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Saving in Developing Countries: Theory and Review

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In the literature on economic development, much of the interest in saving has been focused on the relation between saving and growth. But saving is not only about accumulation. It is about smoothing consumption in the face of volatile and unpredictable income, and helping to ensure the living standards of poor people whose lives are difficult and uncertain. This paper develops a model of households which cannot borrow but which accumulate assets as a buffer stock to protect consumption when incomes are low. Such households dissave as often as they save, do not accumulate assets over the long term, and have on average very small asset holdings. But their consumption is markedly smoother than their income. Much of the evidence is as consistent with this view of saving as it is inconsistent with standard views of smoothing over the life cycle, and with explanations of the link between saving and growth in terms of life-cycle saving behavior. Consumption smoothing is also a useful way of thinking about government policy, where volatility in the world prices of taxed commodities can generate sharp fluctutations in government revenues as well as reallocations of revenue between the private and public sectors. Many important policy issues in developing countries hinge on issues of consumption and smoothing, and research on these issues is currently likely to be more productive than work on the relation between saving and growth, at least until we have a more satisfactory theory of economic growth.

I can think of four good reasons for studying saving in developing countries separately from saving behavior in developed economies.

- At the microeconomic level, developing-country households tend to be large and poor; they have a different demographic structure; more of them are likely to be engaged in agriculture; and their income prospects are much more uncertain. The problem of allocating income over time thus looks rather different in the two contexts, and the same basic models have different implications for behavior and policy.

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- At the macroeconomic level, both developing and developed countries are concerned with saving and growth, with the possible distortion of aggregate saving, and with saving as a measure of economic performance. But few developing countries possess the sort of fiscal system that permits deliberate manipulation of personal disposable income to help stabilize output and employment.
- Much of the postwar literature expresses the belief that saving is too low, and that development and growth are impeded by the shortfall. Sometimes the problem is blamed on the lack of government policy, sometimes on misguided policy.
- Saving is even more difficult to measure in developing than in advanced economies, whether at the household level or as a macroeconomic aggregate. The resulting data inadequacies are pervasive and have seriously hampered progress in answering basic questions.

The discussion is organized around these four topics. I focus on areas that are either not covered in the recent excellent survey by Gersovitz (1988), or where I wish to develop a different perspective. I make no attempt to be comprehensive where I would only be repeating Gersovitz's review.

Section I develops the microeconomic framework for household saving on which the rest of the discussion is based. The analysis is within the framework of the standard life-cycle permanent income model, but it emphasizes different features of behavior to generate results far from the standard "consumption equals permanent income" story that has so far dominated empirical work in developing countries.

Section II turns to macroeconomic saving, beginning with the relations between income growth, population growth, and saving rates predicted by some versions of the life-cycle hypothesis. The section next addresses macroeconomic stabilization. In many developing countries, protecting consumption against fluctuations in income is a public as well as a private problem. Many governments tax primary commodity exports, so that both government and external balances are sensitive to fluctuations in output levels and international commodity prices. Although the issues are perhaps well understood, there is considerable evidence that governments in many developing countries have not been able to design policies that make the appropriate adjustments.

The discussion in section III of whether saving is too low reviews the arguments based on externalities, and inquires whether government policy, by regulating interest rates, distorts patterns of saving and financial intermediations. Much of the argument here hinges on the interest elasticity of saving.

The rest of this introductory section deals with the fourth topic—the data, and how their shortcomings affect the subsequent analysis.

Perhaps the worst problem that besets data on saving is that saving is not measured directly but is the residual between two large magnitudes, each itself measured with error. The consequences show up at all levels of discussion. Household survey data often show an implausibly large fraction of households dissaving, though the implausibility may be associated with faulty theory as well as faulty data. The household survey data are often quite inconsistent with and typically less than the national income estimates—themselves possibly biased downward (see Visaria and Pal 1980; Paxson 1989) and certainly subject to substantial uncertainty.

The standard household survey may well understate saving. The concept of income is itself extraordinarily complex, and most people in developing countries have little reason to distinguish between business and personal cash transactions. A farmer who buys seeds and food in the same market at the same time may not appreciate that, when computing income, he should only deduct the expenditure on seeds from his receipts. Nor is a seller of street food likely to distinguish accurately between what is eaten by his customers and what by his family. A subsistence farmer, whose outgoings approximately equal his incomings, is quite likely to report that his income is zero. (Even in developed countries the measurement of self-employment income is notoriously inaccurate.) The problems are not entirely solved even by the detailed questioning of more sophisticated surveys, in which the surveyor, not the respondent, calculates income. And the national accounts data for household saving are not themselves reliable enough to provide a good cross-check that will show what sort of surveys do best or how they should be redesigned to do better.

In the national accounts, household saving is typically a residual among residuals. Fry (1988) notes that in many countries illegal capital outflows take place because imports are "overinvoiced" and exports are "underinvoiced," so that if saving is calculated as the sum of domestic investment, the government surplus, and the trade surplus, saving will be underestimated by the extent of the illegal capital outflow. Because household saving is not measured directly (either there are no survey data or the statisticians mistrust them), it is derived from national saving by deducting corporate and government saving, so that errors in measuring corporate saving or investment will be absorbed into this ultimate residual. Given these deficiencies, even trends over time may be incorrectly observed, while real changes, especially those that involve foreign transactions (such as increased remittances to India and Pakistan) may affect the measurement as well as the reality of saving. In India around 1980, observers were puzzled by an apparent dramatic increase in saving and investment unaccompanied by a corresponding increase in economic growth. Rakshit (1982, 1983) and a report by the Reserve Bank of India (1982) investigating the measurement issues concluded that the increases, though real, were greatly overstated by the accounting practices.

Data problems also preclude testing even the most basic hypotheses, for example, the classical (Lewis) model in which saving is done almost exclusively by capitalists. If capitalists belong exclusively to the corporate sector, the model is almost certainly false, but in most developing countries we have no way of sorting out the "capitalistic" pockets in the household sector, where a great deal of accumulation may take place within small household-owned business.

Finally, statistical practices for measuring saving are far from uniform across countries—not even between the United States and Japan (see Hayashi 1986), let alone across developing countries. Conventions for calculating depreciation are good examples of practices that are largely arbitrary and vary widely. The (very extensive) literature that makes comparisons between countries thus rests on peculiarly shaky ground. (Good reviews of these and other data problems are contained in Berry 1985, Fry 1988, and Gersovitz 1988.)

I. Household Saving Behavior in Poor Countries

A Simple Theoretical Model

The basic framework of the simple stylized model of household saving developed here—intertemporal utility maximization—is standard in the literature. But it does not deliver the standard result, that consumption should be proportional to permanent income. The special assumptions under which the standard result is derived seem to me to be unusually inappropriate for most households in developing countries. My model therefore diverges from the textbook in four important respects.

First, households in developing countries tend to be larger than households in the United States or Europe, and there is a much greater tendency for several generations to live together. At the extreme, a household might have a stationary demographic structure: old people, as they die, are replaced by those a little younger, and everyone "shifts up"—down to the youngest children, who are replaced by new births. Such a household has no need for "hump" or retirement saving, either as a vehicle for transferring income from high-productivity to low-productivity phases of the life cycle or as a means of transferring wealth between generations. Resources are shared between workers and dependents, and ownership is passed from parents to children. As emphasized by Kotlikoff and Spivak (1981), this kind of household can internalize many of the insurance activities that would otherwise require saving. Transfers within the household can insure individuals against health risk and old age by providing what are effectively annuities, and the close relationships between the individuals concerned may mean not only that moral hazard issues are less severe than in a more individualistic society but also that the *quality* of the protection is very high. Note also that this kind of household lives much longer than any individual and thus gives some substance to the idea of a "dynasty" of consumers.

Second, income derived from agriculture is inherently uncertain, an uncertainty that spreads from agriculture to related occupations and affects most of the population in predominantly agricultural economies. Uncertainty at low income poses a real threat to consumption levels, a threat that is likely to exert a powerful influence on the way in which income is saved and spent. The poorer consumers are, the more risk averse they are generally supposed to be. Declining (absolute) risk aversion has important implications for the shape of the consumption function (see Leland 1968, Zeldes 1989b, and most recently Kimball 1988; forthcoming). The standard model in which consumption equals permanent income cannot be derived from utility maximization in such a context. Note also that the household insurance arrangements discussed in the previous paragraph are unlikely to be able to deal with income uncertainty, particularly in an agricultural setting. Even multiple earners will not provide much protection if all are dependent on local agriculture.

The third divergence from the standard model is the assumption that borrowing is not permitted. This is an extreme simplifying assumption, but more appropriate than its opposite, that households are free to borrow and lend at a fixed real rate of interest. For the present, the fact of borrowing constraints is more important than the reason behind them, although it is not difficult to think of plausible scenarios. In a world of financial repression, there may be no credit available to nonfavored borrowers. Or borrowing rates may be so much greater than lending rates that credit is only a last resort in dire emergency. Even where there are financial intermediaries, they may be unwilling to lend for consumption purposes to individuals who have no collateral or to lend across agricultural seasons rather than within them. The analysis of borrowing constraints under uncertainty is the main theoretical innovation of the section, even though much of the analytical apparatus can be borrowed from elsewhere.

The fourth distinction between household saving in developed and developing countries is a consequence of the previous three. In the model developed here, saving provides a buffer between uncertain and unpredictable income and an already low level of consumption. Saving here is "high-frequency," intertemporal smoothing saving, not life-cycle-hump or intergenerational saving. The analysis is different, and so are the welfare issues, which are focused on the protection of consumption, particularly among those whose consumption levels may not be far above subsistence. The buffer analogy is also technically useful, since the model here is formally identical to the model of optimal commodity stockpiling (see Gustafson 1958 for an early treatment; also see Samuelson 1971, Newbery and Stiglitz 1981, 1982, and Deaton and Laroque 1989 for modern versions). As far as the consumption literature is concerned, the model developed here is essentially the same as that developed by Schechtman and Escudero (1977).

I begin from the standard specification without borrowing restrictions whereby the household maximizes an intertemporal utility function of the form

$$u = E_t \left[\sum_t^{\infty} (1 + \delta)^{-t} \upsilon(c_t) \right] \tag{1}$$

where $\delta > 0$ is the rate of time preference, c is total household consumption, and $\upsilon(c_t)$ is the instantaneous utility associated with consumption c_t. In keeping with the dynastic view of the household, the time horizon is taken to be infinite. The expectation operator, E, is taken with respect to information at time t. The budget constraint evolves in the usual way, so that for real nonhuman wealth A_t, real income y_t, and fixed real interest rate r,

$$A_{t+1} = (1 + r)(A_t + y_t - c_t) \tag{2}$$

The fixed real interest rate is assumed to make later computation more tractable; the assumption in any case may be reasonable in many of the contexts with which I am concerned.

Dynamic programming arguments applied to equations 1 and 2 yield the Euler equation,

$$\lambda\,(c_t) = E_t\left[\frac{(1 + r)\,\lambda\,(c_{t+1})}{(1 + \delta)}\right] \tag{3}$$

where $\lambda(c_t) = v'(c_t)$ is the instantaneous marginal utility of consumption in period t. Often, $\lambda(c_t)$ may be taken as a price or value: when $\lambda(c_t)$ is high, consumption is low, and goods are scarce and valuable.

The concavity of the instantaneous utility function implies that $\lambda(c_t)$ is monotonically decreasing, or in terms of the price interpretation, that price rises with scarcity. I shall also be concerned with the case where $\lambda(c_t)$ is (strictly) convex, so that the scarcer the commodity, the steeper the price rise, flattening out as consumption increases. At a technical level, the convexity of $\lambda(c_t)$ is guaranteed by the usual assumption of declining absolute risk aversion. More intuitively, the convexity of the marginal utility function guarantees a *precautionary* motive for saving. In bad times, when consumption is low, the consequences are much worse than they are better in the good times, when consumption is high. The marginal disutility of losses in consumption near subsistence is greater than the marginal utility of gains in times of relative abundance. Individuals will therefore give up high consumption when it is possible so as to prepare for possible disasters, even if those disasters are few and far between. As can be seen from equation 3, an increase in the riskiness of future consumption will increase the right-hand side of the Euler equation, so that to restore equilibrium, the left-hand side must increase, and current consumption fall (see Sibley 1975). A precautionary motive for saving seems a necessary ingredient in modeling poor households which have the additional misfortune of facing considerable uncertainty in their incomes.

Perhaps the most popular solution to the Euler equation is one which assumes away the precautionary motive by working with quadratic preferences. In this case $\lambda(c_t)$ is a declining linear function but is not strictly convex. Given this linearity, and the additional assumption that the rate of interest r is equal to the rate of time preference δ, equation 3 is satisfied by the permanent income consumption function whereby consumption is the annuity value of the sum of assets and expected future income. In the form consumption equals permanent income, it has been widely applied to household behavior in developing countries, (Bhalla 1979, 1980; Musgrove 1979, 1980; Wolpin 1982; Muellbauer 1982). For present purposes, however, the assumption of certainty equivalence (linear marginal utility) is unattractive because it rules out the sort of precautionary behavior described in the previous paragraph. Unfortunately, apart from some special cases, the Euler equation is a good deal harder to solve in cases when utility is not quadratic. For econometric work this need not be a problem;

Hansen and Singleton (1983) and a host of subsequent studies have used generalized methods of moments techniques to estimate equation 3 directly, conditional on some specification of the instantaneous utility function. However, I need to develop the theory more before I can turn to empirical evidence.

In important papers, Skinner (1988) and Zeldes (1989b) have shown that with a *finite* horizon, precautionary saving can cause major deviations from the certainty equivalent formulation in which consumption equals permanent income. Since borrowings must be repaid in the finite future, possibly at a time when consumption is already low and its marginal utility high, individuals with low nonhuman wealth will be hesitant to borrow at all. This consideration influences even relatively well-off households who own land, who fear having to sell and so face permanently lower incomes thereafter. In many ways, this is an attractive formulation for the analysis of low-income household behavior.

Here I follow another tack and assume that households cannot borrow. I choose this approach partly because the resulting model is easier to handle (largely because it generates a stationary stochastic equilibrium in which consumption is not constant) but also because, at least for some households, borrowing restrictions are real and necessary to explain what we observe. Households in developing countries are often quite long-lived, and many face income processes that are stationary and well understood. But they do not have constant consumption—I suspect because they do not have access to infinite credit and do not therefore make plans that rely upon its availability, particularly when they most need it.

Another motive for adopting a new approach is the "excess sensitivity" literature on the United States (particularly Flavin 1981, Hall and Mishkin 1982, and Hayashi 1987) which has exposed a closer link between actual income and consumption than can be explained by permanent income theory.

Suppose then that the basic model is extended to incorporate borrowing restrictions by adding to the utility function (equation 1) and the budget constraint (equation 2) the inequality constraint, that for all periods t, real wealth cannot be negative:

$$A_t \geq 0 \tag{4}$$

For most households, I also assume that $\delta > r$ (the rate of time preference is greater than the rate of interest). Otherwise, as shown by Schechtman (1976) and by Bewley (1977), the borrowing constraints ultimately have no effect; households eventually accumulate infinite amounts of nonhuman wealth, at which point they never need to borrow, and consumption once again settles down to a constant fixed number. The assumption that δ is greater than r has substantive *economic* content; it takes people to be impatient, unwilling to accumulate, even "feckless," though not of course irrational. With such preferences, assets are a lost opportunity for consumption and would ideally be run down quickly. But there is a benefit to holding assets: they are the insurance against having to reduce consumption to unacceptably low levels when times are bad. Even so, the Schechtman and Bewley results indicate that in this model it is the high level of impatience that keeps people poor. Even without the ability to borrow, patient consumers will eventually become rich, at least as long as r is not driven below δ. I leave such people aside for the moment but will return to them at the end of the next section.

In contrast to the simple Euler equation (3), there are now two possible cases in each time period. In case 1, the consumer would like to borrow but cannot; even if all wealth and current income are consumed, the marginal utility of an additional unit of current consumption is greater than the expected marginal utility to be derived by saving that rupee until tomorrow. In this case, consumption is the sum of assets and income, saving is zero or negative, no assets are carried forward, and marginal utility is not equated across periods. Formally, we have

$$\lambda(A_t + y_t) > E_t\left[\frac{(1 + r)\lambda(c_{t+1})}{(1 + \delta)}\right] \tag{5}$$

$$c_t = A_t + y_t,\ s_t = y_t - c_t \leq 0,\ A_{t+1} = 0$$

In case 2, the consumer does not want to borrow, consumption is less than total cash on hand, and the original Euler equation (3) is satisfied. Of course, this does not mean that the borrowing constraints have no effect. The expected marginal utility of future consumption is different from the unconstrained case because the future contains the possibility of being unable to borrow when it would be desirable to do so.

The two cases of the Euler equation can be combined into a single expression:

$$\lambda\,(c_t) = \max\left\{\lambda\,(A + y_t),\ E_t\left[\frac{(1 + r)\lambda(c_{t+1})}{(1 + \delta)}\right]\right\} \tag{6}$$

In the appendix, I derive the consumption function characterized by the modified Euler equation (6) in the simplest case where income is always positive and is independently and identically distributed over time. This is reasonable enough for a poor agricultural household in a stagnant economy, but it would require substantial modification for a worker facing an increasing nonstationary income stream (see Deaton 1989 for details). The solution takes the form

$$c_t = f(x_t) \tag{7}$$

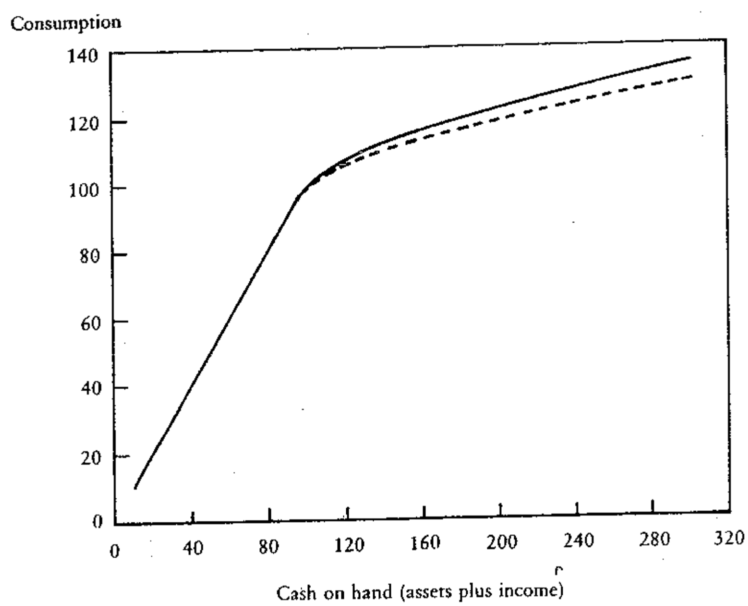
where $x_t = A_t + y_t$ is the amount of cash on hand that is available either for spending today or for keeping for tomorrow. The function $f(x)$ as characterized by equation 7 is determined by the process determining income, for example by its mean and its variance, and by the parameters of the utility function. If any of these change, so will the shape of the function. Although it is not possible to derive an explicit functional form for this consumption function, it can be computed for a range of values of x given a utility function and a stochastic process for income. The appendix explains the calculations; the next subsection uses the calculations to explore the implications of the model.

Implications and Relation to the Evidence

In the consumption functions calculated from equation A-5 in the appendix, I have assumed that income is drawn from a (truncated) normal distribution with mean μ and variance σ^2, truncated at $(\mu - 5\sigma, \mu + 5\sigma)$. The truncation has little or no practical effect, but it ensures that the marginal utility cannot become infinite. The instantaneous utility function reflects the assumption of constant relative risk aversion, that is, it is of the power form, so that the marginal utility of money function $\lambda(c)$ takes the form $c^{-\rho}$. For $\rho > 0$, this marginal utility function is convex, thus guaranteeing a precautionary motive for saving. Figure 1 shows the relation between consumption and cash on hand (assets plus income) for $\rho = 2$ and $\rho = 3$ given that $\mu = 100$, $\sigma = 10$, $r = 0.05$, and $\delta = 0.10$.

When cash is scarce, all of it is spent. At some critical point, which depends on the parameters of the problem but is rarely far from mean income, the slope of the consumption function has a discontinuity, and for higher values of cash on hand, the marginal propensity to consume is lower and continues to fall as the wealth position improves. For consumers with large assets, the liquidity constraints cease to matter, and we are back in the standard case. However, it can be shown that the slope of the consumption function will always remain greater than $r/(1 + r)$; with $\delta > r$, there is always an incentive to consume assets rather than to hold them. Bear in mind that these multiperiod models do not imply that liquidity constraints mean that poor consumers simply consume their

Figure 1. *Liquidity-Constrained Consumption Functions*



Key: ——— coefficient of relative risk aversion, $\rho = 2$; - - - - - $\rho = 3$.
Note: Assumes mean income = 100, standard deviation = 10, interest rate, $r = 0.05$, rate of time preference, $\delta = 0.10$.
Source: Calculated from equation A-5 in appendix.

incomes. Rather they consume all their available resources, which typically will include some assets accumulated in the past. Saving can be negative, and often is. And even when the liquidity constraints are not binding, so that the consumer does not wish to borrow, the consumption function is quite different from what it would be without the possibility of future liquidity constraints. Consumers in this model take precautions against bad years in which they know they will not be able to borrow. The resulting saving behavior is determined by the interaction of the liquidity constraints and the degree of precautionary saving, as controlled by the parameter ρ. These points have been well emphasized by Zeldes (1989a, 1989b).

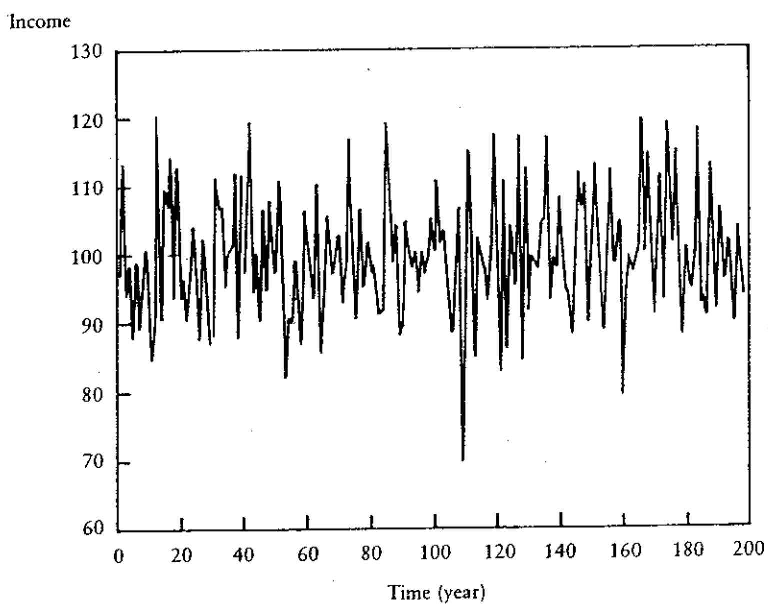
Figure 1 shows how the consumption function shifts downward when the precautionary motive is stronger. Similar downward shifts occur as the riskiness of income increases, although increasing the standard deviation (coefficient of variation) from 10 to 15 (10–15 percent) has only a very small effect on the position of the curve. Higher interest rates also shift the function downward; in this model, assets are a buffer stock, and the cost of holding the buffer in terms of utility forgone depends on the excess of δ over r. Higher interest rates make it cheaper to hold (this sort of) buffer stock, and so there will be more saving and higher asset levels associated with higher interest rates.

Perhaps the most important feature of figure 1 is the prediction that saving will increase with "permanent income" as conventionally defined, so that the elasticity of consumption with respect to measured permanent income will be less than unity. The literature on household saving in developing countries has almost uniformly found this result (see in particular Bhalla 1979, 1980 for India; Musgrove 1979 for Latin America; Muellbauer 1982 for Sri Lanka; Betancourt 1971 for Chile; and Paxson 1989 for Thailand). The exception is Wolpin (1982) who, as Gersovitz (1988) points out, has a rather odd measure of permanent income—he assumes, in the Indian context, that permanent income is positively spatially correlated with permanent differences in rainfall, which may not be true in the presence of migration. According to the theory behind figure 1, consumption is not a function of any simple concept of wealth such as permanent income, but a nonlinear function of cash on hand, the function itself depending on characteristics of incomes and preferences. But clearly the propensity for any given household to consume out of assets will be much lower when assets are high than when assets are low, which is one interpretation of the findings.

To the (limited) extent that a cross section can be interpreted as identical households with different income draws from the same distribution, saving will rise with assets, and thus with conventionally measured permanent income. Of course, different individuals in any cross section will have different income processes, and different versions of the consumption functions shown in figure 1. In the simplest case, where the distribution of income "rescales" as the mean changes, all the consumption functions will be scaled versions of the original, and saving rates will be independent of scale. But since the income and asset processes will not be perfectly correlated across individuals, saving rates will still be positively correlated with assets across all individuals. More complicated stories can be told if there is a systematic relation between the level of income and its variability. Note also that many of the richest households are likely to be those for whom $\delta \leq r$, who have (eventually) accumulated assets and broken out of the liquidity constraints. For members of this group, consumption is growing over time, but so are assets, at least for the group as a whole. Unlike the households in figure 1, these households are responsible for net accumulation over time, and thus for household saving in the aggregate, even in a stationary income environment. The presence of some of these households in the cross section will further enhance the positive correlation between saving and asset levels.

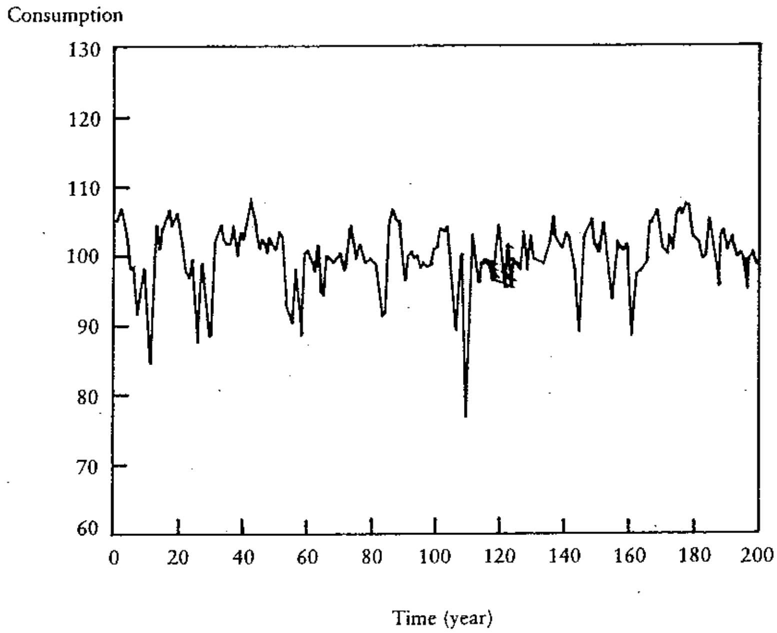
The dynamic behavior of the liquidity-constrained consumers in this model can be seen by looking at figures 2 through 6 which plot a typical 200-period (year) simulation for, respectively, income (normally distributed white noise), consumption, saving, assets, and the marginal utility of consumption. These simulations correspond to the broken line in figure 1, where the coefficient of relative risk aversion is 3. The simple nonautocorrelated behavior of income in figure 2 results in a much more complex time-series process for consumption in figure 3. Note first that stationariness is preserved, that is, that its stochastic characteristics do not vary with time, again (and essentially) because $\delta > r$. Assets are accumulated to spread income over time, but since they are costly to hold, a time will always arrive when it is optimal to use them—that is, to consume

Figure 2. *Simulated Income*



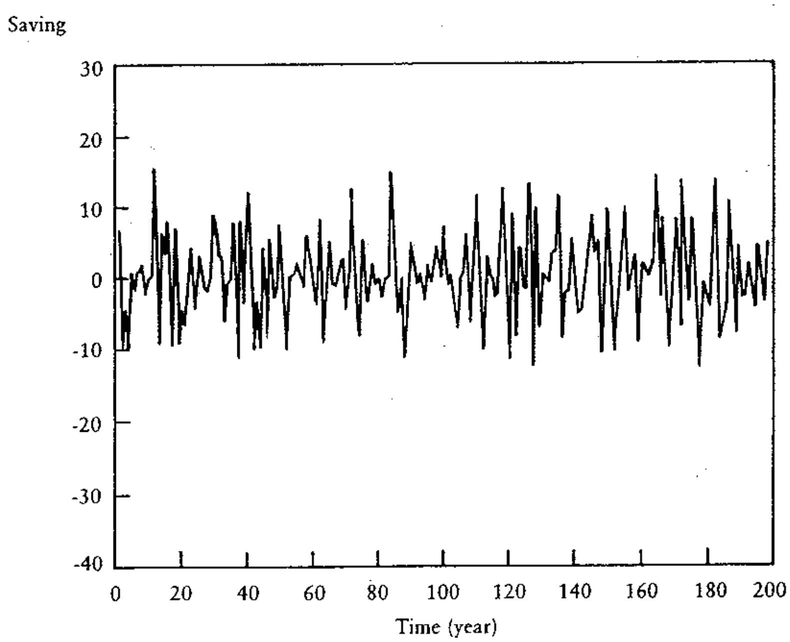
Note: Income is successive random draws from a normal distribution with a mean of 100 and standard deviation of 10.

Figure 3. *Simulated Optimal Consumption Path*



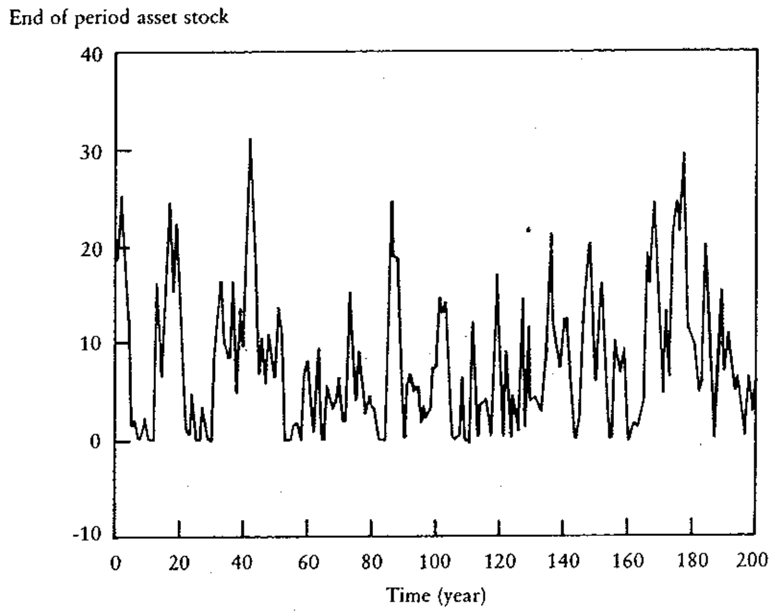
Note: Based on simulated income from figure 2, and consumption determined as in figure 1.

Figure 4. *Simulated Optimal Saving Path*



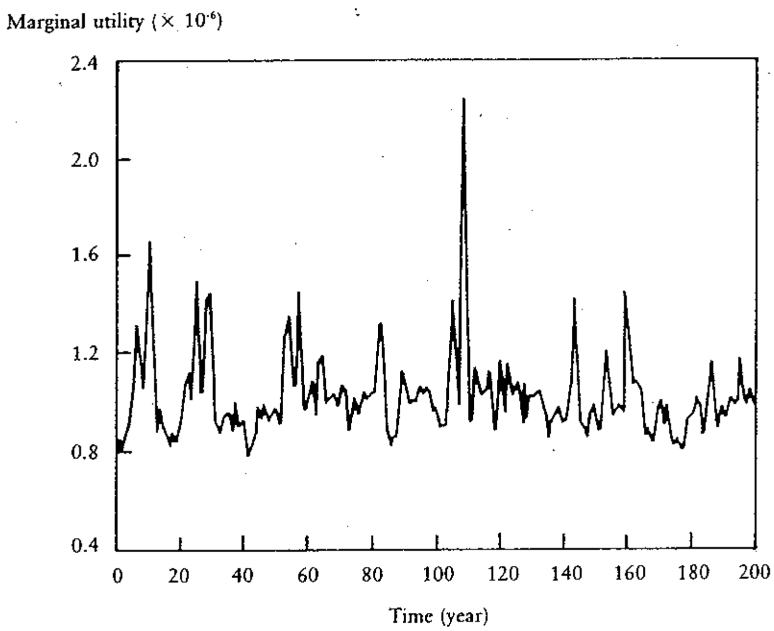
Note: Income plus asset income less consumption is derived from figures 2, 3, and 5.

Figure 5. *Simulated Optimal Asset Path*



Note: Derived as $A(t+1) = (1+r)\{[A(t) + y(t)]\ f[A(t) + y(t)]\}$ where A is real nonhuman wealth, r is the fixed real interest rate, and y is real income.

Figure 6. *Marginal Utility of Consumption*



Note: Coefficient of relative risk aversion, $\rho = 3$.

everything. If things are bad enough, the consumption value of even the last rupee is more valuable than it is ever expected to be again, and so all income and assets will be used. As soon as this happens, the link between the present and the past is broken, and the consumer begins the next period with no assets and a new income draw. Such "stock-outs" can be made arbitrarily rare if a suitable income process is chosen (for example, one in which with very low probability income is very small), but they must happen eventually. Again, these seem attractive features of the model, at least for the poorest countries. The possibility of extended drought or famine is an important motive for precautionary saving, and in such periods, assets will be converted to food, although they may be far from sufficient to avoid serious consequences for consumption and its marginal utility.

Figure 5 shows that asset levels are typically low, and even at their peak do not reach one-third of mean income, in spite of the inherent variability in income and the strong precautionary element in preference. Again this accords well with the facts, not only as far as we know them in developing countries, but also in developed countries such as the United States (see, for example, Venti and Wise 1989, who report that—apart from housing and pension wealth, which are not available to buffer consumption—median family wealth in 1985 was only $600). Even so, modest amounts of asset holding can significantly smooth consumption; consumption is much smoother than income (compare figures 2 and 3) and is strongly autocorrelated over time. The literature quoted above also provides overwhelming evidence that consumption is indeed smoothed in developing countries, Paxson's results for Thailand being only the cleanest and most convincing example.

Note also that the fluctuations in consumption are not symmetric; saving can always prevent consumption from being too high, but when assets are exhausted, nothing can be done to soften the effects of low incomes. Perfect smoothing is neither possible nor optimal, and there is less than perfect protection against bad times—see in particular the downward spike in consumption around period 110, and the much more severe associated spike in marginal utility. Interestingly, although income was low in that period, the effects on consumption and on utility are much more exceptional than appear to be warranted by the behavior of income alone. A bad income draw is not in itself the cause of disaster; much depends on the state of assets before the triggering event. Such extreme responses appear to be characteristic of this sort of nonlinear time series, and they seem to account well for the sort of events labeled "panics," "runs," "manias," and perhaps even for some features of famines.

Finally, note the behavior of saving in figure 4, and especially the fact that it is as often negative as positive, as must be the case given the absence of net asset accumulation. The model here predicts the frequently lamented finding from household survey data that "implausibly" large numbers of households appear to dissave. I would not wish to claim that the data are correct; the measurement problems are real enough. But the fact that half the sample is dissaving in any given year is not theoretically implausible. Indeed, by choosing an asymmetrical density function for income, with very occasional bumper harvests, it would presumably be possible to generate time series in which dissaving occurs in nearly every period. But recall that an inability to borrow does not imply that consumers spend their incomes, and so is entirely consistent with frequent dissaving.

The results in the figures are consistent with the "excess sensitivity" findings in the U.S. literature. When the change in consumption is regressed on the change in income, the simulation results generate a coefficient of 0.291 with a standard error of 0.016—a coefficient much too large to be accounted for by the permanent income theory. Similarly, in the regression of the change in consumption on lagged income, the significant negative coefficient ought instead to be zero for an unconstrained, forward-looking consumer. Such a negative correlation exists in the microdata from the "Panel Study of Income Dynamics in the United States" (Hall and Mishkin 1982). We do not yet know whether similar phenomena exist in developing countries, although work on this and other aspects of the model is currently under way using the World Bank's "Living Standards Survey" for Côte d'Ivoire.

One aspect of reality that is *not* consistent with the model is that there should always be aggregate saving in the household sector as a whole. The model is one of income smoothing with assets acting as a buffer stock; there is no motive for accumulation, and over a long enough run of years total household saving would be expected to average to zero. But even if many household surveys show something like this, most observers would allow some credence to the national income accounts, and suppose that there is some saving to be explained. Population growth would help explain some accumulation. If there are more households, each will need its own buffer stock of assets, so that increasing population will require positive saving as the stocks are built up. Income growth is harder to handle, since the basic model assumes a stationary income process and is not easily modified to accommodate nonstationariness. One possibility is that each individual faces a stationary income stream for his or her life, but that each new generation faces a higher mean process. Such a model would tend to reinforce the population growth effect as each generation holds a larger stock of assets on average.

A more interesting hypothesis is that the preference parameter δ varies from person to person. Some are patient and willing to wait for higher consumption; others are not. For the majority, for whom ($\delta > r$), the model applies, and they spend their lives smoothing consumption, holding few assets, and always subject to liquidity constraints. The minority, with ($\delta \leq r$), are also unable to borrow, but their optimal consumption plans, which typically involve saving now to support higher consumption in the future, also have the characteristic that the stochastic process governing their assets is such as to guarantee that assets will exceed any finite level given enough time to do so. This accumulation, which is stochastic, is an almost accidental outcome of optimal consumption plans for patient consumers who can never borrow. The distribution of preferences thus divides the population into two groups, one of which lives a little better than hand to mouth but never has more than enough to meet emergencies, while the other, as a group, saves and steadily accumulates assets. Such a dichotomy recalls the classic models of saving in which "capitalists" do all the saving (see Lewis 1954; Kaldor 1955–56), but here the capitalists are created willy-nilly as a long-run consequence of their taste for future over present consumption. The preference-based dichotomy also suggests an explanation for the division of consumers into two groups—liquidity-constrained or "rule-of-thumb" consumers and "life-cyclers"—that has recently become popular in the U.S. literature (see Hall and Mishkin 1982; Campbell and Mankiw 1989a, 1989b; Flavin 1988). The theory here explains how the two groups arise, why each is behaving optimally, and why some are liquidity-constrained and others are not. But in its present form it does not do any of this when individual consumers expect their incomes to grow.

II. Macroeconomic Aspects of Saving in Developing Countries

The Life Cycle, Saving, and Growth

One of the most celebrated and most investigated predictions of the life-cycle model is that there should be a relation between aggregate saving and the rates of population and income growth. If saving is hump saving, accumulated during the working years to finance retirement, then population growth provides more savers than dissavers, and positive aggregate saving. Per capita income growth has a similar effect because workers are saving on a larger scale than the retirees are dissaving. For many people, population growth is *the* issue in economic development, and the relation between population growth and capital accumulation is one of the most important of the possible links between population policy and economic welfare (see, in particular, National Academy of Sciences 1986; and Mason 1987, 1988).

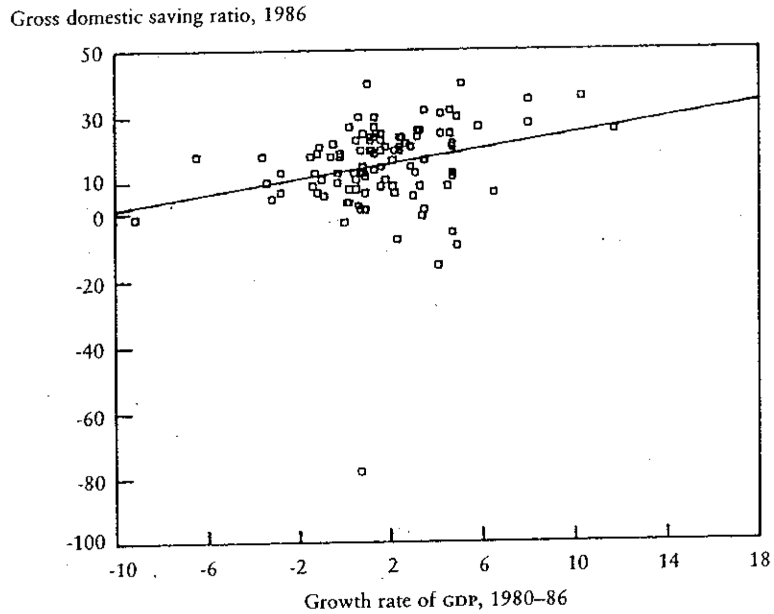
Even at the theoretical level, however, there are complications. If young consumers anticipate a steady growth in income, and can and will borrow against that increase, their dissaving in the early years of the life cycle may induce a *negative* relation between saving and growth. The standard positive relation works best if each worker experiences a stationary income stream over his or her own life cycle, with growth taking place between rather than within generations. The effects of population growth are similarly ambiguous. Even if adults would like their own consumption stream to be constant over the life cycle, their expenditures may exceed income, not only during retirement but also when there are children in the household. Population growth expands the ratio of workers to retirees, but also the ratio of children to adults, and saving may be decreased more by the latter than it is increased by the former. The net effect depends on the costs and benefits of children, a balance that may itself change (from net benefit to net cost) with economic growth (see Caldwell 1982). And do households really want to have flat consumption streams in any case? Cautious young people may not want to borrow against future income growth, even if that growth is extremely likely. And old people, faced with daunting uncertainties about health and death, may not run down their assets in the prescribed manner—a supposition strongly supported by the balance of empirical evidence from developed countries. To these lacunae in the standard argument may be added my own doubts, expressed in the previous section, about the general applicability of the hump-saving concept in developing countries.

The cross-country empirical evidence (well reviewed by Gersovitz 1988) generally supports a positive effect of per capita income growth on saving rates, variously defined; however, the results are rarely well-determined and are uncomfortably reliant on the treatment of the simultaneity between saving (investment) and growth, and on the sample of countries selected. The even more ambiguous role of population growth can perhaps be interpreted as negative dependency effects more or less offsetting the positive effects of population growth. Figures 7 and 8 illustrate fairly typical findings for the relation between saving and the total growth of gross national product (GNP).

Both figures show a positive slope, with the saving rate increasing 1–1.5 percentage points for every percentage increase in the growth rate. The *t*-values are modest but significant at conventional levels. Of course, there are outliers (they happen not to have much effect on the results), and the scatter yields plenty of scope for obtaining different results by suitable sample selections or choice of instrumental variables—all this quite apart from whether the countries should be given the same weight, whatever their population size, data reliability, or anything else.

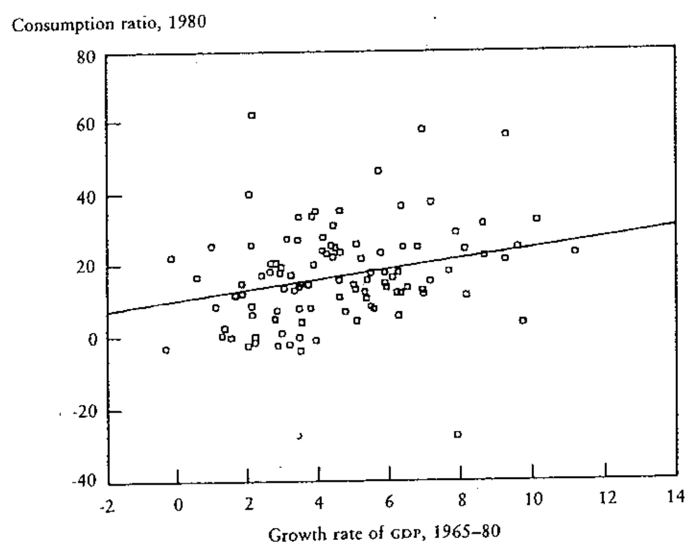
The fundamental problem is the direction of causality: from growth to saving (the life-cycle explanation) or from saving to growth? The problem is tackled by several authors with various instrumental variables, but these efforts are hardly convincing in the absence of an adequate theory of growth. Summers and Carroll (1989) have argued that, whatever produces the positive correlation between saving and growth, it cannot be life-cycle saving. They point out that the life-cycle explanation assumes common preferences across countries, but that differences in economic growth generate differences in the relative lifetime economic standing of young and old in different countries. To use Lucas's (1988) graphic example of the power of compound growth: if a grandchild is fifty years younger than its grandfather, using 1965–86 per capita growth rates, then a citizen of the Republic of Korea is 26 times as rich as his or her grandfather, while an Indian is only 2.4 times as rich. These enormous differences should show up in profiles of the relation between age and consumption—if Korea is compared with India, the profile should be relatively higher among the younger cohorts in the faster growing economy. But Summers and Carroll's (1989) age-consumption profiles for Japan, the Unites States, and Canada are essentially identical in spite of the differences in growth rates; the differences predicated by the life-cycle growth effects are simply not present.

Figure 7. *Gross Domestic Saving and Growth: World Bank Data*



Source: World Bank (1988).

Figure 8. *Saving and Growth: Summers and Heston data*



Note: On the vertical axis, the variable is one minus the sum of the shares of government and private consumption in total GDP, measured in current international prices. The horizontal axis shows the growth rate of per capita gross national product in constant 1980 international prices multiplied by population. Points for 106 countries are shown.
Source: Summers and Heston (1988).

I have been able to obtain data on age-consumption profiles for five countries: Côte d'Ivoire, Hong Kong, Indonesia (rural Java), Korea (cities only), and Thailand (see figures 9–11). The growth rates of real GNP per capita given in table 1 are from both World Bank (1988) and Summers and Heston (1988) data. The right-hand panel shows the ratios of incomes twenty years apart at these growth rates, in which, for example, the numerator could reflect the relative lifetime income of thirty-year-olds and the denominator that for fifty-year-olds. Except for Côte d'Ivoire, where the Summers-Heston growth figure is 0.2 percent a year instead of the 1.2 percent from World Bank (1988), the two sets of estimates agree closely. Both sets of rankings have Côte d'Ivoire growing most slowly, Thailand and Indonesia rapidly, and Hong Kong and Korea very rapidly. The corresponding age-consumption profiles (figures 9–11) show how far the prediction is from reality. In slow-growing Côte d'Ivoire the consumption profile is heavily tipped toward the young; in urban and rural Thailand and in Korean cities, where thirty-year-olds are two to four times richer than fifty-year-olds, the profile peaks for households with heads in their fifties. In rural Java, which is growing about as fast as Thailand, the peak is somewhat earlier, in the mid-forties. For Hong Kong, the published data points are sparse, but household expenditure levels seem not to vary very much with age from the late twenties to the late fifties. For Thailand, Korea, and Côte d'Ivoire, where I have data from more than one year, or for Thailand for more than one sector, profiles from the same country are much more similar than profiles across countries. But the differences across countries are not easily explicable by life-cycle growth effects.

The results should not be overstated. A more sophisticated analysis would take into account the differing family sizes in the different countries as well as the marked declines in fertility in several countries that have meant that older households typically had more children than households of the next generation. Even so, it is hard to see that these considerations could affect the basic point. Note too that the graphs *do not* show that households do not look ahead when planning their consumption, nor that they do not smooth out short-term fluc-

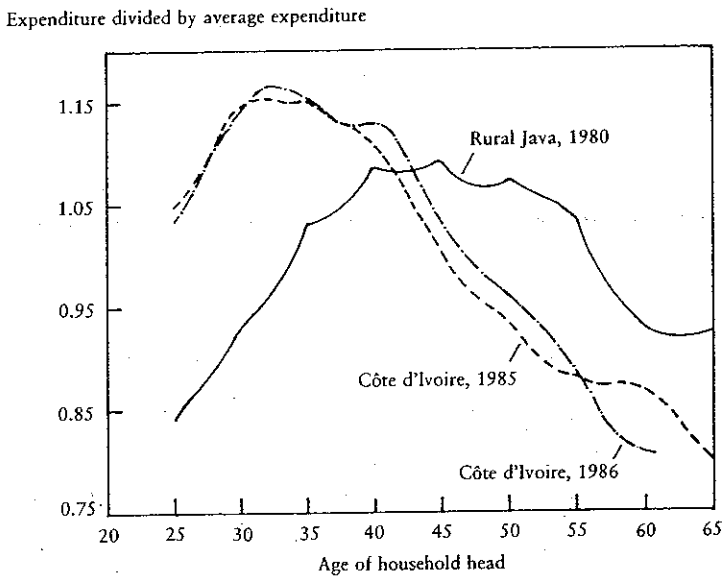
Table 1. *Growth Rates and Twenty-Year Growth Factors*

Country	*growth rate 1965–1986* *WDR*	*SH*	*20-year growth factor* *WDR*	*SH*
	percent per year			
Côte d'Ivoire	1.2	0.2	1.27	1.04
Hong Kong	6.2	6.3	3.33	3.39
Indonesia	4.6	5.1	2.46	2.70
Korea (cities)	6.7	7.0	3.65	3.87
Thailand	4.0	4.2	2.19	2.28

Note: WDR is *World Development Report 1988* (World Bank 1988); SH is Summers and Heston (1988). The SH data are average growth rates from 1965 to 1985. The growth factor is the $(1 + g)^{20}$, where g is the growth rate.

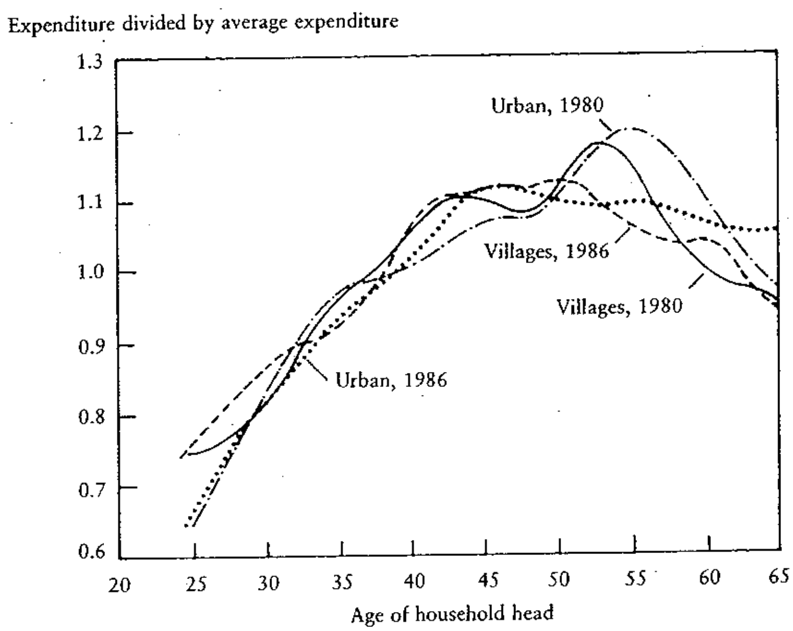
Sources: World Bank (1988); Summers and Heston (1988).

Figure 9. *Age-Consumption Profiles for Java and Côte d'Ivoire*



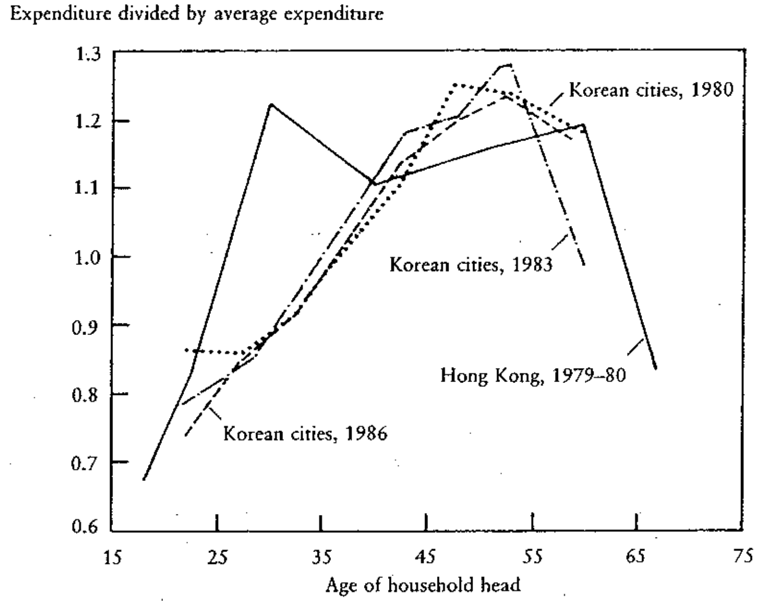
Source: Calculations based on data from La Direction des Etudes et de la Recherche de l'Office National de Formation Professionelle, an agency of the government of Côte d'Ivoire; and on data from the Indonesian National Socioeconomic Survey, Central Bureau of Statistics, Government of Indonesia.

Figure 10. *Age-Consumption Profiles: Villages and Urban Areas of Thailand*



Source: Calculations based on the 1980 and 1986 Socioeconomic Surveys, National Statistical Office, Government of Thailand.

Figure 11. *Age-Consumption Profiles for Korean Cities and Hong Kong*



Sources: Hong Kong (1980); and Korea (1980, 1983, 1986).

tuations in income. But they do show that the relative lifetime economic status of different age groups does not directly determine their current consumption levels. Given this, the standard explanation of life-cycle rate of growth effects, that younger cohorts are saving and spending on a larger scale, simply does not work. Why not is unclear. Even if the life-cycle model is false, there may be strong precautionary motives or constraints that prevent young consumers from borrowing against their expected future incomes. Note finally that all these data show systematic variation of consumption patterns with the age of the household head, so that the model of the infinitely lived demographically stationary household in section I cannot be literally true.

Where this leaves us is anyone's guess. My own feeling is that the cross-country correlations exist, if only weakly, but that we have very little idea of why, or at any rate no way of separating out the many possible explanations. But the support our results give to the Summers and Carroll challenge to the life-cycle explanation suggests that a great deal of the literature needs to be rethought.

Some Stabilization Issues

In developed countries, concern about the nature of the consumption function has centered on its implications for government policy, in particular the extent to which short-term fiscal policy, by manipulating household disposable income, can affect consumption and thus the level of economic activity. If most of consumption is determined by permanent income, short-term fluctuations in income will have less effect on consumption than if liquidity is constrained for a sizable fraction of consumers. Few developing countries have income tax systems that permit fine-tuning of disposable incomes; nevertheless, fiscal arrangements do have important effects on income fluctuations, on the distribution of income, and most likely on the level of national saving. I have in mind various agricultural taxation schemes prevalent in developing countries, particularly in those where there are substantial exports of primary commodities.

Prices of primary commodities are extremely volatile, so that the incomes of countries that sell them fluctuate widely. Such fluctuations are generally considered undesirable in themselves, but their undesirable effects would seem to arise from their translation into fluctuations in consumption. If so, developing countries ought to save and dissave in order to ride out the fluctuations in income. My impression is that this particular saving problem has been rather neglected until very recently. (See Gelb 1988 for a discussion of the effects of oil windfalls, and Bevan, Collier, and Gunning 1987 and Balassa 1988 for discussion of the macroeconomic problems created by the windfalls and losses that accompany commodity price fluctuations.)

Agricultural pricing and tax policies. Agricultural taxation affects the way income fluctuations are shared between government and farmers, and so determines who must save to smooth consumption. To give some examples, as detailed by Bevan, Collier, and Gunning (1987), coffee was not taxed in Kenya at the time of the coffee boom in 1975–76, so that the windfall went directly to the coffee farmers, who apparently succeeded in saving a good deal of it. Arrangements are almost the polar opposite in Côte d'Ivoire, where the government, to guarantee a constant real internal price, sets procurement prices for both coffee and cocoa at levels which bear little relation to world prices—a state of affairs common for most export crops in most of Africa (see Gersovitz and Paxson 1989). With such arrangements, all income fluctuations (and hence the responsibility for smoothing) accrue to the public sector. Between these extremes, the Thai government has varied the rice "premium" in such a way as to allow the domestic price of rice to fluctuate with the world price, though with a smaller amplitude. The government takes a larger share in tax when the world price is high, and vice versa, so that the smoothing problem is shared between the public and private sectors.

The effects of these schemes on total domestic saving depend on how public and private saving differ. One (unlikely) possibility is that there is no difference. Another is that households and farmers do not save, either because of lack of suitable instruments or because they lack foresight. In such a world, the government would have a custodial role both as guardian of future generations and as an insurance company, to protect farmers' consumption against the volatility of commodity prices (see Mirrlees 1988). The custodial role for government was prominent in most of the development literature in the 1960s and 1970s, and it is embedded in most of the standard cost-benefit procedures. A more skeptical attitude toward the ability of governments to handle these problems better than the private sector has prevailed recently, and although there is undoubtedly an element of fashion in these beliefs, there is plenty of evidence of apparently perverse government responses to temporary income shocks (see Balassa 1988). Some governments may find it hard to resist pressures to spend in the face of mounting revenues, and equally hard to make cuts when revenues fall. The result may be that all positive shocks are treated as permanent and all negative shocks as transitory. Even when the temporary revenue gains have been used to finance investment, which is one way of smoothing consumption, there have been problems. Large investment projects are not easy to reverse, and they generate commitments that may be hard to meet once the boom is over. A case in point is the Côte d'Ivoire investment program that required overseas borrowing in addition to the sums available from the boom in coffee and cocoa prices. And the quality of investment projects implemented in response to such revenue booms may be questionable.

In contrast to this evidence on government behavior, the theory and empirical results quoted in section I, although ambiguous on the applicability of simple versions of the permanent income theory, seem quite unambiguous in their finding that farmers can and do save and dissave so as to smooth consumption over time. Much more work needs to be done, on both private saving behavior and government saving, consumption, and investment patterns, to reach a realistic assessment of the effects of pricing schemes, of how to redesign them to avoid the most serious pitfalls, and of the potential value of the sort of international compensatory schemes advocated by Balassa (1988).

Fluctuations in commodity prices. How ought consumers and governments to respond to commodity price fluctuations? I shall take the simplest view, that price fluctuations induce income fluctuations, and that consumption, at least in the aggregate, ought to respond to permanent but not transitory innovations. We therefore need a mechanism for sorting out permanent fluctuations from transitory ones. Ideally, it is income that ought to be decomposed into permanent and transitory components, but the relation between prices and incomes is complicated and differs from country to country. Instead, I focus on commodity prices themselves.

The standard theory of commodity price determination is one of speculative demand for inventories interacting with agricultural supply and demand (see the references on optimal commodity stockpiling given in section I). Typically, the underlying supply and demand conditions are assumed to be stationary, so that, although the theory is consistent with extreme volatility and nonlinearity in the stochastic process which determines prices, the price process is stationary. As a consequence, price booms and slumps are transitory, and price shocks convey no useful information about prices in the far future. But this is theory, not necessarily fact, and although actual commodity prices do indeed go up and down, it is far from clear that shocks invariably die away and that booms and slumps are always temporary. Indeed, several analysts of commodity prices, for example Labys and Granger (1970) or Ghosh, Gilbert, and Hughes-Hallett (1987), treat the first difference of commodity prices as stationary (the standard prescription of the time-series analyst faced with the very high and slowly diminishing autocorrelations in most commodity prices). Many of these formulations imply that shocks are infinitely persistent and that there are no forces that act to bring prices back to some fundamental level. While this position does not seem to be sustainable, it is plausible that some part of commodity price shocks reflects shocks to fundamentals, not just temporary shortages or gluts associated with bad or good harvests and the actions of profit-maximizing speculators.

Fortunately, the extent to which price shocks are permanent is a topic amenable to empirical investigation. The precise question to be answered is how much of an innovation in the price can be expected to persist indefinitely, and how much to evaporate, at least eventually. Cochrane (1988) and Campbell and Mankiw (1987) have developed an estimate of persistence based on the successive autocorrelations in the first differences of the time series. If the time series is anchored, either to a constant base or a deterministic trend, then innovations must eventually be followed by compensating changes in the opposite directions, and there will eventually be a predominant pattern of negative autocorrelations in the first differences. Consider, for example, a white noise series ($\mu + \epsilon_t$). The first difference is ($\epsilon_t - \epsilon_{t-1}$), which has autocorrelations at all leads and lags of (. . . 0, 0, 0, −0.5, 1, −0.5, 0, 0, . . .) where the 1 is the autocorrelation at lag 0, and the −0.5s at lead and lag one. These autocorrelations add to zero, and the series has zero persistence. By contrast, a random walk with drift $\Delta y_t = \theta + \epsilon_t$ has a first difference which is white noise, and the sum of all its autocorrelations is unity, so that a random walk has a persistence measure of 1; all shocks are permanent. Any stationary series has a persistence measure of zero, but not all series with unit roots are necessarily very persistent. For example, the sum of a random walk and white noise has a persistence measure less than unity, while a unit root series that is positively autocorrelated in first differences has a persistence measure greater than unity.

Table 2 lists summary statistics and persistence measures for thirteen commodity prices important for developing-country exports and incomes. The data come from the World Bank and are monthly from January 1960 through February 1988. The Bank routinely deflates these prices by an index of import prices for developing countries; here I have deflated by the U.S. consumer price index. The difference in the deflator is insignificant compared with the fluctuations in the series. The coefficients of variation show the volatility of the series. The sugar price is by far the most volatile, and the banana price by far the least; neither commodity is traded in anything like a free competitive market. The second and third columns show the autocorrelation coefficients of the prices themselves at lags of one and twelve months. Apart from bananas, which alone

Table 2. *Monthly Commodity Prices: Summary Statistics*

Commodity	Coefficient of variation	Autocorrelation[a]		Persistence measures[b]	
		1 month	12 months	60 months	120 months
Arabica coffee	0.42	0.98	0.53	0.81	0.41
Bananas	0.18	0.80	0.58	0.07	0.02
Cocoa	0.51	0.99	0.74	1.26	0.67
Copper	0.41	0.97	0.60	0.41	0.28
Cotton	0.26	0.98	0.50	0.92	0.62
Iron ore	0.31	0.99	0.85	0.31	0.16
Jute	0.36	0.97	0.62	0.37	0.14
Maize	0.27	0.98	0.70	0.70	0.35
Palm oil	0.34	0.97	0.49	0.44	0.23
Rice	0.43	0.99	0.55	0.85	0.60
Sugar	0.92	0.97	0.42	0.43	0.22
Tea	0.32	0.95	0.64	0.15	0.08
Tin	0.36	0.99	0.79	1.79	1.62

[a] The first and twelfth autocorrelation coefficients of the deflated series.

[b] Campbell/Mankiw-Cochrane measures of persistence, that is, the normalized spectral density at frequency zero, estimated using a triangular (Bartlett) window with window widths of 60 and 120 months respectively.

Source: Calculations based on World Bank data.

among these commodities are perishable and show seasonal price variation, all the first-order autocorrelations are more than 0.95, and only one is less than 0.97; even after twelve months, most of the autocorrelation remains.

These kinds of statistics are characteristic of integrated, nonstationary processes. Nevertheless, the persistence measures show considerable variability from commodity to commodity. Two estimates are shown, corresponding to "window widths" of 60 and 120 months respectively. The need for the window width arises from the impossibility of adding all terms in an infinite series; here I calculate the weighted average of either 60 or 120 autocorrelations with weights declining linearly with the length of the lag. There is a standard tradeoff here between bias and variance. Small window widths are relatively precise but, by omitting higher-order autocorrelations, run the risk of bias, especially if the price reverts only slowly to its base. Wide windows lead to imprecise estimates, and at extreme lengths are biased toward zero. The asymptotic t-values for the two estimates are 2.1 and 1.5 respectively.

For most of the commodities, particularly bananas, copper, iron ore, jute, palm oil, sugar, and tea, the persistence estimates are small; it would probably make sense to accept the standard view that shocks are not persistent. For a second group—coffee, cocoa, cotton, maize, and rice—the estimates are a good deal larger, so that there is some evidence that some fraction of actual, historical shocks has been permanent. For one commodity, tin, the persistence estimate is very large, even at the wider bandwidth. A country facing fluctuations in the price of tin would be justified in taking the view not only that price changes are permanent, but that it makes sense to expect further movements in the same direction. For commodities with low persistence estimates (the first group), price booms are times to save, and slumps times to dissave. For those in the second group, price booms would justify at least some increase in consumption levels. For tin, a rise in price would justify a country borrowing so as to spend more than the current increase in income. If commodity income is more than unit persistent, consumption levels should be *more* volatile than income.

The commodity boom in the 1970s appeared to trigger exactly this sort of behavior, with some countries *borrowing* internationally during the boom. Of course, the evidence here would not support such a strategy in general; indeed the lack of persistence for most of the commodities helps explain why those policies had such disastrous consequences. But it is much easier after the event to assess the transitoriness of a price boom, and the figures in the table show that it is far from obvious in advance how saving ought to respond to fluctuations in commodity prices, even when governments can and will implement the correct policies.

III. Is There Too Little Saving?

The idea that underdevelopment is a problem of too little saving is deeply embedded in the history of development economics. The argument seems simple enough: capital accumulation is a necessary and sufficient condition for growth, and capital accumulation is almost synonymous with saving; the route to development is then one of raising saving ratios. But since Lewis's (1954) statement of this "central problem of economic development," the argument has been assailed by the standard economist's question of what prevents the market from working without outside interference, and further eroded by questioning of the link between saving and growth. Solow's (1956) model does not generate any relation between saving and growth in long-run equilibrium, although increases in saving will generate increases in growth over a transition path that may be very long-lived. Recently, there has been a renewed interest in "increasing returns" models of growth (see particularly Arrow 1962; Romer 1986, 1988; and Lucas 1988; reviewed splendidly by Romer forthcoming). But these models emphasize, not so much saving, but the role of *human* capital formation, so that while such models predict a relation between the willingness to wait and the rate of growth, there is no necessary relation between growth and the rate of *physical* capital accumulation.

Nor has the empirical evidence suggested any straightforward link between growth and either saving or investment. Figures 7 and 8, with the axes reversed, show the same weak relations that, in the previous section, were interpreted the other way round. There is also a very high cross-country correlation between saving and investment, so that the picture would not be different if the latter were substituted for the former. The point is not that there has not been growth, nor that there have not been much higher saving ratios. Even after recent events, postwar growth in the developing world has been very high by all historical standards, and there are now many developing countries with saving rates that would have seemed unimaginably high to the development economists of the 1950s. In 1986, China's gross domestic saving was 36 percent of gross domestic product (GDP), India's 21 percent, Kenya's 26 percent, Thailand's 25 percent, and the People's Republic of the Congo's 30 percent. The point is that across countries there is at best only a very weak relation between saving and growth, perhaps because it is the productivity of investment that is crucial, not its volume.

Nevertheless, there are substantive issues about the "right" amount of saving. If there are positive externalities to saving by each individual, too little of it will be done, an argument formalized in Sen's (1967) "Isolation Paradox." It can also be argued that future generations will not be adequately represented by their currently living ancestors, so that governments must act on their behalf. Alternatively, it might simply be that optimal intertemporal choice under uncertainty is difficult in that it requires a degree of calculation and sophistication that is too difficult for individuals and can reasonably be expected only of a planning agency. Whatever the virtues (and vices) of planning agencies, the evidence that households make good intertemporal allocations is far from overwhelming. The ability of households and farmers to smooth out short-term income fluctuations is well established, but that is not the same as being able to make ideal provision for the long-term future. The empirical literature on life-cycle models, although successful in many respects, has repeatedly failed to observe the sorts of lifetime profiles of consumption and labor supply that would be expected from long-term intertemporal optimization (see Browning, Deaton, and Irish 1985; and Mankiw, Rotemberg, and Summers 1985).

In opposition to the view that governments need to step in to remedy the deficiencies of private-sector saving is the contention that government interference, not market failure, is responsible for inadequate saving in many developing countries. The "financial repression" literature (associated with the work of McKinnon 1973 and Shaw 1973; see Fry 1988 for an extensive review and references), argues that governments have reasons for keeping domestic interest rates low and for repressing financial intermediation in general. Low interest rates keep down the cost of domestic borrowing, and the lack of alternative borrowers allows the government to exploit its monopoly as a seller of financial securities. Low interest rates and lack of investment opportunities are then held to be responsible for low domestic saving. According to this view, financial liberalization is the recipe for higher saving ratios and higher growth. These arguments tend to parallel the similar arguments in developed economies that government policies, particularly tax policy, lower the return to saving and hamper capital accumulation.

Apart from the connection between saving and growth, which I have already discussed, these arguments take it as axiomatic that saving responds positively to interest rates. Once again, there is no theoretical basis whatsoever for this presumption. Changes in interest rates have both income and substitution effects, and can increase or decrease current consumption depending on the balance between the two. Higher (real) interest rates do indeed increase the incentive to postpone consumption and tend to make the planned consumption profile grow more rapidly over time, but the current starting point of that profile can move either up or down. There is also an enormous body of research, mostly but not exclusively in developed economies, that has singularly failed to show *any* empirical relation between interest rates and the rate of saving.

The empirical work can be divided into two classes: those studies that look for a direct effect of interest rates on saving, and those, following the more recent "Euler equation" approach, that look for a relation between the *rate of growth* of consumption and the interest rate. Theory predicts nothing in the first case and is consistent with any finding; in the second case, the effect ought to be positive, at least in the simplest models of infinitely lived consumers. Perhaps the most frequently cited of the first kind of study is Boskin (1978), who finds a very strong positive interest elasticity of saving. However, this study stands almost alone, and it is also notable for the very nonstandard data series that are used. Much more typical is the time-series study by Blinder and Deaton (1985), which finds some interest rate effects in some specifications but whose results are not robust either to changes in the sample period or to the inclusion or exclusion of other variables. Indeed, the consumption function literature abounds in studies that include, in addition to income, some favorite "exotic" variable, which does well in that particular study. However, attempts to estimate more comprehensive models rarely support the original studies. For developing countries, studies have usually been on pooled cross-section time-series data for a range of countries over some span of years. A number of early studies by Maxwell Fry reported high interest elasticities. Giovannini (1983, 1985), in what appear to be careful studies, was unable to find any positive effects in similar data for the 1970s rather than the 1960s. My reading of Gupta (1987) too is that well-defined robust estimates are very hard to obtain. Fry's (1988) review and update of his earlier studies once again finds positive interest elasticities. However, I find this latest evidence unconvincing, largely because Fry does not give enough information for me to tell how the equations were estimated. The literature as a whole is not very enlightening: the value of these sorts of cross-country studies is in any case dubious, particularly given the data problems, and several of the studies do not reach econometric standards that would allow the reader to take their results at face value.

Studies of the second type, linking consumption growth to real interest rates or, better, to *expected* real interest rates, have been, if anything, even more unsuccessful. In the U.S. data, whether prewar or postwar, there is no relation whatever between consumption growth and real interest rates, whether or not the latter are expected or realized, and however sophisticated or careful the estimation technique. Even at the most obvious level, post-tax real interest rates in the United States have been negative as often as positive, and yet consumption growth has nearly always been positive, a finding that would require a *negative* rate of time preference (see Deaton 1987). Other, more sophisticated studies, come to the same conclusion (see Hall 1988; Campbell and Mankiw 1989 and forthcoming; and Hotz, Kydland, and Sedlacek 1988). There have been few recent studies for developing economies, but Giovannini (1985) has examined the effects of expected real interest rates on consumption growth in eighteen developing economies. He finds some nonzero effect in five (India, Jamaica, Greece, Myanmar, and Turkey), and no effects in the other thirteen (Argentina, Brazil, Colombia, Indonesia, Kenya, Korea, Malaysia, Mexico, Philippines, Portugal, Singapore, Taiwan, and Thailand).

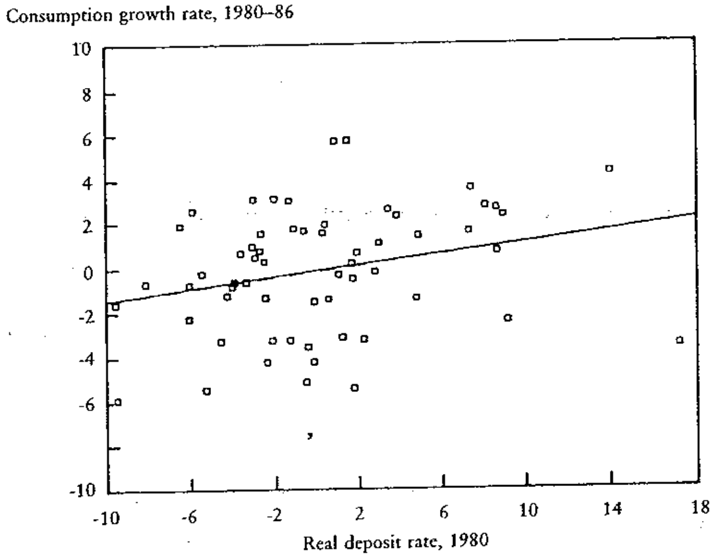
The last two figures, 12 and 13, show the cross-economy scatter of real interest rates and consumption growth. Clearly, the treatment of expectations in these figures could be much improved, but I should still expect any important patterns to show up. An important point to note is what is *not* on the figures, that is, the set of fourteen economies (thirteen in figure 13) whose real interest rates were less than −10 percent (Argentina, Bolivia, Ghana, Israel, Madagascar, Mexico, Nicaragua, Sierra Leone, Somalia, Tanzania, Turkey, Uganda, Zambia, and in figure 12, Yugoslavia). Several of these have negative rates of several hundred percent, and their inclusion would dominate the figures, as well as producing regression lines with slope zero. The (insignificant) positive slopes in the two figures should be interpreted with that exclusion in mind. There is certainly no evidence here of any well-defined relation between interest rates and consumption growth, particularly in the Summers-Heston data. If we were to believe that preferences are common across countries, these results would be prima facie evidence against the supposition that consumption is being optimally allocated over time. By the standards of a decade or so ago, such evidence would be taken as favoring some form of state planning. We are nowadays much more skeptical about the ability of planning agencies to solve these problems, but that does not mean that saving is being optimally done. Indeed, the evidence reviewed in this section does not point to any simple policy solution for the saving problem, if problem it is. Apart from the ambiguity of the empirical results, one of the main difficulties is our lack of an accepted and well-supported theory of economic growth.

IV. Conclusions

My view is that the research priorities for the immediate future lie with the topics covered in sections I and II. I think the literature has sufficiently belabored the problems of physical accumulation. The issues are certainly important, but I cannot see useful ways forward without major theoretical advances, particularly in the theory of growth. The recent developments reviewed in Romer (1989) hold promise of such an advance, but, if that promise is fulfilled, research is likely to be redirected, perhaps toward a more intensive study of human capital formation.

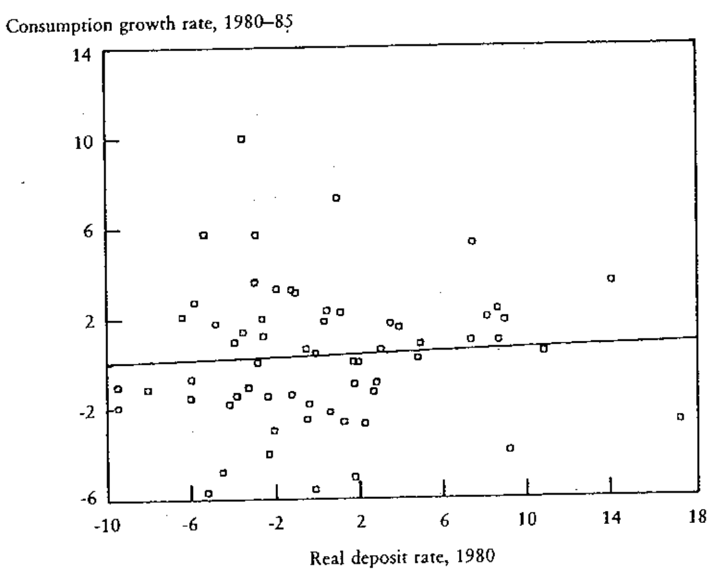
The rather negative results of section III should at least serve as a warning to those who like to make glib generalizations on the basis of the experiences of

Figure 12. *Consumption Growth and Interest Rates: World Bank Data*



Note: 60 countries excluding 14 with real deposit rates less than −10 percent.
Source: World Bank (1988). Consumption growth is from table 4, column 2, deflated by population growth from table 27, column 2. Interest rates are the nominal deposit rate in 1980 (table 25, column 7) less the actual rate of inflation for 1980–86 (table 25, column 6).

Figure 13. *Private Consumption Growth and Interest Rates: Summers and Heston Data*



Note: 62 countries, excluding 13 with real deposit rates less than −10 percent.
Sources: Interest rates: World Bank (1988, table 25); consumption growth: Summers and Heston (1988).

a few carefully selected countries: saving is not only about accumulation, but about consumption smoothing in the face of volatile incomes, and about providing insurance for poor people whose lives are difficult and uncertain. I think that the data exist that would help us understand more about how poor households use saving and assets, and I think we need a more positive understanding of how governments respond to fluctuations in their revenues.

Finally, and this is an area in which the World Bank should be taking the lead, we need to know more about the data, what they mean, and how to improve them. Useful work could be done by bringing together national income accountants and survey statisticians in a few countries where there is extensive experience in both areas. We also need experimental household surveys that will track cash flows within households, perhaps in quite small samples more akin to village studies, so that we can learn whether the apparent patterns of saving and dissaving are real, and if not, how to improve the survey questionnaires. Without such studies, and without these data improvements, our understanding is likely to remain precarious.

Appendix: The Consumption Function with Liquidity Constraints

Section I deals with two cases of the Euler equation with a borrowing constraint. In the first case, which satisfies equation 3, the consumer is spending less than the total of his cash on hand (assets and current income), while in the second, equation 5, everything is being spent, and there may be dissaving. The two branches of the Euler equation can be combined into a single expression by writing

$$\lambda\,(c_t) = \max\left\{\lambda(A_t + y_t),\, E_t\left[\frac{(1 + r)\lambda(c_{t+1})}{(1 + \delta)}\right]\right\} \tag{A-1}$$

In order to derive a solution to equation A-1 and for computational reasons, I will work with the simplest case, in which income is independently and identically distributed over time. I also require an assumption that prevents the marginal utility of money from becoming infinite in the worst possible case, which is when the individual has no assets and receives the lowest possible value of income. To this end, I assume that the income process is such that y_t always falls in the interval (y_0, y_1), with $y_1 > y_0 > 0$, y_1 possibly infinite but $\lambda(y_0) < \infty$. Income level y_0 is income in the "workhouse," and it is sufficient to sustain life. Define the "state" variable x_t as $A_t + y_t$; x_t is the amount of cash on hand. Given x_t, the consumer knows all that he or she needs to know; the interest rate is fixed, and because of the assumption that incomes are independent over time, income tomorrow is unpredictable by past events. As a consequence, consumption must be a function of x_t, and I write the consumption function

$$c_t = f(x_t) \tag{A-2}$$

and the modified Euler equation (A-1) can be used to characterize the function $f(x)$. Note that if income were serially correlated, consumption would be a function of at least two state variables.

From the budget constraint (equation 2 in the main text) x_t evolves according to

$$x_{t+1} = (1 + r)[x_t - f(x_t)] + y_{t+1} \qquad \text{(A-3)}$$

From A-1 and A-3, inverting the monotonically decreasing function $\lambda(c_t)$ gives

$$f(x_t) = \min\left(x_t, \lambda^{-1}\left\{E_t \frac{(1 + r)\lambda[f(x_{t+1})]}{1 + \delta}\right\}\right) \qquad \text{(A-4)}$$

Substituting from A-3, and replacing the expectation by an integral,

$$f(x_t) = \min\left\{x_t, \lambda^{-1}\left[\int \frac{(1 + r)}{(1 + \delta)} \lambda[f\{(1 + r)[x_t - f(x_t)] + y\}]dF(y)\right]\right\} \qquad \text{(A-5)}$$

where $F(y)$ is the distribution function of income y. Although A-5 is far from being an explicit functional form, it is straightforward to calculate the function from this expression, provided again that $\delta > r$. Given values of the two parameters, a marginal utility function, and a density function for income, an initial guess is made for $f(x_t)$, for example the piecewise linear form

$$f_0(x) = \min\left[x, \frac{(rx + \mu)}{(1 + r)}\right] \qquad \text{(A-6)}$$

where $\mu = E(y)$. The guess is substituted into the right-hand side of A-5, and a new function $f_1(x)$ is calculated using numerical integration to evaluate the expectation. After the first guess, only numerical solutions are possible, and the function must be evaluated over some suitable grid for x. Deaton and Laroque (1989) show that, provided $\delta > r$, this procedure defines a contraction mapping from one function to the next, so that the numerical calculations will be convergent.

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