84.
Barro, Robert J. (1978)	"The Impact of Social Security on Private Saving: Evidence from the U Time Series", American Enterprise Institute, Washington, D.C..
Barro, Robert J. (1974)	"Are Government Bonds Net Wealth?", J.Pol. Econ., Vol [November-Dec].
Barro, Robert J. and Gary S. Becker (1989)	"Fertility Choice in a Model of Economic Growth, Revised 19 Econometrica.
Becker, Gary and Robet J. Barro (1988)	"A Reformulation of the Economic Theory of Fertility", Q.J.E.,1988.
Ben-Porath, Yoram and Finis Welch (1976)	"Do Sex Preferences Really Matter?", Q.J.E., 90(2);285-307.
Bernheim, B.D. and D. Ray (1987)	"Economic Growth with Intergenerational Altruism",R LIV(2);227-243.
Bernheim B.D., A.Shleifer and L. Summers (1984),	"Bequests as means of payments", NBER # 1303.
Blinder A.; Gordon, Roger H. and Wise D.W.(1981)	"Life Cycle Savings and Bequests: Cross-Sectional Estimates of the I Cycle Model", NBER, Working Paper No.61.
Bollen, Kenneth A. and Barbara Entwisal (1981)	"Pension Programs in LDCs: An Indirect Means of Fertility Reductio Ann Arbor: University of Michi, Research Report No..
Champernowne, D.G. (1969),	"Uncertainty and Estimation in Economics: Vol.3", Holden Days, Francisco.
Cox D. (1986)	"Motives and Private Income Transfers", Stanford University, E-86-
Crawford, Vincent P. and David M.Lilien (1981)	"Social Security and Retirement Decision", Quarterly Journa Economics, Vol. 96(3), 505-29.
Darby, Michael R. (1979)	"Effects of Social Security on Income and the capital st Amer.Ent.Inst., Washigton, D.C..
Demeny P. (1983)	"International Development and Population Policy", Paper prepare Harvard-Dra, Cambridge, Massachus.

Diamond, P and Hausman, Jerry (1983) "Individual Retirment and Savings Behavior", [Mimeo], May.

Eckstein E.; Wolpin, K. (1985) "Endogenous Fertility and Optimal Population Size", Journal of Public Economics, 27.

Eizenger, E. (1961) "Demographic Factors and Savings", North Holland Publishing Co., Amsterdam.

Entwisle, Barbara (1980) "On the Relationship Between Pension Programs and Fertility Levels, paper presented at the annual meeting of the American Sociological Association", American Sociological Associate, New York.

Espenshade, Thomas J. (1975) "The Impact of Children on Household Saving: Age Effects Versus Family Size", Population Studies, Vol. 29, 123-5.

Feldstein, Martin (1974) "Incidence of a Capital Income Tax in a Growing Economy with Variable Savings Rates", Rev. Econ. Stud., Vol.41 (4), 505-13.

Feldstein, Martin (1976) "Savings Behaviour : New Influences and Consequences - Social Security and Saving: The Extended Life Cycle Theory",,.

Feldstein, Martin (1977) "Social Security and Private Saving: International Evidence in an Extended Life Cycle Model, in M.Feldstein and R.Inman (ed), "The Economics of Public Services", London:, Macmillan.

Feldstein, Martin (1978) "Reply" in Robert Barro, "The Impact of Social Security on Private Saving: Evidence from the U.S. Time Series", American Enterprise Institute, Washington, D.C..

Feldstein, Martin (1980) "Fiscal Policies, Inflation, and Capital Formation", A.E.R., Vol. 70(4).

Feldstein, Martin and Pellechio, Anthony J. (1977) "Social Security Wealth: The Impact of Alternative Inflation Adjustments. Working Paper 212.", Washington, D.C.:, National Bureau of E.

Fisher, Irving (1930) "The Theory of Interest as Determined by Impatience to Spend Income and Opportunity to Invest it", New York:, The Macmillan Co..

Friedman M.(1957) "A Theory of Consumption Function",, Princeton University Press,.

Fry, Maxwell J., and Andrew Manson (1982) "The Variable Rate of Growth Effect in the Life-Cycle Saving Model", Economic Inquiry, Vol.20, 462-442.

Gillaspy, R.T. and Jeffrey B. Nugent (1983) "Old Age Pensions and Fertility in Rural Areas of Less Developed Countries: Some Evidence from Mexico", Economic Development and Cultu, Vol.31(4), 809-29.

Hamermesh, Daniel S. (1985) "Expectations, Life Expectancy, and Economic Behaviour", Quarterly J. Economics, 389-408.

Hammer, Jeffrey S. (1986) "Children and Savings in Less Developed Countries", J.Develop. Econ.,.

Hayashi F. (1985) "Tests for Liquidity Constraints: A critical Survey, Paper Presented at a Symposium in the Fifth World Congress of Econometric Society, Cambridge Mass", Econometric Society, Cambridge, Mass..

Heckman, J and R.J. Willis (1975) "Estimation of Stochastic Model of Reproduction: An Econometric Approach" in N.E.Terleckyj(ed), "Household Production and Consumption", Columbia University Press, New York.

Hotz, V.J. and R.A. Miller (1988) "An Empirical Analysis of Life Cycle Fertility and Female Labour Supply", Econometrica,.

Hubbard,Glenn R.(1985) "Social Security, Liquidity Constraints, and Pre-Retirement Consumption", Southern Economic J.,.

Munnell. Alicia (1974) "The Impact of Social Security on Personal Savings". Nat. Tax. J., Vol.27(4), 553-67.

Nehar, Philip A. (1971) "Peasants, Procreation, ad Pensions", American Economic Review, Vol.61(3), 380-89.

Nerlove M., Razin A. and E.Sadka (1987) "Household and Economy", Academic Press NY.

Nerlove, M.; Razin A.; Sadka E.(1984) "Bequests and the Size of Population When Population is Endogenous", J. Political Economy, 92:3.

Newman, John and C.E. McCulloch (1984) "A Hazard Rate Approach to Timing of Births", Econometrica Vol.52(4).

Nugent J.(1985) "The Old-age Security Motive for Fertility", Population and Development Review.

Peek, Peter (1974) "Household Savings and Demographic Change in the Philippines", Malayan Economic Review, Oct.,86-104.

Ram,Rati (1984) "Dependency Rates and Savings: Reply, A.E.R., Vol. 74(1), 234-237.

Raut L.K. (1985) "Capital Accumulation, Income Inequality and Endogenous Fertility in an Overlapping Generations General Equilibrium Model, in "Three Essays on Inter-Temporal Economic Development: Essay II", Ph.D. Dissertation", Yale University.

Raut L.K. (1990) "Capital Accumulation, Income Distribution and Endogenous Fertility in an Overlapping Generations General Equilibrium Model", J.Development Economics 34(1/2): 123-150.

Raut L.K. (1991) "Effects of Social Security on Fertility and Saving: An Overlapping Generations Model", (forthcoming) Indian Economic Review.

Raut L.K. (1992) "Old-Age Security and Gender Preference Hypothesis: A Duration Analysis of Malaysian Family Life Survey Data," Working Paper, Department of Economics, University of California-San Diego.

Raut L.K. (1992b) "Two-sided Altruism, Operative Gift, Bequest and Fertility," (mimeo), Department of Economics, University of Peansylvania.

Raut L.K. and T.N. Srinivasan(1990) "Endogenous Fertility, Technical Change and Growth in a Model of Overlapping Generations," Discussion Paper, Economic Growth Center, Yale University.

Razin, Assaf and Uri Ben-Zion (1975) "An Intergenerational Model of Population Growth", AER, December.

Ridker, R.G. (1980) "No Births Bonous Scheme: The Use of Savings Accounts for Family Planning in South Inida," Population and Development Review, Vol.6:31-46.

Samuelson, P. (1958) "An Exact Consumption-Loan Model of Interest with or Without the Social contrivance of Money", Political Economy, LXVI:6.

Somermeyer W.H. and R.Bannink (1973) "A Consumption-Savings Model and its Applications", Amsterdam:, North Holland Publis.

Tobin, James (1967) "Life Cycle Saving and Balanced Growth, in "Ten economic studies in the tradition of Irving Fisher", (eds) William Fellner et. al.", NY:, Wiley.

United Nations (1982) "Demographic Indicators of countries: Estimates and rejections as assessed in 1980", New York, United Nations.

Kelley, A.(1980) "Interactions of Economic and Demographic Household Behaviour, in (ed) Easterlin, " Population and Economic Change in Developing Countries", Chicago, University of Chicago.

Kelley, A.C. and Williamson Jeffery G(1968) "Household Saving Behaviour in the Developing Economies: The Indonesian Case", Economic Development and Cultu, Vol.16(3).

Kim Kwang Suk (1974) "The Household Saving Behaviour in Korea. Interim Report 7402", Korea Development Institute, February.

King, Mervin A. (1983) "The Economics of Saving, Cambridge, MA:NBER Working Paper No.1247",NBER, Oct.

Kotlikoff, Laurence (1979) "Testing the Theory of Social Security and Life Cycle Accumulation", American Economic Review, Vol.LXIX, 396-410.

Kotlikoff, Laurence and Summers, Lawrence H. (1981) "The Role of Intergenerational Transfers in Aggregate Capital Accumulation", J.Polit. Econ., Vol.89(1), 706-32.

Kurz, Mordecal (1984) "The Life-Cycle Hypothesis as a Tool of Theory and Policy, Mimeo",.

Leff, N.H. (1969) "Dependency Rates and Saving Rates", American Economic Review, vol.LIX, 886-95.

Leiniger, Wolfgang (1986) "The Exisistence of Perfect Equilibria in a model of Growth with Altruism Between Generations", Review of Econ. Studies,.

Levhari and T.N. Srinivasan (1969) "Optimal Savings under Uncertainty", Review of econ. Study,.

Levhari, David and Leonard J. Mirman (1977) "Savings and Consumption with an Uncertain Horizon", Journal of Political Economy, Vol.85(2), 265-281.

Lewis, Frank D. (1983) "Fertility and Savings in the United States: 1830-1900",Journal of Political Economy, Vol.91(5), 825-840.

Mason, Andrew (1975) "An Empirical Analysis of Life-Cycle Savings, Income and Household Size, Ph.D.Dissertation", University of Michigan, Ann Arbor.

Mason, Andrew (1981) "An Extension of the Life Cycle Model and its Application to Population Growth and Aggregate Saving", East-West Population Institute, January.

Mason,Andrew (1984) "National Saving Rates and Population Growth: A New Model and New Evidence, paper prepared for the National Research Council and presented to a meeting" on the Consequences of population Growth" held at Woods Hall , M A, August",.

Menchick, Paul L., and David Martin (1983) "Income Distribution, Lifetime Savings and Bequests", Amer.Econ.Rev, Vol.83(4), 672-90.

Modigliani,Franco and Arlie Sterling (1983) "Determinants of Private Saving with Special Reference to Role of Social Security-Cross Country Tests, in Franco Modigliani and Richard Hemming (eds),"The Determinants of National Saving and Wealth" St.Martin's Press, New York.

Modigliani, Franco and Richard Brumberg (1954) "Utility Analysis and the Consumption Function: An Interpretation of Cross-Section Data, in K.Khurihara (ed), "Post Keynesian Economics" New Burnswick:, Princeton University.

Morley S.(1981) "The Effect of Changes in the Population on Several Measures of Income Distribution", Am.Econ.Rev.,.

Muller, Eva (1976) "The Economic Value of Children in Peasant Agriculture", in Ronani Ridker (ed), "Population and Development: The Search for Selective Interventions", Baltmore, Johns Hopkins Univer.

Willis, Robert J. (1984) "The Old Age Security Hypothesis and Population Growth", Cambridge, Mass.

Wolpin, Kenneth I. (1984) "An Estimable Dynamic Stochastic Model of Fertility and Child Mortality", Journal of Political Economy, Vol.92(51).

World Development Report (1986) "Overview and Historical Perspective",

Yarri, M.E. (1965) "Uncertain Lifetime, Life Insurance, and the Theory of Consumer", Rev. Econ. Studies, Vol. 32, 137-58.