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LIFE CYCLE INCOME AND CONSUMPTION IN COLOMBIA

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by

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ABSTRACT

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This thesis applies the 1978 Colombian EH-4 cross-sectional household budget study to two empirical versions of the Modigliani-Ando-Brumberg life cycle consumption model. The first version uses "normal income" as a proxy for life cycle income. Normal income is defined as a weighted average of the mean income of the socioeconomic groups (education, occupation, home-tenure, region) to which an individual belongs. As both the simple linear case and a slightly more complex approach permitting interactions among grouping variables, the marginal propensity to consume from normal income is less than one but greater than the MPC from the proxy for transitory income.

The second empirical version derives from a one-parameter intertemporal utility function. In this model consumption depends on expected income in each period and the market interest rate. An individual's expected income i years in the future is defined as the mean income of members of his education/occupation group who are currently i years older. For a given interest rate (r), permanent income is

$$Y^{*} = \sum_{i=o}^{L} Y_i \, (1 + r)^{-i} \; / \; \sum_{i=o}^{L} (1 + r)^{-i}$$

where Y_i is expected income each year and L is the end of the planning horizon. Y^* is calculated for various interest rates. The "best" interest rate is chosen as the rate which provides the highest adjusted correlation between Y^* and consumption.

For most groups the interest rate chosen is 7.5 percent. For all groups, estimated MPC from Y^* is close to one and greater than the MPC from transitory income. Hypothesis tests performed on several predictions of the M-A-B do not reject the predictions.

If low income individuals are less willing to plan for the future (that is, they have high psychological discount rates or short time horizons) than high income individuals, they should have higher marginal consumption propensities from both permanent and transitory income throughout the life cycle. On the other hand, if all individuals tend to have the same psychological rates but low income persons are less able to borrow against future income due to market imperfections, the predicted MPC's from permanent income depend on relative variation in income across the life cycle and vary by age.

For transitory income, young low income individuals will apply any variation in income to current consumption since they are consuming at less than their permanent income level, but the MPC from transitory income should decline with age. Hypothesis tests tend to reject the higher psychological discount rate assumption and favor the market imperfections assumption.

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This thesis is dedicated to Dr. Tuncay Sunman.

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Chapter I

INTRODUCTION AND REVIEW OF THE LITERATURE

This thesis applies economic theory and a newly available data set to the study of individual savings decisions. The theoretical approach relies upon three basic insights of the life-cycle income-consumption model associated with Modigliani, Ando and Brumberg (M-B-A) [19,20]: The economically rational individual uses the best available information on future incomes, interest rates and other relevant variables to plan his consumption and savings decisions over long time periods; a major motivation to borrow or lend from current income is to provide a relatively constant consumption stream throughout the life-cycle; the individual attempts to maintain his desired consumption level in the face of unexpected changes in income through borrowing against his future earnings (in the case of a loss) or adding the additional income to his life-time resources (in the case of a gain). The life-cycle model provides a rich source of positive statements about savings behavior. This thesis tests some propositions of the theory upon the EH-4 cross-sectional household budget study undertaken in Colombia in 1971. Following this introductory and literature review chapter, the four remaining chapters consist of a description of the data and variables employed in the thesis (Chapter II), application of the data to a "normal income" model in which permanent income is estimated from mean incomes of socio-economic groups (Chapter III), a theoretical and empirical study of a

more comprehensive life-cycle model which is closer to the M-B-A formulation (Chapter IV), and a final chapter which summarizes and presents conclusions from the previous chapters.

The Modigliani-Ando-Brumberg life-cycle theory follows a long tradition in economics by assuming that an individual's savings behavior is essentially rational, the outcome of a decision about present versus future consumption which corresponds to the familiar choice among commodity bundles at any given time. The individual adjusts his present-future consumption choices until the marginal rate of substitution between consumption in any two periods is equal to the foregone interest income from consuming now rather than investing the income until a future period. In this framework there are no differences in marginal savings propensities between two individuals of the same age and life-expectancy, no matter what their relative income differences may be, unless they either have differing tastes for present over future consumption, or face different market interest rates. At least two questions arise from this fundamental proposition. First, do income or social classes in fact exhibit different marginal savings propensities which cannot be explained by differences in age composition? Second, to the extent to which differences are found, are they to be attributed to psychological traits or tastes or to differing external circumstances, especially interest rates?

Attempts to answer these questions must deal with a number of methodological problems. To begin, it is not easy to choose a simple unambiguous measure of saving. Any delay in consumption, whether for a week or for decades, may be arbitrarily defined as saving. In practice, any income which is not consumed in the year in which it is earned is

generally considered saving. Moreover, saving may take many forms, not all of which are easily measurable (e.g., the service flow from a pair of shoes may continue for several years). Government planners may prefer that savings occur in forms which are readily transformed into capital goods, but, as Marshall points out[2], people receive benefits from housing and even clothes which are both necessary for them to work and which extend over long periods of time. Most recent empirical work defines saving as the difference between current income (which usually includes the service flow from housing and occasionally durables but not clothing, medical care, education, etc.) and consumption of non-durables plus the services of housing. Thus saving includes but is not limited to the accumulation of financial assets. This broad definition leads to the observation that since people may save in various ways, the fact that some persons, probably in the upper income classes, devote a large fraction of their income to acquisition of financial assets does not necessarily lead to the conclusion that they have a higher marginal savings propensity.

Supposing that under this broad definition of savings, differences in marginal savings rates are found between individuals, the question remains whether this is due to differences in tastes (or as Marshall puts it, abilities to see the future clearly) or external factors, such as the cost of borrowing and lending against future income. The answer has practical importance. For example, if the differences are due to taste then reforms of the capital market will not increase the savings propensity of the low MPS groups, while income transfers from high MPS groups to low MPS groups will have a negative impact on the growth rate of the economy.

Some economists apply a "minimum level of subsistence" argument to

support the view that even under perfect capital markets, low income individuals will exhibit a low MPS. This approach, summarized by Thomas Mayer [17], defines a subsistence individual as one whose permanent income is so low that any increase in income must be devoted to his immediate need for food and shelter. Granting that this definition might apply to some people who are literally at the edge of starvation, it does not necessarily describe the behavior of large numbers of persons who are not only poor now, but have always been and expect to remain poor forever. It seems at least as reasonable to suppose that a poor person's memory of yesterday's hunger and anticipation of tomorrow's is sufficiently strong to encourage him to allocate his consumption in order to minimize the rigors of poverty.[3] The contrast between the rarity of a poor farmer's consumption of his seed grain and the frequency of squatter settlement dwellers' construction of durable housing indicates that many of the permanently poor do plan for the future. Further, the desire to accumulate a "contingency reserve" against possible income loss would seem to be stronger for the poor, for whom the consequences of personal bankruptcy may be dire.

The other possibility is that a higher MPC by the poor is the rational response to capital market imperfections. If poor persons must pay significantly higher rates to borrow and receive lower returns on their savings they may be expected to devote a large fraction of any additional income to current consumption. It is possible in principle to distinguish between the "short time horizon" and "capital market imperfections" hypotheses. Myopic persons prefer present consumption over future throughout their lives, therefore their MPC's should be high when they are old and facing retirement as well as when they are

young. Capital market imperfections, on the other hand, have differing effects across the life-cycle. Young persons who face difficulty borrowing will have high MPC's from transitory income as they attempt to raise present consumption to equal the consumption available in later, higher income years. On the other hand, as they approach retirement their MPC from both transitory and permanent income will tend to decline as they save in order to provide for retirement. In fact if they receive a lower return on loans than other persons, older poor persons could have a lower MPC than rich persons of the same age. Since their wealth will not provide a large income flow during retirement they must contribute more from pre-retirement income.

Three topics emerge from this discussion. First, the life-cycle model provides a tool rooted in traditional economic theory which may be used to analyze personal savings behavior. One interesting question concerns the generality of the model. Is it appropriate to apply this model to developing countries, specifically Colombia? Second, the model contains a troublesome black box. To some extent the marginal propensity to save depends on the individual's psychological "impatience to consume" or time-horizon. It is difficult to assert on theoretical grounds whether savings propensities will differ between individuals, or between income, occupational or educational groups. Therefore even if the life-cycle model is accepted, resolution of this issue remains primarily an empirical problem. Third, in those instances for which differences in savings propensities occur, are they to be attributed to internal, psychological factors or to external, capital market imperfections? The remainder of this chapter reviews the available evidence on these topics.

2. Empirical Evidence on the Life-Cycle Theory

The life-cycle theory and the related permanent income hypothesis (PIH) have spawned a large literature. Most empirical analyses are devoted to the PIH rather than the life-cycle model, however the predictions of the models and their empirical formulations are sufficiently similar that conclusions concerning one theory frequently are transferable to the other. Of the three recent (1973) surveys of the literature on savings behavior, by Ferber [5] for the developed countries and by Mikesell and Zinser [18] and Snyder [25] for developing countries, only Mikesell and Zinser attempt to distinguish between the PIH and life-cycle theories. Ferber concludes that "as of the present time the concept of permanent income seems to be both operational and highly meaningful" [5, p. 1309], although it requires modification if it is to provide a strong fit with empirical evidence. According to Snyder, "the permanent income hypothesis in developing countries is at an early stage of testing, but the evidence to date appears to be nominally in its favour" [25, 143]. To Mikesell and Zinser there is "clear, if not total, support for a medium term version of the Friedman 'Permanent Income' hypothesis. Efforts to find support for the MBA 'Life-Cycle' hypothesis have been much less successful" [18, p. 19].

The less than successful support for the life-cycle model may be due to the infrequency of attempts. Mikesell and Zinser refer to only two studies of the life-cycle theory. One of these, by Landsberger [15] applies to Israeli cross-sectional data the proposition that the MPC from windfall income increases with age. Some interpretations of the theory hold that this implication follows from the fact that older persons have fewer years over which to consume any unexpected increase in life-

time resources. As discussed in Chapter IV below, this is not a necessary conclusion since as retirement approaches the individual has a greater incentive to devote an increase in income to a retirement fund. In any case, Landsberger found that the marginal propensity to consume from windfall income increased for five out of eight pairs. This may be interpreted as support or at worst non-rejection of the basic theory. The implications of the second study, by Kelley and Williamson [13] are also inconclusive. These authors relate average per-capita savings to mean current income for five age classes in Indonesia. They find that the "variation in age-specific household savings predicted by the [life-cycle] model is far greater than the actual mean savings levels," particularly for the younger age group [13, p. 396]. Two problems, of unequal significance, may affect this result. The minor problem is the assumption that desired consumption by each family member, whether child or adult, is equal. A more significant problem is that mean current income for each age group i years in the future is assumed to equal the average income of persons currently i years older. Given the well-known association between education and variation in income over the life-cycle, this assumption is suspect for the relatively highly educated[4] younger age group. As Kelley and Williamson observe, "the discounted expected future income stream would far exceed that based upon current income experience for the 20-29 age group" [13, p. 397]. Thus the low saving rate from current income by this age group may be consistent with the life-cycle model. In another test the results of a separate regression of per-capita income on per-capita savings for each of the age groups "indicate not only a great variation in the marginal propensity to save over age groups, but also a confirmation of this aspect of the life-cycle

hypothesis" [13, p. 398]. A minimum reasonable conclusion is that neither the Landsberg or Kelley and Williamson study conclusively rejects the life-cycle theory.

Adequate tests of the life-cycle theory must conform with the three propositions mentioned at the beginning of this chapter, i.e., that individuals consider future income in solving a rational utility maximization problem, that the consumption from current income varies predictably over the life cycle and that unexpected changes in current income affect current consumption primarily through effects on the lifetime budget constraint. A rigorous formulation of the theory by Somermeyer and Bannink [26] carefully addresses the first two of these propositions. The authors show that maximization of a simple additive-log inter-temporal utility function constrained by total available resources over the life cycle implies that consumption in each period will satisfy the equation:

$$c_1 = \alpha_1 \left[(K_o - K_L)(1 + r)^{1-L} + \sum_{i=1}^{L} Y_i(1 + r)^{1-L}\right]$$

where K_o is present wealth, K_L is desired wealth at death, r is the market interest rate, Y_i is expected income i years in the future, and L is expected remaining lifetime. The parameter α_1 is termed the "urgency to consume." It reflects the desired increase in current consumption per unit increase in total resources. This parameter should vary inversely with L since a shorter remaining life span implies a larger fraction of the increase may be consumed now.[5]

In order to apply this equation to 1960 cross-sectional survey data for the Netherlands, the authors make a number of assumptions. Estimated K_o includes net assets excluding real estate and durable goods for

which no information was available; K_L is assumed to be zero. The time pattern of future income for each individual is assumed to follow that of the mean income for members of his occupation and sex group, i.e., expected Y_i equals the individual's current income times the ratio of mean income i years in the future to current mean income for members of his occupation-sex group. This implicitly assumes that no transitory variation in income occurs; any current good or bad fortune will continue into the future. The interest rate, r, is taken as an average of long-term government bonds (4.08 percent).[6]

The parameter α_1 is estimated for a number of socio-economic and age groups. Among the results is that the "urgency to consume" is consistent with its expected value (i.e., it increases with age) for all groups except the oldest (65+). The authors point out that the older group's behavior may reflect an overestimation of life expectancies or the need to provide a contingency against illness or disability. Another interesting result is that although the urgency to consume is higher for manual workers than non-manual the smaller variability in the lifetime income for manual workers counteracts this effect.[7] On balance, "the savings rates of manual workers generally exceed those of non-manual workers" [26, p. 391]. The same reasoning applies to the effects of education so that Somermeyer and Bannink agree with the empirical finding, as opposed to theory, of Klein [14] that a relatively high level of education is associated with a relatively low rate of savings. The general conclusion is that their effort to find an empirical formulation of the life-cycle model consistent with its basic theoretical tenets is successful despite the restrictive assumptions. This is encouraging since the present work (in Chapter IV) also assumes the restrictive

log-additive utility function.

An interesting extension of the life-cycle theory has been undertaken by J. K. Hill [9, 10]. He points out that the prediction of the model that the marginal propensity to consume from transitory income should be quite low (approximately the reciprocal of the individual's remaining life-expectancy) has not been confirmed by the evidence, especially in developing countries. By implication the length of the effective planning horizon is much less than the life-time horizon assumed by the theory. Several facts unrecognized by the conventional model may account for this discrepancy: Imperfect capital markets, uncertainty in real incomes and rates of return,[8] imperfect information or a strong taste preference for present over future consumption. In a theoretical analysis Hill considers the influence of the first of these possibilities. The Modigliani-Brumberg-Ando approach assumes that individuals may borrow and lend at the same rate and without quantitative restrictions on borrowing as long as the lifetime budget constraint is satisfied. This assumption is unrealistic for developed countries, still less for developing countries in which capital markets are notoriously fragmented and imperfect. Hill modifies the individual's budget constraint by introducing differing rates for returns in assets and costs of liabilities. He shows that two of the observed exceptions to the M-B-A life-cycle model become reconcilable. To explain the high MPC's from transitory income, Hill notes that individuals who are net borrowers will exhibit current consumption at less than their lifetime averages. Therefore, a transitory increase in income will be applied to current consumption rather than spread over the remaining lifetime since the marginal benefit of current consumption will exceed that from

future consumption. At the same time the high borrowing rate discourages borrowing during the early years and, once the debt is retired, the individual will consume at a higher rate than that selected under perfect capital markets. This would explain the relatively slight variation in average age-specific household savings observed by Kelley and Williamson.

A major contribution of Hill's analysis is the demonstration that truncated planning horizons may be due to external circumstance rather than unwillingness to plan consumption over the life cycle. The long horizon rationality posited by Modigliani and Brumberg is preserved after the less crucial and unrealistic assumption of perfect capital markets is discarded. Unfortunately, since consumption now depends mainly on current income it is difficult to distinguish the life-cycle model from the Keynesian absolute income approach.

In his empirical analysis Hill extends the rigorous application of utility theory espoused by Somermeyer and Bannink by use of a two-parameter exponential utility function and different borrowing and lending rates. The resulting consumption function is tested against Colombian cross-sectional household expenditure data. Given the assumed borrowing and lending rates facing each of six income classes (three urban and three rural) Hill estimates the parameters of each class' utility function by maximum likelihood techniques. The first parameter, γ, measures the degree to which a household will indifferently substitute bewteen present and future consumption when interest rates or incomes vary. The estimated values of γ are broadly

consistent with, although smaller than, those estimated for the U.S. The second parameter (δ), termed the impatience rate, indicates the excess over one unit of future consumption which a household requires if it foregoes one unit of present consumption yet remains on the same indifference level. He finds that δ is negative for all income groups. This contradicts the contention of the classical theorists that it is positive and varies inversely with the income classes. Estimates for the U.S. have found similar unexpected values. Hill interprets this finding as evidence "that life-cycle motives for saving are imperceptible within the Colombian data base" [10, p. 38]. However they may also reflect strong self-financing behavior by households who forego present consumption in order to accumulate durables or a retirement fund without regard to interest rates in external markets, i.e., the own rate of interest may be substantially greater than the market rate.

Hill uses the estimated parameter values together with a set of more plausible alternatives to estimate MPC's from permanent and transitory income. He finds that these estimates are consistent with the imperfect capital markets life-cycle model, and that MPC's from permanent income are greater for low-income persons than high. He also estimates these MPC's under the assumption that all income classes face the same lending and borrowing rates and concludes that "the inter-class differences in the propensities are generated by differences in tastes and family size rather than capital market opportunities" [10, p. 45]. However, in view of his earlier statements that "the cross-section data base may not permit a separation of consumption characteristics which are attributable to the tastes of the household from those which are due to its financial environment" [10, p. 32] and "none of the estimates [of

the taste parameters for various income groups] are distinguishable at a 90 percent level of confidence" [10, p. 36], this conclusion must be viewed with reservations.

R. Ramanathan [24] conducted a study of the approprite discount rate for the life-cycle model which is similar to the analysis in Chapter IV of this thesis. He used the same approach to estimate permanent income (Y*) as Somermeyer and Bannink and others:

$$Y^* = \sum_{i=o}^{L} Y_i(1 + r)^{-i} \Big/ \sum_{i=o}^{L} (1 + r)^{-i}$$

where Y_i is the mean income for members of the occupation class to which the individual belongs who are currently i years older[9] and r is the discount rate. Saving is regressed on Y*, residual income (Y - Y*) and wealth:

$$S = a_o + a_1 Y^* + a_2(Y - Y^*) + a_3 W + a_4 W \cdot Y + u.$$

The regression is repeated for various discount rates (0, .25, .5, ∞) and the simple correlation between observed and predicted savings is chosen as the criterion of success. He finds that the values of r^2 are quite close to each other despite the wide variance in discount rates. He concludes that since estimates of permanent income which use a zero discount rate (termed the "cell mean" approach) "are easier to obtain and involve fewer assumptions, we may as well use them in estimating parameters" [24, p. 385]. One may easily take exception to the "fewer assumptions" statement, since a zero discount rate means that capital markets are so perfect that one may lend or borrow at a zero interest

rate. Two criticisms are applicable to his conclusions: First he does not separate net borrowers from lenders in the regressions, although first, the income effects of an interest rate change have opposite signs for the two groups, and, second, there is no reason to suppose borrowing and lending rates are equal. Also the alternative interest rates are unreasonably high or low. Certainly few people are able to borrow at zero percent or lend at 25 percent or more per year. Note that if people expect their incomes to grow at a rate g, the appropriate normal income estimate becomes

$$Y^* = \sum_{i=o}^{L} Y_i(1 + r)^{-i} (1 + g)^i \Big/ \sum_{i=o}^{L} (1 + r)^{-i}$$

and it is impossible to distinguish g and r in Y*. Thus, for example, if the "true" discount rate is ten percent but people expect incomes to grow at four percent, the best estimate for r in the regression is six percent. Therefore expectations of increased income bias the observed r downward. Thus we need not be surprised that a zero interest rate appears more reasonable than 25 percent.

Ramanathan also estimates the MPC from transitory and permanent income (using the zero discount rate) for various occupation classes.[12] He finds that MPC from transitory income is greater than zero (contradicting a strict Friedmanian model) but less than the MPC from permanent income. Curiously, self-employed businessmen have the highest MPC (.99) from permanent income while clerical workers have the lowest (.48). This may result partially from a greater concentration of young persons in the clerical group, or from interactions between wealth and income or expectations of future income gains for the self-employed group.

The "cell-mean" approach mentioned by Ramanathan is applied to Colombian data in a working paper[10] by J. Crockett and I. Friend [2]. The implicit theory of this approach is that individuals base their consumption decisions on the mean or "normal" income of members of their education, occupation or, in some versions, home-tenure group. (The terms "cell-mean" and "normal income" are equivalent.) In their theoretical discussion Crockett and Friend state that

> "normal income may be defined as the expected value of annual income over whatever time period is most relevant . . . it may not be longer than a single year or as long as the working life of the household head" (p. 35, fn. 2).

However, as pointed out above, the empirical formulation of the theory is equivalent to the life-cycle, additive-log utility function model of Somermeyer and Bannink with the additional assumption that market interest and psychological discount rates are zero. Chapter III of this thesis applied the Crockett-Friend model to the newly available DANE EH-4 survey for Colombia. Chapter III includes a discussion of the advantages and problems of the normal income theory, however some remarks are appropriate at this point.

The basic equation estimated in the Crockett-Friend paper takes the following form:

$$C = a_o + a_1 Y_N + a_2 Y_T + a_3 (Y - Y_N - Y_T) + a_1 \delta_i F_i$$

$$+ a_5 \delta_j A_j + a_6 Y_K / Y + u_1.$$

where Y_N is estimated normal income, Y_T is a priori specified transitory income, and $(Y - Y_N - Y_T)$ is residual income, i.e., the difference between current income and the other components. Dummy variables are entered for family size (F_i) and age (A_j) classes; Y_K/Y, the ratio of dividend and interest income to total income, is used as a proxy for the ratio of wealth holdings to labor income. In turn, Y_N is estimated by a version of:[11]

$$Y_N = b_o + b_1\overline{Y} \text{ (education class)} + b_2\overline{Y} \text{ (occupation class)}$$

$$+ b_3\overline{Y} \text{ (home-tenure class)} + u_2 .$$

For our purposes, their major results are that the three income measures were all highly significant, with the coefficient of Y_N largest and that of Y_T smallest and that the elasticity of consumption from normal income is less than one. The use of additive dummies for family size and age groups means that MPC (the coefficient of normal income) is not allowed to vary. This is consistent with the normal income approach but not with the conventional life-cycle model. The finding that consumption is inelastic may be effected by these assumptions.

To return to the topics listed at the end of the previous section: First, it seems that the life-cycle approach is reasonably accepted for the developed countries but is still under contention in developing countries. Second, two studies (Somermeyer and Bannink, and Ramanathan) which examined differences in MPC's between occupation groups found that high income groups do not necessarily have low MPC's. Third, the only study (Hill) which attempts to distinguish capital market from

psychological influences on savings does not lead to firm conclusions. Clearly further exploration of the life-cycle model is warranted.

FOOTNOTES

[1]The term "normal income" was first used by Irwin Friend and Irving Kravis [7]. It refers to expected average income over the relevant time horizon.

[2]Alfred Marshal [16], sections II, III, 2 and II, III, 3.

[3]The distinction is between acute and chronic poverty. A starving person with a life expectancy of hours will have a high MPC; poor persons may have shorter life expectancies than the rich, thus higher MPC's. In both cases the outcome is the result of external rather than psychological factors.

[4]The urban 20-29 age group averaged 9.6 years of education; the urban 60-69 age group averaged .87 years.

[5]Somermeyer and Bannink use age-occupation-sex specific survival rates to choose L. In this case L is the end of the life-span rather than the expected retirement date so α_1 includes a "retirement fund" motive.

[6]The same rate is used for all groups. Whether this corresponds to the inflation and growth adjusted yields for each group is unknown.

[7]For example, suppose a manual worker expects his income to remain constant each year in the future while a non-manual worker expects his income to double next year and remain constant afterwards. A non-transitory one dollar increase in current income would imply a one dollar increase in each following year for the first person and a two dollar increase for the second. Naturally the non-manual worker will have a larger MPC.

[8]See Nagatani [23] for a description of the effect of uncertainty in future incomes on savings behavior in a life-cycle model. Nagatani shows that in an uncertain world prospective labor income and wealth holdings have differing effects on consumption.

[9]Ramanathan uses six age classes rather than permitting income to vary each year but this is not important for the exposition.

[10]Published in Spanish as "Consumo e Inversión en el Desarollo Económico," Ensayos Eciel (4, August 1977), pp. 121-160.

[11]$\bar{Y}$ refers to the mean income of the class.

Chapter II

DESCRIPTION OF THE DATA AND DEFINITION OF VARIABLES USED IN THE STUDY

This thesis applies econometric analysis to the Colombian household expenditure survey known as EH-4 (Encuesta de Hogares, Stage 4) undertaken in June-July 1971 by DANE[1] (Departamento Administrativo Nacional de Estadística). The survey was designed to provide data on family incomes, the composition and structure of consumption and living conditions in both urban and rural Colombia. To date it is the most comprehensive cross-sectional data base available for Colombia although its usefulness has only begun to be explored.

The survey was conducted by the interview method applied to a total of 5,404 households in the five principle regions of the country. The sampling technique was non-proportional, weighted toward upper income groups. DANE classified neighborhoods into six income groups and randomly selected housing units within each previously selected neighborhood. All members of each housing unit were included in the survey. The survey distinguished between primary families, defined as the head of the household and all residents related to the head who shared meals, and secondary members who did not share meals with the primary family.[2] Since complete income and consumption information was not obtained for secondary families they are excluded from the present study. Also since income and consumption data based on interviews with rural families are notoriously unreliable,[3] the present study includes only the 2,926 urban respondents.

The EH-4 questionnaire obtained information on housing characteristics, the composition of expenditures and sources of income for each family member. Detailed information was solicited in each category. For example, 74 questions were included in the income section and over 600 questions applied to household expenditures. One of the necessary tasks before income-consumption analysis was undertaken was to aggregate this information into economically meaningful variables. The definitions chosen are summarized on Table 1. A number of remarks are appropriate: 1) Net business income is included in labor income due to the difficulty of separating labor and capital income for the self-employed. 2) Income, real estate and social security taxes are excluded to conform with the usual definition of disposable income. 3) Overtime pay is included with labor income under the assumption that it is usually anticipated. 4) Two-tenths of imputed rent is deducted from gross imputed rent to approximate depreciation expense. Net imputed rent is added to labor income in Chapter III, section 2, following the Crockett and Friend [2] methodology. 5) In Chapter III, section 3, and Chapter IV, net imputed rent for home-owners and one-half of imputed rent for households purchasing housing is included with capital income to approximate the service flow, net of interest payments, from housing. If mortgage interest rates are 10 percent and the term of the mortgage is 15 years (which roughly describes lending conditions in Colombia in 1971) total interest payments approximately equal the principal, so the arbitrary attribution of one-half of imputed rent to interest is justifiable on the average. However some bias remains since the fraction of imputed rent assignable to interest varies inversely with the age of the house.

6) In part of Chapter III and IV, one-half of durable expenditures are included in consumption to roughly approximate the annual service flow from durables. No service flow was attributed to durables purchased in previous years. 7) Expenditures for jewelry are considered a form of saving. 8) In the definitions of Total Consumption I and Non-durable Consumption of Chapter III, one-half of amortization and interest payments are included with consumption to facilitate comparison with the Crockett and Friend study. Since many home-buyers did not report their amortization and interest payments, Chapter IV substitutes one-half of imputed rent for buyers to consumption to approximate the non-durable consumption (interest) flow.

The individualistic orientation of life-cycle models is probably more appropriate for Western developed countries than countries similar to Colombia in which adult children frequently remain in the household of their parents. One may argue that the major savings motive under the life-cycle hypothesis, the provision of retirement income, is substantially weakened in this type of society. The position taken in this study is that this is a testable proposition, refutable by the evidence. However, some adjustments in the data are necessary to improve the correspondence between the empirical definitions and their theoretical counterparts. In many cases the "family head" identified by the household is a non-working parent or grandparent of the principal income earner of the family. Since these family heads may have no income and little control over the disposition of the household's expenditures, the principal income earner is chosen as the unit of analysis.

Table 1

Definitions of Variables

Variable	Components
Labor Income	Wages, salaries, primas (annual bonuses), overtime pay, vacation and travel pay, social security payments, income-in-kind, less income and social security taxes, business income less business expenditures.
Capital Income	Interest, dividends, profits, rental income, net income from boarders.
Imputed Rent	Eight-tenths of rental value of owner-occupied housing less real-estate taxes and value of repairs.
Windfall Income	Unexpected bonuses, auxilios (auxiliary pay), severance pay, lottery income, gifts and gifts-in-kind, less money lost or stolen.
Non-durable Consumption	Food, clothing, utilities, transportation, fuel, education, household and personal care, one-half of imputed rent for renters, tourism, medical and gift, interest paid on loans.
Durable Consumption	Appliances, furniture, vehicles, expenditures for home improvements, imputed rent for home-owners, one-half of imputed rent for home-buyers.

The age, education and occupation groupings of the thesis are those of the principal income earner (also referred to as the "household head"). The contradiction between the individualistic behavior to which the theory refers and the interdependent family in the survey is probably reduced by the use of family size grouping variables for both income and consumption in most of the analysis. The income of each family member is added to the household head's income, implicitly assuming that the head controls the disposition between consumption and saving of all income and that the entire family retires when the head does and dissolves at the head's death. There is clearly an opportunity to weaken these assumptions in future research.

The EH-4 survey data, like most large data bases, contains some obvious errors. Those observations which strongly violated common sense in responses to important questions were eliminated. Specifically, an observation was dropped if it exhibited any of the following properties:

1. Total family income (including loans received) zero or negative (one case).
2. Food expenditures more than twice income (one case).
3. Education expenditures greater than income (one case).
4. Taxes paid greater than income (one case).
5. Total expenditures more than twice total income (including loans received) (11 cases).

Some homeowners reported different amounts for imputed rent as an expenditure and as income. The greater of the two figures was assumed

correct. For a data base which has been seldom used the number of obvious errors is quite small.

The analysis of Chapters III and IV requires estimates of mean income for groups showing educational and occupational characteristics of the principal income earner. The basic educational classes used in this study are:

E_1 = no education

E_2 = some primary education

E_3 = bachillerato (primary school) degree

E_4 = some secondary education

E_5 = some university education.

The occupations were originally coded into 96 categories. The aggregates used in this study are:

O_1 = professional, technical, teacher

O_2 = managerial

O_3 = self-employed

O_4 = white-collar

O_5 = blue-collar

O_6 = other (including military).

The cell-mean or normal income approach of Chapter III uses two sets of education-occupation interactions. The comprehensive model (section 3) uses 16 education-occupation cells:

$C_1 = O_1$ and E_1, E_2, E_3, E_4 (Professional/Low education)

$C_2 = O_1$ and E_5	(Professional/High education)
$C_3 = O_1$ and E_1, E_2	(Manager/Low education)
$C_4 = O_2$ and E_3, E_4, E_5	(Manager/High education)
$C_5 = O_3$ and E_1	(Self-employed/Low education)
$C_6 = O_3$ and E_2	(Self-employed/Medium education)
$C_7 = O_3$ and E_3, E_4, E_5	(Self-employed/High education)
$C_8 = O_4$ and E_1, E_2	(White-collar/Low education)
$C_9 = O_4$ and E_3	(White-collar/Medium education)
$C_{10} = O_4$ and E_4, E_5	(White-collar/High education)
$C_{11} = O_5$ and E_1, E_2	(Blue-collar/Low education)
$C_{12} = O_5$ and E_2	(Blue-collar/Medium education)
$C_{13} = O_5$ and E_3, E_4, E_5	(Blue-collar/High education)
$C_{14} = O_6$ and E_3, E_4, E_5	(Other/Low education)
$C_{15} = O_6$ and E_1	(Other/Medium education)
$C_{16} = O_6$ and E_3, E_4, E_5	(Other/High education)

The narrow model of Chapter III, section 2, follows the methodology of Crocket and Friend [4] as closely as possible in order to determine the robustness of their results when applied to a different data set. Accordingly the following groups are used:

$F_1 = O_1$, O_2	(Professional, technical, manager)
$F_2 = O_2$	(Self-employed)
$F_3 = O_4$	(White-collar)
$F_4 = O_5$, O_6	(Blue-collar, other)
$F_5 = E_1$	(No education)
$F_6 = E_2$, E_3	(Primary education)

$F_7 = E_4$ (Secondary education)

$F_8 = E_5$ (University education)

The analysis of Chapter IV uses a time-discounted approach to estimate the appropriate interest rate for a life-cycle model of Colombia. It also compares savings behavior among occupation and educational classes. To permit adequate statistical analysis it is desirable to increase the size of each occupation/eduation cell, at some cost of increasing the heterogeneity within the cell. The cells used in Chapter IV are:

$G_1 = O_1$ and E_1, E_2, E_3, E_4 (Professional/Low)

$G_2 = O_2$ and E_5 (Professional/High)

$G_3 = O_2$ and E_1, E_2, E_3 (Manager/Low)

$G_4 = O_2$ and E_4, E_5 (Manager/High)

$G_5 = O_3$ and E_1, E_2 (Self-employed/Low)

$G_6 = O_3$ and E_3, E_4, E_5 (Self-employed/High)

$G_7 = O_4$ and E_1, E_2 (White-collar/Low)

$G_8 = O_4$ and E_3, E_4, E_5 (White-collar/High)

$G_9 = O_5$ and E_1, E_2 (Blue-collar/Low)

$G_{10} = O_5$ and E_3, E_4, E_5 (Blue-collar/High)

Due to the disparate occupations and low sample size of O_6 (other occupations) it is excluded from the analysis of Chapter IV.

Mean current incomes of the various groups used in this study including classifications by family size, region and home tenure, are given in Table 2. In general these values conform with a priori

Table 2

Mean Current Incomes of Education, Occupation, Home Tenure, Family Size and Region Groups

Group	Current Labor Y (1)	(1) + Capital Y (2)	(2) + Imputed rent[1]* (3)
Occupation:			
Professional	65747	68248	76832
Manager	66742	69031	75934
White-collar	48292	51051	56673
Blue-collar	26322	27673	30593
Self-employed	33004	35039	38666
Other	19047	23777	28142
Education:			
None	15142	16462	18133
Primary	24878	26210	29171
Bachillerato	47877	51138	56547
Secondary	52424	54080	60201
University	83944	87331	99332
Occupation/ Education:			
Prof/Low	47112	48643	53470
Prof/High	107317	111998	128969
Mngr/Low	48378	47856	50712
Mngr/High	75469	78106	86746
Self/None	16749	17206	18569
Self/Med	28158	29552	32554
Self/High	51402	55579	61665
White/Low	36263	37949	42648
White/Med	49444	52743	58143
White/High	65787	68571	76622
Blue/None	15786	17514	19064
Blue/Med	24135	25273	28077
Blue/High	49655	50480	56154
Other/None	6634	10464	13277
Other/Med	15160	19079	22987
Other/High	38946	46317	53103

Table 2 (continued)

Group	Current Labor Y (1)	(1) + Capital Y (2)	(2) + Imputed rent* (3)
Region:			
Atlantic	32941	33994	37046
Eastern	27028	29399	32525
Bogata	44813	47086	54676
Central	32382	34647	38433
Pacific	31188	32801	36107
Family size:			
1-3	20911	23023	25806
4-6	32003	34168	38072
6 +	40675	42264	46913
Tenancy:			
Own	32728	35268	41123
Buying	39290	40820	47585
Rent	34906	36415	37927
Other	20202	20999	23834

*Includes one-half of net imputed rent for home-buyers. Net imputed rent is .8 of gross included rent, assuming taxes and depreciation are 20 percent of imputed rent. See text for further explanation.

notions and the results reported by Musgrove [16, Ch. 5] for the earlier Colombian cross-sectional ECIEL-CEDE survey data. Notice that although the differences in mean incomes across occupations are wide (e.g., the ratio of Manager/Blue-collar is 2.5), the differences across education groups are even wider (University/No education is 5.5). Among other possibilities this may reflect the limited access to higher education in Colombia at least until recent times.[4] The broad definitions of occupation disguise wide variations in income as is indicated by the occupation/education groupings. The ratio between the highest (Professional/High education) and lowest (Blue-collar/No education) (ignoring the "other" occupation) is 6.8; within a single occupation the range is from 1.6 (manager) to 3.1 (self-employed). Thus the use of combined occupation/education groups appears appropriate whenever possible. There is a clear trade-off between maintaining adequate sample sizes and limiting heterogeneity within groups.

The discounted life-cycle income approach of Chapter IV requires age-income profiles for each occupation/education group. Two general techniques for this are used in the literature. One technique, known as the "moving average" technique (Ramanathan [24]), calculates the mean income within age brackets (usually 10-year intervals), then "smoothes" the abrupt changes between brackets by an averaging function. That is, it assumes first, that a typical household expects its income ten years in the future will equal the current mean income of a household in its occupation/education group ten years older, and, second, that all households in a bracket are in the middle of it. The growth in expected incomes between two successive brackets is

$$\bar{Y}_{i+1} = \bar{Y}_i^{10} .$$

Then for any intermediate year t the estimated expected income is

$$\bar{Y}(t) = \bar{Y}_i^{t} .$$

One difficulty with this approach is that changes in the growth rate of incomes occur only at the midpoint of the intervals. The difference between the actual and estimated date of change could be as much as nine years. Another difficulty is that the peaks and valleys of the age-income cycle may be substantially underestimated by the 10-year averages. Since the implications of the life-cycle model depend on variation in income over the life cycle these defects could be important.

The second approach, adopted here (c.f., Hill [9]), estimates a regression between income and age over the life cycle. To permit non-linear variation a quadratic term for age is frequently employed. In the present study a cubed term is included to permit a closer correspondence between estimated and actual group income. Errors in estimating peaks and valleys still occur, but the sensitivity of least-square regressions to extreme points permits a closer approximation than the "moving average" technique.

Apart from occupation, education and age, family size often affects a household's income (c.f., Musgrove [2], Ch. 2), Kelly [12]. In order to permit some variation in estimated income by family size, three family size grouping variables are included in the age-income regressions. Family size is permitted to affect the intercept term but not the other components of the regression; implicitly, this assumes that family size shifts the age-income profile without affecting its shape.

The major features of the income-age-family size regressions are summarized in Table 3. Column one lists the number of observations in each occupation/education group. The groups are sufficiently large to permit adequate tests, with the exception of the two manager groups. References in Chapter IV to behavior of managers may be affected by small sample bias. The second column presents the adjusted coefficient of determination for the estimated equations. As in other studies (c.f., Hill [9]) the Professional/High education group exhibited the closest correspondence between age and income ($\bar{R}^2 = .26$), with other groups showing less than 10 percent of income correlated with age. This may be interpreted as evidence that within income depends on other variables than age, such as skill, work effort, or chance. Income does vary significantly with age as is shown by the third column of the table. The significant F-statistics in six of seven cases (ignoring managers) implies the hypothesis that income does not vary with age may be rejected (at the 95 percent level). The last column shows that all groups except Manager/Low and Blue-collar/Low experience at least a 50 percent variation in estimated income between age 20 and the peak year of their income. As may be expected blue-collar groups experience less variation, but the 12 percent level predicted for this group is still significant. It appears the assumption that incomes are not constant over the life cycle is appropriate.

The purpose of this chapter has been to describe the data and variables used in this study. The DANE EH-4 survey is relatively new and its value as a source of information on Colombian household behavior has only begun to be realized. A number of the assumptions and definitions used in this study are tentative and subject to improvement.

Table 3

Statistics for Age Regressions:

$$Y = a_o + a_1 Age + a_2 Age^2 + a_3 Age^3 + a_4 \delta_4 Family\ Size\ (4\text{-}6) + a_5 \delta_5 Family\ Size\ (7+).$$

Group	Number of Observations	$\bar{R}^2$	F-statistic[1]	Y_{Max}/Y_{20}[2]
Professional/Low	183	.03	3.36*	1.88
Professional/High	82	.26	6.64*	1.75
Manager/Low	21	-.18	1.57	3.12
Manager/High	49	-.08	1.35	1.12
Self-employed/Low	321	.08	3.08*	1.58
Self-employed/High	123	.04	2.68**	1.83
White-collar/Low	68	.06	3.07**	1.65
White-collar/High	171	.03	4.73*	1.78
Blue-collar/Low	1010	.09	4.02*	1.12
Blue-collar/High	85	.04	1.46	1.65

Notes: [1]F-Statistic for H_o: $a_1 = a_2 = a_3 = 0$.

[2]Ratio of predicted peak income to predicted income at age 20 for family size (4-6).

*indicates significance at the 1 percent level.

**indicates significance at the 5 percent level.

Nevertheless the data provides the opportunity to further the study of life-cycle income and consumption behavior in Colombia.

FOOTNOTES

[1]For a summary description of the results of the EH-4 see Los Presupuestos Familiares en Colombia 1971 (Bogotá, DANE, 1976).

[2]Encuesta de Hogares 1970 (Bogatá, DANE, 1971) describes the sampling techniques and survey design of the Encuesta de Hogares series.

[3]See S. Bhalla, [2].

[4]The statements by Musgrove that "education has a greater impact on income than occupation" [21, p. 74] and "education is by far the most powerful variable in explaining income differences" [22, p. 365] may confuse correlation with causation. An increased supply of educated persons clearly affects their relative incomes. Also higher education in Colombia is almost certainly highly correlated with family social status which may affect incomes of current degree holders. As higher education expands this status-based component will be reduced.

Chapter III

A NORMAL INCOME VERSION OF THE LIFE-CYCLE THEORY

The Modigliani-Ando-Brumberg life-cycle income and consumption theory assumes that the individual plans his consumption decisions on the basis of expectations about future incomes over the remainder of his working life. Since the method by which the individual estimates future income is unknown, researchers must find a proxy variable which is measurable, consistent with the life-cycle theory and provides implications distinct from competing theories.

A common approach is to choose an index of past incomes as this proxy. This methodology supposes that the individuals' information about future incomes is an extrapolation from past income experiences, with the influence of past income receding over time. Despite the popularity[1] of this approach it is not without flaws. Among these is that omitted variables which influence both income and consumption may vary with time. These omitted variables include changes in demographic structure, occupation, education, social insurance, income distribution, etc. Thus the effects of these omitted variables may be confused with the effects of past income on consumption. A second problem, particularly in developing countries, is that both income and consumption in time-series data are estimated with errors which may be correlated, so that the expected error of a regression equation between consumption and income has an unknown mean and variance. A recent paper by R. Hall [8] contains a third criticism of the time-series approach. Hall shows

that in any time period the rational life-cycle individual has used all information of past and future incomes to determine his consumption in that period. Therefore consumption in the following period should be fully predicted by this period's consumption plus an error term. Thus lagged values of incomes should not improve estimations of current consumption. Unfortunately since consumption in this period is highly correlated with current income, the task of distinguishing life-cycle models from absolute income models, which assume consumption is fully predicted by income this period or the preceeding period, is extremely difficult with time-series data.

For these reasons, attempts have been made to use cross-sectional survey data to test life-cycle models. The first and third objection to the time-series approach do not apply to cross-sectional data, and the large sample sizes encourage the use of complex estimating techniques to reduce the influence of the second problem. However cross-sectional data is also not without limitations. The problems of separating measurement errors among consumption, permanent income and transitory income are still formidable.[2] Even during a year in which net transitory income effects are small across the entire economy, many individuals may experience transitory gains or losses. Also cross-sectional evidence will not predict well when relative[3] or absolute prices change or other time-dependent factors distort the economy. Cross-sectional data does have the advantage of permitting comparisons among groups in the society so that hypotheses on the effects of education, occupation, sex, etc., may be tested.

If cross-sectional data is used, one must still find a method for approximating expected future income from the information in the survey

data. The common solution is to suppose that individuals view the current incomes of their peers in education, occupation or other characteristics as indicators of the income they may expect in the future. An empirical approximation to this process is to assign individuals to groups, determine the current mean incomes of members of the group, then attribute the mean income to each member as a proxy for his permanent income. Three versions of these approximation techniques are offered in this thesis. Section II of this chapter follows the method used by Crockett and Friend in their study of income and consumption in Colombia. Section III modifies some of the assumptions of their approach and adapts the technique to the information available in the Colombian EH-4 survey. In Chapter IV the strong assumption of Crockett and Friend that an individual can borrow and lend at a zero interest rate (so that he acts as if his income is constant throughout his life) is tested and weakened.

2. Application of the Crockett-Friend Methodology to the EH-4 Data

In a paper primarily designed to study the effects of asset disequilibrium on saving, J. Crockett and I. Friend [4] (C-F) estimate a proxy for permanent income by using a weighting function on the mean income of several socio-economic groups to which the individual belongs. This methodology, used previously by the authors and others[4], is generally termed the normal income approach and the proxy is called "normal income." In this section the normal income approach of Crockett and Friend is applied as closely as possible to the 1971 Colombian DANE EH-4 cross-sectional household survey. Since Crockett and Friend's study used a different data set for the same country, the 1971 ECIEL-CEDE

household expenditure survey[5], replication of their results would increase one's confidence in both the normal income methodology and the newly available EH-4 survey.

To estimate normal income, C-F assume it to be a function of the individual's occupation, education, home-value (for home-owners) and home-tenure group (i.e., owner, renter, or other) and other factors (X):

$$Y_N = F(O, E, HV, HT, X). \tag{1}$$

C-F and other users of the normal income approach make the bold assumption that the arguments of equation (1) may be replaced by the (arithmetic) mean incomes of the occupation, educational, etc. groups to which the individual belongs. Thus

$$Y_N = G(\overline{Y}_o, \overline{Y}_e, \overline{Y}_{HV}, \overline{Y}_{HT}, X). \tag{2}$$

Leaving aside (until Section 3) discussion of the choice of the correct groups to which the individual belongs, equation (1) is equivalent to equation (2) only in two implausible cases. In the first case, except for a random variance, the income of each member of the group is equal, so that the mean income of the group equals the expected current income of each member. In particular this case permits no systematic income variation over the life-cycle.[6] Equally unlikely is the alternative possibility that individuals costlessly lend or borrow so that they can satisfy their life-time budget constraint while acting as if their income were constant in each period.[7] The consequences of modifying this assumption are explored in Chapter IV; for the present the assumption will be maintained.

Crockett and Friend estimate the weight applied to each component of normal income in equation (2) with a linear equation of mean income of each group to which the individual belongs, along with dummy variables which permit the intercept term to vary among the four cities included in the survey. These variables are then regressed on current income:

$$Y = a_o + a_1\overline{Y}_o + a_2\overline{Y}_E + a_3\overline{Y}_{HT} + \sum_{i=o}^{3} a_{4+i}\,\delta_i \ .$$

where $\delta_i = 1$ so for individuals in city i, 0 otherwise. The grouping variables used are:

Occupation: 1) professional, technical, managerial
2) white-collar
3) blue-collar
4) other (including self-employed).

Education: 1) none
2) primary
3) secondary
4) higher.

Home tenure: 1) own or buying
2) rent
3) other.

Crockett and Friend do not mention the method they use to classify households by home value, therefore it is not possible to follow their methodology with respect to this variable. Omission of the home-value

grouping variable in the analysis of the EH-4 survey is unlikely to substantially bias the comparability of the results for at least two reasons: First, home tenure class and home value class are correlated; second, occupation and education alone accounted for 30 percent of the income variance ($\bar{R}^2$) in their study while all remaining variables raised the $\bar{R}^2$ to only 36 percent. Also, since the home value question in the EH-4 survey was frequently unanswered and the reliability of the response is suspect, the use of this information would probably not contribute greatly to the explanatory power of the regression.

The classifications by city in the C-F study were replaced by five regional classifications due to inability to decode the entry for city size in the EH-4 data set. Since each of the four cities in the ECIEL-CEDE survey is in a different region, this substitution should have little effect. Thus the regression comparable with equation (3) used for the EH-4 survey is:

$$Y = a_o + a_1\bar{Y}_o + a_2\bar{Y}_E + a_3\bar{Y}_{HT} + \sum_{i=1}^{4} \delta_i \ . \qquad (4)$$

where $\delta_i = 1$ for region i, 0 otherwise.

Table 4 presents the results of estimating equations (3) and (4). The equations are similar in coefficients of determination, signs and relative magnitudes of estimated coefficients. Crockett and Friend state (quoted in Musgrove [24], p. 74) that all coefficients in their equation were significant except the Medillín and Barranquilla dummies. Since Medillín is in the Central region and Cali is in the Pacific, this also applies to the EH-4 regression. A hypothesis test indicates that the coefficient for education is larger than that for occupation at the one percent level (t-statistic = 5.9) in the EH-4 data.

Table 4

Disposable Income as a Function of Mean Incomes in Socio-Economic Classes

Roberts* $\bar{R}^2 = .25$

$$Y = -34680 + .84\bar{Y}_E + .36\bar{Y}_o + .78\bar{Y}_{HT} - 7914 \text{ (Atlantic)}$$
$$(-5.2) \quad (21.2) \quad (6.5) \quad (4.6) \quad (-3.1)$$
$$+ 5226 \text{ (Eastern)} - 2144 \text{ (Central)} - 1883 \text{ (Pacific)}.$$
$$(2.1) \quad (-.93) \quad (-.95)$$

Crockett and Friend** $\bar{R}^2 = .36$

$$Y = -14500 + .67\bar{Y}_E + .35\bar{Y}_o + 1.23\bar{Y}_{HT} + .59\bar{Y}_{HV}$$
$$- 585 \text{ (Barranquilla)} - 1161 \text{ (Cali)} + 392 \text{ (Medellín)}.$$

Notes:

*Variables are defined in the text. Bogatá Region included in intercept. Values in parenthesis are t-statistics. Data: DANE EH-4 survey.

**Bogatá city included in intercept. T-statistics not included with regression. Regression coefficients quoted from Musgrove [24], p. 73. Data: ECIEL-CEDE survey.

In the next stage of the analysis the weights of the coefficients in Table 1 are multiplied with mean income for the groups to which the individual observation belongs in order to calculate estimated normal income ($\hat{Y}_N$). Various definitions of consumption are then regressed on normal income and other variables to test this version of the life-cycle model. The estimated equation is:

$$C = a_o + a_1\hat{Y}_N + a_2(Y - \hat{Y}_N) + a_3 Y_K/Y + a_4 \text{ (Family Size)} + \sum_{i=1}^{3} a_{4+i}\,\delta_i \text{ (Age group i)}. \quad (5)$$

In this equation $(Y - \hat{Y}_N)$ is the difference between current income and estimated normal income (known as residual income), Y_K/Y is the ratio of capital income (dividends and interest) to current income, and δ_i is a dummy variable for age of the household head. The age groups are: <35 (included in intercept), 35-49, 50-64, and >64. Residual income $(\hat{Y}_N - Y)$ is included as a proxy for transitory income.

Since $\hat{Y}_N$ is an imperfect estimator for true Y_N, residual income contains some parts of Y_N, so under the hypothesis that the marginal propensity to consume from normal income is greater than MPC from transitory income, the estimated coefficient for residual income will be greater than that for true transitory income. Y_K/Y is included as an indicator of asset disequilibrium under the hypothesis that households with a high ratio of capital to total income have a large stock of assets, thus less need to save in order to acquire more.[8] The predicted sign of this coefficient is positive. Family size and age groups are included in order to permit a type of life-cycle behavior. Since these variables enter additively, their effects only show up in variations of

the intercept, so the predicted effects of life-cycle variables on marginal consumption propensities in the M-A-B theory are not tested.

Three definitions of consumption are regressed on these variables. Total Consumption I includes expenditures on home improvements, payments on vehicle loans and imputed rent but excludes amortization and interest payments on housing. Total Consumption II attempts to distinguish between savings in the form of acquiring equity in housing from the consumption of housing services. Accordingly, Total Consumption II replaces imputed rent with one-half of mortgage amortization and interest payments. In this definition purchases of vehicles are considered consumption while repayments of vehicle loans are treated as saving so that net outlay on vehicles replaces vehicle loan repayments. Non-durable Consumption excludes all previous variables except half of amortization and interest on mortgages.

Part II of Table 5 presents the estimated coefficients for the C-F regressions applied to the EH-4 data. As expected, the broad definitions of consumption (Total Consumption I and II) indicate a higher MPC from both normal income and residual income than the narrow definition (Non-durable Consumption). A hypothesis test confirmed that MPC from normal income is less than one (all t-statistics were greater than 4.1) as the life-cycle theory predicts. The family size coefficients are significantly positive for all three definitions of consumption. Of the nine coefficient of dummy variables for age groups only two were significantly different from zero (at the one percent level). According to this evidence, average total consumption for the age-group 35-49 is greater than that for the age group <35 while non-durable consumption is not significantly greater. The average total consumption

may be higher due to the fact that income usually peaks within the 35-49 age group. If, as seems reasonable, net imputed rent from owner-occupied housing increases with age, this may account for the non-significance of the age 35-49 coefficient for non-durable consumption, since this definition excludes imputed rent. In general the estimated regressions conform with the basic hypotheses of the C-F version of the life-cycle model.

Part I of Table 5 reproduces the estimated coefficients of the C-F regressions. It is interesting to compare the evidence in Parts I and II. The coefficients of normal income are similar for all definitions of consumption, although C-F report a somewhat higher MPC from normal income for Non-Durable Consumption. The coefficients for residual income are also similar. The only coefficients which are significant for C-F and insignificant for Roberts are the dummy variables for age 65+ in the Total Consumption II and Non-Durable Consumption regressions. Two age coefficients (age 35-49 in Total Consumption I and II) are significant in Roberts but not in C-F. There are no variables which are both significant and opposite in sign between the two data sets. The coefficients of determination are similar for both data sets. Overall the results of the C-F methodology differ very little between the two Colombian cross-sectional survey data sets.

To compare the C-F model with a conventional current income model the regressions of Table 5, Part II were repeated with normal and residual income replaced by current income. The predictive power of the model as measured by the adjusted $\bar{R}^2$ was not greatly affected. For the current income version the $\bar{R}^2$ were (.75, .74, and .59) for Total Consumption I and II and Non-Durable Consumption respectively. However

Table 5

Normal Income and Consumption

I. Crockett and Friend[1]

	Total Consumption I	Total Consumption II	Non-Durable Consumption
Normal Income ($Y - Y_N$)	.79 (79.7)	.73 (55.8)	.66 (73.5)
Residual Income ($Y - Y_N$)	.55 (70.1)	.46 (45.1)	.41 (58.6)
Elasticity with Respect to Normal Income	.84	.88	.82
Family Size[2]	184 (7.8)	141 (4.5)	159 (7.4)
Age Dummies[2]			
35-49	175 (1.2)	88 (.4)	-.5 (0)
50-64	381 (2.1)	-97 (-.4)	246 (1.5)
65+	-113 (-.4)	-124.7 (-3.0)	-814 (1.8)
Capital Income/ Current Income	423 (4.1)	259 (1.8)	239 (2.6)
Intercept	-114	28	121
$\bar{R}^2$	.80	.64	.76

Notes: Variables are defined in the text. Values in parentheses are t-statistics.

[1]Data Source: ECIEL-CEDE survey.

[2]For Crockett-Friend data is quarterly, for Roberts yearly. Thus the coefficients must be adjusted for comparability.

Table 5 (continued)

II. Roberts[3]

	Total Consumption I	Total Consumption II	Non-Durable Consumption
Normal Income ($Y - Y_N$)	.76 (58.4)	.77 (58.0)	.57 (43.1)
Residual Income ($Y - Y_N$)	.57 (69.2)	.57 (68.4)	.37 (44.8)
Elasticity with Respect to Normal Income	.89	.89	.79
Family Size[2]	682 (7.0)	706 (7.1)	635 (6.5)
Age Dummies[2]			
35-49	1474 (2.2)	1670 (2.5)	749 (9.8)
50-64	1498 (1.81)	1614 (1.92)	312 (.37)
65+	1961 (1.55)	2205 (1.72)	-1991 (-1.56)
Capital Income/ Current Income	2696 (7.8)	2760 (2.9)	2114 (6.1)
Intercept	-476 (-.53)	-614 (-.66)	2005 (2.2)
$\bar{R}^2$	.76	.76	.61

Notes: Variables are defined in the test. Values in parentheses are t-statistics.

[2]For Crockett-Friend data is quarterly, for Roberts yearly. Thus the coefficients must be adjusted for comparability.

[3]Data Source: Dane EH-4 survey.

the estimated coefficients for current income were (.63, .63, and .42) respectively, while the elasticities of consumption from current income were (.71, .71, and .58). These values are lower than those estimated for the C-F model. Since the coefficient for normal income in the C-F model is significant while the improvement in $\bar{R}^2$ is slight, it is difficult to choose between the current and normal income models. Two conclusions with respect to the C-F normal income model seem appropriate: First, if individuals believe a change in income is permanent, they will have a higher MPC than otherwise. Second, the C-F version of the life-cycle model does not perform a great deal better than current income models in explaining consumption behavior from actual income which is a mix of permanent and transitory elements. A third conclusion applies to the value of the EH-4 data set: In the regressions reported in this section the EH-4 data provided results which are similar to those derived from the well-established ECIEL-CEDE survey data. Since the remainder of the thesis uses the EH-4 data, this conclusion is comforting.

3. Extensions of the Methodology

In section 2 normal income is estimated as a weighted average of mean incomes of the various socio-economic groups to which the individual belongs. The weights are determined by a linear regression of current income on the mean incomes of the groups. This linear formulation may be too simple to adequately capture the relationship between normal income and its various components. For example, the formula of equation (4) assumes that each occupation, education and home-tenure group uses exactly the same weights for the independent variables in

determining its normal income. Also, as indicated by Table 2 of Chapter II, there is considerable variation in income within each occupation and education group. By the use of combination occupation/education grouping variables a more precise estimate of the typical income attributable to occupation and education may be obtained. Since the use of the same weights for each occupation/education and home tenure group is unnecessary, it may be worthwhile to modify the estimating equation to permit differing coefficients for each group. The normal income model does not precisely describe the manner in which normal income is determined from the means of the independent variables, therefore the influence of these modifications on the estimated consumption equation will provide information on the sufficiency of the simple linear formulation.

Other modifications of the general approach also merit consideration: First, if region of residence affects normal income, the influence is probably reflected in the mean incomes in the region. Just as the individual observes mean incomes in his occupation, education and housing tenure class, he may use the typical income in his region to determine his expected normal income. Second, family size also affects the normal income calculation. Although the influence of family size is not certain (e.g., mothers may work less outside the home, fathers may work harder to provide for a family), present family size is an imperfect guide to future family size and other difficulties, it certainly seems worthwhile to include mean income by family size in the estimating equation.

Another modification is to remove capital income from the income concept used for normal income. The individual need not estimate capital

income by observing mean capital income of his peers. Capital income, while not isolated from the forces which determine labor income, is frequently known with more certainty[10] or at any rate the uncertainty is different than that for labor income.

Crockett and Friend add one-half of imputed rent to income, assuming the other half is paid to the mortgager as interest. Since the EH-4 survey records home-buyers and home-owners separately, the C-F assumption may be modified by adding one-half of imputed rent to current income for buyers and all of imputed rent for owners. The home-tenure distinction is expanded to include owners, buyers, renters and others to permit this distinction. It may be held that imputed rent should be added to capital income. This approach is followed in Chapter IV, but for the present the C-F method is maintained.

In symbols, the weights for normal income are now estimated by the equation

$$Y = a_o + \Sigma \delta_i b_i \bar{Y}_i \text{ (occupation/education group)}$$
$$+ \Sigma \delta_j c_j \bar{Y}_j \text{ (home-tenure class)} + \Sigma \delta_k d_k \bar{Y}_k \text{ (Region)} \qquad (6)$$
$$+ \Sigma \delta_m f_m \bar{Y}_m \text{ (family-size class)}$$

Where $\bar{Y}_k$ refers to mean income in group k, and δ_k is a (0,1) dummy variable for group k. The results of this estimation are presented in column 1 of Appendix II, Table 1. The adjusted coefficient of determination of this equation is not substantially greater than that for the simpler equation (4), which argues against the use of the more complex method, however it is of more interest to examine the effect of the

complex method on the estimated consumption functions.

The effects of using the new set of weights to calculate $\hat{Y}_N$ on the consumption regression are reported in Table 6. The most striking result is the higher estimated coefficients for normal income. The normal income version of the life-cycle theory predicts that marginal consumption propensities for normal income should be close to one.[11] As mentioned in section 2 estimated residual income still includes elements of true normal income and hence the estimates for normal income are biased downward while those for residual income are biased upward. It appears that this bias is reduced by the modified technique. The adjusted coefficients of determination are slightly increased, particularly for Non-Durable Consumption. The elasticity of consumption with respect to normal income is increased in two cases and unchanged in the third. In general the modified technique provides results which more closely conform to the general implications of the model.

The normal income version of the life-cycle model provides a relatively simple method to test the life-cycle theory on cross-sectional data. Two basic predictions of the theory are consistent with the results: 1) Individuals use information on expected future income, together with current income and other information to allocate income between consumption and savings, and 2) the marginal propensity to consume from permanent income (approximated by normal income) is greater than from transitory income (approximated by residual income). Other interesting questions such as whether individuals discount future incomes at a positive rate, whether the marginal propensity to consume varies over the life-cycle and whether and why consumption propensities vary among education and occupation groups will be addressed in the more complex model of Chapter IV.

Table 6

Normal Income and Consumption: Estimates from Education/Occupation Subgroups[1]

	Total Consumption I	Total Consumption II	Non-Durable Consumption
Normal Income (Elasticity)[2]	.94 (.93) (60.1)	.95 (.89) (58.2)	.90 (.93) (52.0)
Residual Income	.51 (79.9)	.52 (69.8)	.47 (70.7)
Capital Income	.89 (8.1)	.86 (10.2)	.78 (6.8)
Family Size	161 (3.2)	139 (2.4)	143 (3.0)
Age Dummies			
35-49	2087 (2.47)	1899 (2.2)	2377 (2.9)
50-64	1086 (1.00)	1664 (1.5)	1941 (1.86)
65+	-283 (-.17)	1744 (1.0)	1779 (1.1)
Capital Income/ Current Income	8415 (4.0)	165 (6.4)	4120 (1.7)
Intercept	495 (.55)	1423 (1.56)	865 (.98)
$\bar{R}^2$	.80	.78	.73

Note: [1]Variables defined in the text.

[2]Elasticities of consumption at the means with respect to normal income are in parentheses to the right of the estimated coefficient for normal income.

FOOTNOTES

[1]R. Ferber [5] lists over 20 separate time-series tests of permanent income or life-cycle models.

[2]C.f., P. Musgrove [22] and S. Bhalla [2] for recent attempts to reduce this problem.

[3]Although Howe [11] and others have managed to use cross-sectional evidence to study relative price changes.

[4]C.f., I. Friend and I. Kravis [7], I. Friend [6], J. Crockett [3] and R. Betancourt [1].

[5]See P. Musgrove [21] for a description of this data.

[6]Which is unlikely according to the evidence of Chapter II, Table 3.

[7]In this case individuals would still vary their consumption over their life cycle, unless they were indifferent between present and future consumption. This is evident from the model and discussion of Chapter IV, section 2.

[8]See Crockett and Friend [4] for discussion of this hypothesis.

[9]To maintain adequate sample sizes in each occupation/education group while increasing the number of occupations some adjustments in definitions are required. See Chapter II for the occupation/education groups used.

[10]This is particularly true in Colombia where corporations very seldom change dividend payments.

[11]They are not expected to equal one due to possible capital market imperfections or retirement fund effects. See Friend and Kravis [7].

Chapter IV

A LIFE-CYCLE MODEL OF CONSUMPTION

1. Introduction

The Crockett-Friend normal income model employed in the previous chapter assumes that long-term income is equivalent to a weighted average of the mean current incomes of the various socio-economic groups (occupation, education, home-tenure) to which an individual belongs. This approach is inconsistent with the Modigliani-Brumberg-Ando life-cycle model on two related grounds. First, it assumes individuals both use a zero discount rate to determine the present value of future expected income and are indifferent between equal consumption levels now and in the future; second, it does not allow the propensity to consume from long-term income to vary with the age of the individual. An additional problem is that all deviations of current income from the mean group income are attributed to residual (or transitory) income, that is, ability related differences in long-term income are excluded. The present chapter examines the consequences of modifying these assumptions, then derives and tests several implications of the resulting life-cycle model. The following section of this chapter (section 2) contains a discussion of the theory of life-cycle consumption and derives several testable implications of the theory. Section 3 applies an empirical formulation of the theory to the DANE EH-4 cross-sectional survey data. It concentrates on the determination of the appropriate discount rate for future income and consumption. The last section (section 4) compares

the empirically observed marginal consumption propensities from permanent and transitory income for various groups (age, education, occupation) with the theoretical predictions of section 2.

2. The Theory of Life-Cycle Consumption

If future incomes are known with certainty and legacies are ruled out, the life-cycle consumption problem may be expressed as a multi-period utility maximization problem

$$\max U = U(C_o, \ldots, C_L) \tag{1}$$

subject to the budget constraint

$$\sum_{i=o}^{L} (Y_i - C_i)(1 + r)^{-i} = 0 \tag{2}$$

where L is the expected remaining lifetime of the individual and r is the market lending and borrowing rate. The first order conditions are

$$\begin{aligned} &u_i - \lambda(1 + r)^{-i} = 0 \quad (i = 0, \ldots, L) \\ &\sum_{i=o}^{L} (Y_i - C_i)(1 + r)^{-i} = 0 \end{aligned} \tag{3}$$

where $u_i = \partial U/\partial C_i$ and λ is the Lagrangean multiplier for the budget constraint. If consumption is to be positive in each period the following additional conditions must hold:

$$\rho_i = \frac{\partial U_i}{\partial U_{i+1}} = 1 + r \quad (i = 0, \ldots, t) \tag{4}$$

where ρ_i is the marginal rate of time preference between periods i and i+1. Intuitively if $\rho < r$ the individual will increase his utility by

consuming less now and increasing his consumption in the next period. If future income is not known with certainty or borrowing and lending rates differ this result is modified.

The effects of a change in the rate of interest may be divided into income and substitution effects. In the illustrative case in which the consumer's horizon emcompasses only two market dates these effects may be summarized as:

$$\frac{\partial C_o}{\partial r} = \left(\frac{\partial C_o}{\partial r}\right) + (Y_o - C_o)(1 + r)^{-1} \left(\frac{\partial C_o}{\partial Y}\right) \tag{5}$$

The substitution effect is

$$\left(\frac{\partial C_o}{\partial r}\right) = -\lambda (1 + r)^{-2} \frac{D_{21}}{D} \tag{6}$$

where D is the determinant of the bordered Hessian of the maximization problem, and D_{21} is the co-factor of the (2,1) element. Second order conditions require that $D > 0$ and

$$D_{21} = \begin{vmatrix} U_{12} & 1 \\ -(1+r)^{-1} & 0 \end{vmatrix} = (1 + r)^{-1} > 0.$$

As expected, the substitution effect is negative, indicating that an increase in r will cause consumers to postpone consumption.

It seems reasonable to assume that an increase in income will tend to increase consumption in all periods so that $(\partial C_o/\partial Y)$ is positive. Thus the direction of the income effect depends on the individual's borrowing position during the first period. If the individual is a net borrower $(Y_o - C_o < 0)$, a higher interest rate

increases his interest expense and thus decreases his net income. The substitution and income effects move in the same direction. If he is a lender the increased income tends to increase current consumption while the substitution effect decreases it; the net effect depends on whether

$$(Y_o - C_o).(\frac{\partial C_o}{\partial Y}) \gtrless (\frac{\partial C_o}{\partial r}) \ .$$

Several remarks follow from the above. First, the response of current consumption to variations in future income depend on the market rate of interest. Second, the individual's consumption may exceed or fall short of current income, only his lifetime budget constraint must be satisfied. Third, borrowers and lenders have asymmetric responses to variations in interest rates.[1] Finally, variations in income which are regarded as temporary (and thus have only a small effect on lifetime income) will increase consumption by less than variations which are expected to continue into the future.[2]

The adoption of an explicit utility function permits calculation of the optimal consumption vector. A common candidate is the simple additive logarithmic utility function[3]

$$U = \sum_{i=o}^{L} \alpha_i \log C_i \qquad (7)$$

where the planning horizon extends from 0 to L and α_i reflects the contribution to utility at the present of a unit of consumption i periods in the future. Maximizing (7) subject to the budget constraint (2) yields the first order conditions:

$$C_i^* = \alpha_i \sum_{j=o}^{L} Y_j \, (1 + r)^{-j} / (1 + r)^{i} \sum_{j=o}^{L} \alpha_j \, . \quad (i=o,\ldots,L)$$

C_i^* depends upon the psychological parameter α_i. The equality of the marginal rate of substitution between any two periods with $(1 + r)$ (equation 4) means that

$$\frac{\alpha i}{\alpha_{i+1}} = \frac{1}{1 + r} \, .$$

This requirement is satisfied by an assumption that

$$\alpha_i = \alpha/(1 + r)^{-i} \, .$$

In this case C_i^* becomes

$$C_i^* = \sum_{j=o}^{L} Y_j \, (1 + r)^{-j} / \, \Sigma(1 + r)^{-j} \, . \qquad (8)$$

Note that (8) states that consumption in each period is constant and depends only on the vector of incomes and the interest rate. Since with this utility function $C_o = \ldots = C_i = \ldots = C_L$, consumption in the first period is

$$C_o^* = \sum_{i=o}^{L} Y_i (1+r)^{-i} \; / \; \sum_{i=o}^{L} (1 + r)^{-i} \, . \qquad (9)$$

Conventionally, the variable C_o^* is referred to as permanent or long-run income and denoted by Y^*.

So far we have considered only the simplest case in which the individual neither begins nor ends life with any net assets. It is not difficult to extend the model to permit endowments and bequests.[4] The logarithmic utility function becomes

$$U = \sum_{i=o}^{L} \alpha_i \log C_i + V(A_L)$$

where V is the utility at this time of leaving a legacy equal to A_L L years in the future. The revised budget constraint is

$$A_o + \sum_{i=o}^{L} (Y_i - C_i)(1 + r)^{-i} = A_L(1 + r)^{-i} .$$

If individuals expect a sharp drop in income upon retirement it is reasonable to consider the end of the planning horizon (L) as the number of years remaining until retirement, and A_L as the purchase price of an annuity to provide for retirement plus any desired bequests. If desired consumption during retirement is proportional to average income during the working years, for a given r,

$$A_L^* = \phi(Y^*) .$$

Planned saving over the working life must accumulate to $(\phi(Y^*) - A_o(1 + r)^L)$. Using the logarithmic utility function, desired consumption in each period is now

$$C_o^* = Y^* - 1/\sum_{i=o}^{L} (1 + r)^{-1}. \quad (\phi(Y^*) - A_o(1 + r)^L).$$

This consumption function indicates that consumption as a fraction of permanent income decreases as retirement approaches (as L becomes smaller) and increases with wealth.

Two hypotheses about the level of wealth intended for bequests and retirement are that it is a linear function of permanent income

$$\phi(Y^*) = b \cdot Y^* , \quad 0 \leq b \leq 1,$$

or that it increases logarithmically with income

$$\phi(Y^*) = A + b \cdot \ln Y^* \ , \ b > 1.$$

Substituting the linear form into (9) and writing $F_1(r,L)$ for the term $1/ \sum_{i=o}^{L} (1 + r)^{-i}$ and $F_2(r,L)$ for $F_1 \cdot (1+r)^L$ yields

$$C_o^* = Y^* - F_1(r,L)(b \cdot Y^*) + F_2(r,L)A_o \ . \qquad (10)$$

Equation (10) summarizes the major features of the life-cycle model which are appropriate to the present study.

Two interpretations may be placed on the life-cycle consumption function (10). One interpretation is that the individual calculates his life-cycle budget constraint once, at the beginning of his working life, then achieves his planned consumption levels in each period with only minor variations due to transitory income gains or losses. Alternatively, he may re-calculate his permanent income, asset position and sustainable consumption at intervals, perhaps each year. If the individual has perfect foresight (except for transitory income) and capital markets are perfect, the two interpretations are functionally equivalent. For example, under the second approach permanent income will decline after the peak earning years, but assets will have been expanded to provide the same net flow of income as in earlier years, so that consumption is the same as that predicted by the "once per lifetime" interpretation. Empirically, it is unlikely that assets will be perfectly adjusted, particularly in the early years when individuals may wish to have negative assets (i.e., liabilities greater than assets) as they borrow

against future income. The second approach permits precise statements about consumption from permanent income and wealth as it varies over the life cycle. Its empirical formulation may be tested to examine the extent to which people follow the life-cycle model in each stage of life, in the midst of uncertainties and market imperfections. Thus the specification of desired consumption in equation (10) is the key result of the life-cycle model.

Equation (10) provides several interesting testable propositions including:

1. The marginal propensity to consume from permanent income is less than or equal to one.

$$\frac{\partial C_o}{\partial Y^*} = 1 - F_1 b \text{ and } 0 \leq F_1, b \leq 1$$

2. The MPC from transitory income is less than the MPC from permanent income.

$$\frac{\partial C_o^*}{\partial Y_o} = \frac{\partial C_o}{\partial Y^*} \cdot \frac{\partial Y^*}{\partial Y_o}$$

$$\frac{\partial Y^*}{\partial Y_o} = 1 / \sum_{i=o}^{L} (1 + r)^{-i} < 1 .$$

3. The MPC from wealth is positive.

$$\frac{\partial C_o^*}{\partial A_o} = F_2(r, L) > 0.$$

4. For given initial wealth, the average propensity to consume from

permanent income decreases as permanent income increases.

$$\frac{C_o}{Y^*} = 1 - F_1 \cdot b + \frac{F_2 A_o}{Y^*}$$

$$\frac{\partial(\frac{C_o^*}{Y^*})}{\partial Y^*} = - \frac{F_2 A_o}{(Y^*)^2} < 0 .$$

5. If the bequest motive is positive ($b > 0$), the MPC from permanent income decreases with age.

$$\frac{\partial^2 C_o^*}{\partial Y^* \partial L} = \frac{\partial(1 - F_1 b)}{\partial L} , \frac{\partial F_1}{\partial L} < 0 ,$$

thus $\frac{\partial^2 C_o^*}{\partial Y^* L} > 0$, and (by definition) L decreases as age increases.

6. Marginal propensities to consume vary among education and occupation groups only if interest rates or life-expectancies differ, since all MPC's depend only on r and L.

3. An Empirical Application of the Life-Cycle Model

The major result of the theoretical analysis of section 2 is the specification of current consumption as a function of permanent income summarized in equation (10). Despite the use of an explicit cardinal utility function, equation (10) depends upon the unknown vector of expected future incomes (y_i)[5] and the unknown parameters r and L. Econometric testing of the model requires further assumptions to specify these variables.

A practical method to specify (y_i) assumes that individuals expect to receive the same income k years in the future as a typical member of

their occupation and education group k years older currently receives, perhaps augmented by an expected growth rate in income or a differential based on their above or below average skills.[6] In sumbols, $y_i^e = \bar{y}_i$ where

$$\bar{y}_i = \sum_{j=1}^{M_i} y_j / M_i \tag{11}$$

and M_i is the number of individuals in the group aged i. Since y_i may vary considerably among individuals and ages it is convenient and reasonable to estimate the vector (y^e) by regressing current income on age within the relevant occupation and education group:

$$y = a_o + a_1 Age + a_2 Age^2 + e \quad .$$ [7]

Expected income at each age i is

$$y_i^e = \hat{a}_o + \hat{a}_1 \cdot i + \hat{a}_2 i^2 \ . \tag{12}$$

Permanent income y^* is the discounted sum of future expected income. Rearranging subscripts and notation so that y_o refers to expected income of individuals currently aged t and L refers to the years remaining until retirement (e.g., if retirement is at age 65 and the individual is presently aged 30, $y_o = y_{30}^e$ and L = 35).

$$y^* = \sum_{i=o}^{L} y_i (1 + r)^{-i} / \sum_{i=o}^{L} (1 + r)^{-i} \ . \tag{13}$$

If income is expected to grow at the constant rate g, y^* becomes:

$$y^{*'} = \sum_{i=o}^{L} y_i (1 + r)^{-i} (1 + g)^i / \sum_{i=o}^{L} (1 + r)^{-i} \ . \tag{14}$$

Each occupation-education group is quite heterogeneous (e.g., the professional/high education group includes both college professors and medical doctors). Also differing skills within the same occupation will affect income. An additional modification will permit inclusion of some skill related differentials in expected income. Suppose the individual's current income exceeds (falls short of) the estimated current income of his age cohort's by $y - y^*$. Some portion (s) of this difference he attributes to his own skill or other permanent factors, the remainder (1 - s) he considers temporary. Then he believes his income in each remaining year will exceed that of his peers by $s(y - y^*)$ so that his permanent income is

$$y^{*''} = y^{*'} + s(y - y^{*'}) \ . \tag{15}$$

(For simplicity the prime notation will be suppressed so that y^* now refers to $y^{*''}$.)

The individual's current income (y) may be considered to have two components. One part is permanent income, equal to the discounted flow of present and future income which he has estimated from the current income of his occupational/educational cohorts. The other part, termed residual income, is not predicted by the model. It may be anticipated but determined by factors other than one's age, education or occupation. Since residual income contains some true transitory income the marginal propensity to consume from residual income $(y - y^*)$ should be less than MPC from y^* (section 2, proposition 2). Apart from residual income, some elements of income may be <u>a priori</u> specified as transitory. These include lottery winnings, money lost or stolen, gifts and unexpected bonuses. For clarity this

form of income is termed windfall income. Since windfall income is a proxy for transitory income the predictions of proposition 2 should also apply to it. Equation (10) also describes consumption behavior from wealth (proposition 3) so the empirical form of the consumption equation should include wealth as well. Therefore, the life-cycle/permanent-income model summarized in equation (10) may be tested through the empirical specification

$$C = b_o + b_1 y^* + b_2(y - y^*) + b_3 y_{wind} + b_4 A_o + e \qquad (17)$$

where y^* is defined by equations 13-15, $y - y^*$ is residual income (the difference between current and permanent income), y_{wind} is *a priori* specified windfall income and A_o is wealth (equation [16]).

Permanent income (y^*) in equation (17) depends on the unknown expected life-span (L), discount rate (r) growth rate (g) and skill factor (s). In the absence of reliable age-specific survival rates the end of the planning horizon is assumed to be 72 under the belief that many persons in Colombia work as long as they are physically able. The model is most sensitive to the length of the planning horizons for older persons since even at moderate interest rates events in the distant future have little effect on current plans.

The correct choice of r, g, and s is more problematic. The model is quite dependent upon the discount rate. If individuals use a high discount rate the life-cycle model does not differ significantly from current income models; at low interest rates the model resembles the "normal income" model of Crockett and Friend (Chapter III) in which consumption is a function of mean incomes of socio-economic groupings regardless of the period during the life-cycle in which they are earned.

It is evident from equation (14) that the growth rate (g) and discount rate (r) have symmetric effects on y^*. Since neither g nor r for each occupation/education group is known a priori it is necessary to choose a net discount rate (r - g). (For clarity this net rate will be referred to as r_n.) The model is not as sensitive to the choice of s since varying s transfers income from the permanent to the residual income classification without changing the total.

Before estimating equation (17) it is appropriate to consider the useful implication of the theoretical analysis of section 2 that the marginal propensity to consume from income as the interest rate varies differs between those individuals who may be expected to borrow against future income (that is, whose income is less than its life-cycle peak) and lenders, whose incomes tend to decline in the future. Equation (5) shows that the sign of the income effect differs between borrowers and lenders. Other differences may also occur. One may suppose that capital markets are imperfect in Colombia so that borrowers face relatively high interest rates or borrowing constraints. These considerations indicate that it is appropriate to estimate the coefficients of equation (17) separately for borrowers and lenders. Operationally, borrowers are defined as persons whose occupation/education group's mean income this year (y_o) is less than their permanent income (y^*); borrowers have $y^* > y_o$, lenders have $y^* \leq y_o$.

The values of r_n and s used by individuals to solve their life-cycle income/consumption maximization problem are unknown. The approach adopted in this chapter is to estimate the consumption function (17) in an OLS regression under the assumption that the appropriate choice of r and s is that which maximizes the adjusted multiple correlation

coefficient ($\bar{R}^2$). Tables A.1.1-A.1.5 in Appendix A present the results of calculating y^* (and A_o) for r_n in increments of .05 in the range (0, .35) and s in increments of .2 in the range (0, 1) for five occupation/education groups[9] then regressing consumption on y^*, $y - y^*$, y_{wind} and A_o as equation (17) specifies. Tables 7 and 8 summarize the results of this exercise. Part I.A. of Table 7 presents the effects of varying r for the value of the skill parameter which maximizes $\bar{R}^2$. In all cases variation of the discount rate (r_n) within the range (0, .3) at least affects the $\bar{R}^2$ at the second decimal place. The change in $\bar{R}^2$ between "best" and "worst" discount rate varies from about one percent (professionl/borrowers) to about 20 percent (self-employed lenders); the typical variation is around five percent. Further, the variations are generally consistent in the sense that the $\bar{R}^2$ increases and decreases smoothly around the peak value.[10] In Part 1.B the skill parameter is varied around the value of r which maximizes $\bar{R}^2$. These results also behave consistently, although the "best" value of s differs from zero in only three cases.[11]

The construction of s assumes that all individuals use the same weight to divide the difference between their current income and the estimated income for members of their socio-economic groups at their age into permanent and transitory components. The fact that the value of s which maximizes $\bar{R}^2$ is usually zero may indicate that this assumption is too crude to capture the process by which people adjust their expected future incomes to include skill differences.

Table 8 presents the estimated coefficients for equation (17) for the values of r_n and s which maximize $\bar{R}^2$ for each group. A number of remarks on the results are appropriate. First, as assumed

Table 7

Adjusted Correlation Coefficients ($\bar{R}^2$) for Various Discount Rates (r_n) and Skill Parameters (s)

I. A. Discount Rates Variable, Skill Factors Fixed

Group	Skill Parameter(s)	Discount Rate (r_n)						
		0	.05	.1	.15	.2	.25	.3
Professional:								
Borrowers	.2	.767	.776	.771	.770	.767	.767	.765
Lenders	.4	.732	.791	.740	.733	.733	.734	.707
Managers:								
Borrowers	.0	.821	.846	.871	.827	.832	.836	.838
Lenders	.0	.787	.806	.770	.738	.729	.723	.719
Self-Employed:								
Borrowers	.0	.644	.654	.642	.639	.638		
Lenders	.0	.819	.828	.883	.749	.733		
White-Collar:								
Borrowers	.2	.695	.700	.701	.703	.691		
Lenders	.0	.751	.745	.786	.737	.658		
Blue-Collar:								
Borrowers	.0	.679	.712	.680	.672	.670		
Lenders	.0	.652	.856	.670	.657	.663		

Table 7 (continued)

I. B. Discount Rates Fixed, Skill Parameters Variable

Group	Discount Rate (r_n)	Skill Parameter(s) 0	.2	.4	.6	.8	1.0
Professional:							
Borrowers	.05	.771	.776	.775	.765	.756	.752
Lenders	.05	.758	.786	.791	.780	.777	.777
Manager:							
Borrowers	.1	.871	.724	.650	.667	.686	.697
Lenders	.05	.806	.729	.622	.696	.639	.657
Self-Employed:							
Borrowers	.05	.654	.652	.650			
Lenders	.1	.883	.781	.636			
White-Collar:							
Borrowlers	.15	.702	.703	.695			
Lenders	.1	.786	.666	.636			
Blue-Collar:							
Borrowers	.05	.712	.707	.707			
Lenders	.05	.856	.751	.738			

Table 8

Normal Income and Consumption: Summary of Results for Occupational Groups*

Group	Y^*	$Y-Y^*$	Y_{WIND}	WEALTH	INTERCEPT	R^{-2}
Professional:						
Borrowers	1.13	.66	.27	.09	-7533	.776
r_n=.05, s=.2	(10.0)	(10.0)	(1.43)	(4.4)	(-1.13)	
Lenders	.86	.49	1.87	.17	-18	.791
r_n=.05, s=.4	(5.4)	(5.0)	(3.8)	(5.5)	(-.02)	
Manager:						
Borrowers	1.59	.67	.50	.07	-53669	.871
r_n=.1, s = 0	(2.7)	(4.6)	(8.1)	(2.6)	(-1.28)	
Lenders	.97	.71	.31	.15	-337	.806
r_n=.05, s=0	(5.0)	(13.4)	(.83)	(4.5)	(-.03)	
Self-Employed:						
Borrowers	1.27	.99	.18	.07	-2531	.654
r_n=.05, s=0	(11.5)	(20.1)	(.89)	(4.8)	(-.68)	
Lenders	1.03	.93	.49	.11	254	.883
r_n=.1, s=0	(6.3)	(13.9)	(2.7)	(8.2)	(.03)	
White-Collar						
Borrowers	.94	.90	.21	.01	8350	.703
r_n=.15, s=.2	(7.4)	(13.9)	(1.33)	(6.3)	(1.51)	
Lenders	.55	.71	.22	.11	16628	.786
r_n=.1, s=0	(2.2)	(8.3)	(.85)	(4.2)	(1.80)	
Blue-Collar						
Borrowers	1.14	.83	.41	.08	823	.712
r_n=.05, s=0	(17.6)	(41.2)	(6.1)	(23.5)	(.58)	
Lenders	.96	.83	1.12	.08	1337	.856
r_n=.05, s=0	(2.8)	(8.8)	(9.1)	(12.4)	(.34)	

*Results are presented for value of the discount rate (r) and skill parameters (s) which maximize $\bar{R}^2$.

by the life-cycle model the appropriate discount rate is always greater than zero. Remembering that the estimated value of r_n equals the difference between the discount rate and the expected growth rate in incomes (equation [14]), the "best" estimate of r_n appears reasonable.[12]

Second, with the exception of the self-employed, the "best" discount rates for borrowers are greater than or equal to those for lenders. (The reversal for self-employed may indicate their opportunity to invest in their own businesses at a high rate of return.) In all cases the MPC from permanent income (y^*) is greater for borrowers than for lenders, suggesting that borrowers may be constrained by market imperfections from achieving their desired smoothing of the consumption stream, so that increases in borrowers' incomes are devoted to current consumption.

Third, with the exception of white-collar lenders, the MPC from permanent income is greater than from residual income ($y - y^*$) and, excepting professional and blue-collar lenders, the MPC from residual income is greater than from windfall income. This is consistent with the important feature of life-cycle and permanent income models derived in proposition 2 of section 2.

The MPC from wealth is positive as suggested by proposition 4 of section 2. Since borrowers may be expected to be younger than lenders the observation that MPC from wealth for lenders exceeds borrowers' is somewhat surprising (see proposition 5 above). There are several ways to reconcile this apparent contradiction. Perhaps borrowers devote more of their capital income to home improvements, which are not included in the present definition of consumption. Lenders may have achieved their desired legacies ($\phi(y^*) < A_o(1 + r)^L$) so that additional

capital income may be devoted to current consumption. Alternatively, wealth may be subject to increasing returns so that the income flow for lenders (who possess greater wealth) is larger than for borrowers. However, the proposition that MPC from wealth decreases with age is best tested by comparing specific age groups' behavior as is pursued in Table 4 and its accompanying discussion below.

The coefficient of the intercept term is never significantly different from zero, which appears at first to contradict the proposition (proposition 3) that APC decreases as y^* increases.[13] However this proposition refers to the relation between y^* and initial wealth, A_o. Since the coefficient for A_o is positive the substance of the proposition is maintained. Proposition 3 reconciles the tendency for the average consumption propensity to decrease with increasing income in empirical studies with the hypothesis of life-cycle models that MPC is constant as income varies. On the other hand, if higher income and wealth classes possess longer time horizons one would expect them to exhibit lower MPC's from permanent income. This does not seem to be true in all cases. For example, professional borrowers have a lower MPC from y^* than managers or the self-employed, but greater than white-collar individuals and about the same as blue-collar workers. These estimated coefficients provide tentative support for the proposition (proposition 6) that there is no reason to suppose that MPC's should differ in the absense of age, wealth or capital market differences.

It appears that the basic approach of this chapter is reasonably fruitful. The adjusted $\bar{R}^2$ of the estimated equations are generally high, indicating that this simple model "explains" much of the observed

variation in consumption. Estimated coefficients performed generally as predicted, all groups' consumption functions appear to discount the future at reasonable, non-zero interest rates, and none of the estimated coefficients differ unreasonably from their expected values. The discounted life-cycle framework is sufficiently robust to encourage the more complete examination of its implications presented in the next section.

4. Tests of Implications of the Model

The empirical model specified in the previous section provides a framework for testing a number of interesting hypotheses, including the six propositions listed in section 2. In order to facilitate comparison, equal values for the discount rate (r_n = .075) and the skill factor (s = 0) are applied to each observation. Each occupational group is divided into subgroups based on age (17-32, 33-50, 51-72) rather than the borrower-lender distinction to permit age related variations. This modification is designed to focus on those specific hypotheses which refer to behavior by age classes rather than borrowers vs. lenders. Unfortunately sample sizes were not sufficiently large to permit the separation of the age classes into borrower-lender subgroups.

Two of the principal predictions of life-cycle theories are expressed in propositions 1 and 2. A finding that the marginal propensity to consume from permanent income is greater than one would contradict both proposition 1 and the evidence from virtually all other empirical studies. Fortunately, Part 1 of Table 9 indicates that only two out of fifteen cases have MPC's from y^* significantly (at

the one percent level) greater than one, as indicated by the values of the t-statistics. Both of these exceptions are among the self-employed, for whom the measurement of consumption and income is particularly uncertain. On the other hand, only one group (professionals 17-32) evidenced an MPC from y^* significantly less than one. Equation (10) indicates that the MPC from y^* will be less than one whenever the bequest motive is positive (when $b > 0$ in the relationship $\phi(y^*) = b \cdot y^*$). Apparently this motive is not strong for the sample population.[14] The major proposition that MPC from permanent income is less than or equal to one is generally confirmed in this test.

A second series of theorems derived from permanent-income or life-cycle models concerns the marginal propensity to consume from transitory income. A narrow form of the permanent income hypothesis (PIH) holds that the MPC from transitory income is zero. Life-cycle models provide the weaker and inherently more plausible assertion (proposition 2) that transitory income will be added to permanent income and consumed equally over the remainder of the life-cycle. This implies that the MPC from transitory income will be greater than zero, less than one and less than the MPC from y^*. It also seems plausible that MPC from transitory income (as from y^*) increases with age due to the decreasing remaining life span over which the additional income is to be consumed. These hypotheses are explored in parts of Tables 8-11.

The borrower-lender distinction in Table 8 rejects the narrow PIH hypothesis that MPC from transitory income is equal to zero. The residual income proxy for transitory income rejects the hypothesis in 10 of 10 cases while the windfall income proxy rejects it in

Table 9

Hypothesis Tests for Marginal Propensity to Consume

Hypothesis	Group	Age		
		17-32	33-50	50+
1. MPC from Y^* < 1				
	Professional	-3.6*	.49	1.2
	Managerial	-1.8	1.2	- .54
	Self-employed	6.1	.78	2.0*
	White-collar	- .48	-1.7	- .04
	Blue-collar	-1.0	.11	.57
2. MPC from $(Y - Y^*)$ < 1				
	Professional	-6.7*	-4.7	-1.0
	Managerial	-1.6	-3.7*	-2.9*
	Self-employed	7.9*	-1.6	-3.3*
	White-collar	1.0	-4.4*	-2.1*
	Blue-collar	-4.8*	-8.7*	-6.0*
3. MPC from Y_{WIND} < 1				
	Professional	-7.0*	- .7	- .56
	Managerial	-1.8**	-3.1*	-1.9**
	Self-employed	-2.9*	-2.8*	-2.8*
	White-collar	-4.1*	-4.0*	-2.2*
	Blue-collar	-5.1*	-6.8*	-1.8*
4. MPC from Y^* > MPC from $(Y - Y^*)$				
	Professional	2.7*	2.8*	1.7
	Managerial	-1.3	3.3*	.66
	Self-employed	1.0	1.7	3.3*
	White-collar	.00	.00	.90
	Blue-collar	1.0	3.8*	2.7*
5. MPC from Y^* > MPC from Y_{WIND}				
	Professional	4.6*	.81	.81
	Managerial	.55	2.2*	1.8**
	Self-employed	4.4*	2.7*	3.4*
	White-collar	3.2*	2.5*	1.1
	Blue-collar	2.8*	5.7*	1.5

Note: Values are t-statistics. * indicates significance at .01 (one-tail), and ** indicates significance at .025 (one-tail).

Table 10

Age-Related Consumption Functions
(Summary)

	Y^*	$Y - Y^*$	Y_{WIND}	Wealth	Constant	$\bar{R}^2$
Under 32:						
Professionals	.86 (15.0)	.68 (14.8)	.36 (3.6)	.13 (12.9)	-1524 (-.48)	.92
Managers	.75 (1.09)	.89 (14.3)	.85 (2.42)	.88 (1.44)	8280 (.42)	.94
Self-employed	1.88 (6.0)	1.55 (21.3)	.16 (.51)	.66 (3.0)	-10151 (-2.51)	.85
White-collar	.95 (1.98)	1.06 (13.4)	-.02 (-.08)	1.05 (6.3)	5818 (.72)	.69
Blue-collar	.95 (8.7)	.83 (23.8)	.53 (5.3)	.07 (20.5)	2352 (1.09)	.76
33-50:						
Professionals	1.13 (7.5)	.66 (10.0)	.72 (1.89)	.08 (2.3)	-5721 (-.64)	.73
Managers	1.79 (3.0)	.69 (9.3)	.25 (.58)	2.3 (4.5)	-22524 (-1.23)	.80
Self-employed	1.43 (4.5)	.86 (10.0)	.12 (.40)	.46 (1.49)	1579 (.27)	.53
White-collar	.81 (2.25)	.73 (13.8)	.09 (.36)	.82 (4.4)	11586 (1.55)	.77
Blue-collar	1.08 (13.7)	.75 (28.1)	.22 (2.01)	.19 (14.5)	841 (.47)	.69
50+:						
Professionals	1.31 (6.8)	.85 (6.9)	.68 (.97)	.12 (1.48)	-7189 (-.58)	.80
Managers	1.87 (3.8)	.72 (9.6)	-.77 (-.77)	.32 (1.93)	-16139 (-.81)	.93

Table 10 (continued)

	Y^*	$Y - Y^*$	$\cdot Y_{WIND}$	Wealth	Constant	$\bar{R}^2$
Self-employed	1.32 (6.8)	.93 (14.8)	.52 (2.14)	.09 (4.4)	-1099 (-.26)	.75
White-collar	1.26 (1.99)	.66 (4.4)	.44 (1.68)	.56 (1.87)	2464 (.18)	.68
Blue-collar	1.22 (8.8)	.77 (18.8)	.77 (5.9)	.16 (13.1)	-2386 (-.86)	.85

4 of 10 cases. Table 10 divides each occupation group into age subgroups to provide further evidence. All subgroups reject the null hypothesis that MPC from residual income ($y - y^*$) equals zero and 6 of 10 cases reject the hypothesis for windfall income. Since windfall income (bonuses, overtime and lottery winnings) is zero for most observations, these results tend to reject the null hypothesis and support its alternative, that MPC from transitory income is greater than zero.

Table 9 explores the second prediction of proposition 2, that MPC from transitory income is less than one. For residual income the null hypothesis (MPC $\geq$ 1) is rejected in 11 of 15 cases at the one percent level and 12 of 15 cases at the 2.5 percent level. Only one case, self-employed 17-32, exhibited an MPC significantly greater than one. Thus this facet of proposition 2 conforms well with the evidence.

A strong implication of the life-cycle model is that the marginal propensity to consume from permanent income should exceed that from transitory income. This hypothesis is also examined in Table 9 (parts 4 and 5). At the one percent level the null hypothesis (MPC from transitory income $\geq$ MPC from permanent income) is rejected in 6 of 15 cases for residual income and 9 of 15 cases for windfall income (10 of 15 cases for windfall income at the 2.5 percent level). Bearing in mind that residual income ($y - y^*$) is correlated with permanent income (y^*) (see Chapter III, section 2), the evidence tends to be against the null hypothesis and thus supportive of its alternative.

As an individual grows older his marginal propensity to consume from transitory income will tend to increase, since he has fewer years over which to spend the increase (or deduct the decrease). To some

extent this tendency is countered by the retirement and bequest motive. As retirement nears, the life-cycle individual devotes an increasing fraction of all income to retirement (see proposition 5).[15] One would expect the retirement and bequest fund motive to assume increasing importance for older persons since, among other reasons, this fund may be used to pay for medical expenses and older persons may overestimate their life expectancies. A third influence on MPC from transitory income stems from capital market imperfections. If young persons face high borrowing costs and have few assets so that their means for self-finance are small, an unexpected increase in income will be used to reduce the borrowing constraint and increase current consumption, while a fall in income will reduce present consumption more than future.

The net influence of the three tendencies is unclear. One may suppose that the younger age groups would exhibit the highest MPC from transitory income (due to borrowing constraints) while the differences between middle and older groups would be slight (due to the conflicting effects of the life-cycle and retirement fund motives). The evidence of Table 11 is consistent with this supposition. In part 2.b comparing young with middle-aged persons, four of five occupational groups exhibit significantly higher MPC from residual income while the lowest income group (blue-collar) has a significantly higher MPC from windfall income. Only the professional group did not exhibit a high MPC from residual income. In the comparison of young with older age groups (part 3.b) the young again show a higher MPC from residual income but this is significant in only one case: for windfall income older persons have a higher MPC in four of five cases but none are significant.

Between the middle and older age groups no pattern is apparent for either residual or windfall income. Out of ten coefficients for both proxies for transitory income, four are positive (none significant) and six are negative (one significant).

In general, the predictions for MPC's from transitory income in life-cycle models are confirmed (rather, not rejected) by the empirical evidence. Since the basic predictions of the model concerning consumption behavior from both permanent and transitory income have usually been confirmed in other analyses for Colombia and other countries these results are encouraging.

One of the least controversial implications of the theory is that the MPC from wealth is positive (proposition 3). This occurs for two reasons: The flow of income from wealth augments the stream of sustainable consumption, and higher initial wealth implies that less saving is required for retirement and legacies. Tables 8 and 10 confirm that in every case the MPC from wealth is significantly greater than zero. An interesting corollary is that, even though the intercept term in the consumption function is not significantly different from zero, APC declines as permanent income increases due to the positive coefficient for wealth (proposition 4). This provides a rational basis for this common empirical observation.

An analogous corollary of proposition 1 is that the MPC from permanent income is invariant to changes in wealth. It is difficult to test directly this (perhaps counter-intuitive) assertion since wealth and permanent income are highly correlated. Table 10 presents some indirect evidence. If professionals have greater wealth than other groups, the corollary is contradicted if MPC from y^* is consistently

lower for professionals than for other groups. One might expect the tendency to be more pronounced for older individuals who are more concerned with retirement and legacies. According to the evidence of Table 8 only the young self-employed (of 12 subgroups) exhibited a significantly higher MPC from y^*. The implications of the life-cycle model for consumption from wealth are consistent with the available evidence.

An interesting implication of the life-cycle theory is that the marginal propensity to consume from permanent income remains constant or decreases with age. If the retirement and bequest motive is insignificant MPC from permanent income is constant and equal to one as increased income contributes equally to consumption in each period. If the retirement and bequest motive is effective MPC from y^* will decline. The interest from a dollar contributed by a younger person to a retirement fund will compound for many years, so an older person must contribute more to provide an equal contribution (proposition 5). The estimated strength of the retirement motive in empirical analysis depends on the choice of the end of the planning horizon (L). If L is less than the life expectancy, many people will accumulate funds to provide for the time between retirement and death so that MPC from y^* will decline. In the model estimated in this chapter L is set at age 72 which is at or beyond the life expectancy of most people. As the above discussion of the tests of proposition 1 indicated, it appears that the retirement and bequest motive is not strong in this empirical formulation. Thus the age effect on MPC from y^* should be slight.

Parts 1.a-4.a of Table 11 present the evidence on proposition 5. Three of the five occupation groups show no change in MPC from y^* with

Table 11

Hypothesis Tests for Differences in Marginal Propensities to Consume Between Age Groups

Test	Group				
	Professionals	Managers	Self-employed	White-collar	Blue-collar
1. Joint test for equality of MPC's (F-statistics)					
a. Y^*	3.17**	.35	4.0**	.61	.63
b. $Y - Y^*$	1.10	7.4 *	21.4 *	6.2 *	2.44
c. Y_{WIND}	.57	.95	.51	.94	4.00**
d. Wealth	.24	20.9 *	20.8 *	2.3	104.5 *
2. MPC for young (17-32) vs. middle (33-50) (t-statistics)					
a. Y^*	-2.00**	- .68	2.72*	1.10	- .93
b. $Y - Y^*$	.14	3.8 *	5.89*	3.3 *	2.10**
c. Y_{WIND}	-1.03	.43	.14	- .07	1.84**
d. Wealth	.38**	- 6.5*	.94	-1.60	-10.8*

Table 11 (continued)

Test	Group				
	Professionals	Managers	Self-employed	White-collar	Blue-collar
3. MPC for young vs. older (51-72) (t-statistics)					
a. Y^*	-2.10**	- .78	2.13**	.15	- .91
b. $Y - Y^*$	-1.26	1.61	.15	2.4 *	1.52
c. Y_{WIND}	- .43	1.36	- .59	-1.28	-1.49
d. Wealth	- .56	- .71	-6.4 *	-1.43	-9.7 *
4. MPC for middle vs. older (t-statistics)					
a. Y^*	- .70	- .09	6.00*	- .51	- .33
b. $Y - Y^*$	-1.47	- 1.26	.14	.44	- .02
c. Y_{WIND}	.09	1.18	- .99	-1.06	-2.76*
d. Wealth	- .64	1.33	-5.0	-1.11	-3.8 *

Notes: * indicates significance at the one-percent level (one-tail).

** indicates significance at the five-percent level (one-tail).

Positive t-statistics indicate estimated coefficient of first group greater than that of second group.

age (indicated by the F-test in 1.a). The two groups which do exhibit differences vary in different directions. The MPC from y^* for the self-employed group declines across the life cycle in accordance with proposition 5. The professional group contradicts the proposition for the young age group. This may result from the large variance in income across the life cycle for this group. The young professional's peak income years may be so far in the future than he cannot borrow against his future prospects. By the middle and later years this effect would disappear. Overall the evidence for proposition 5 is mixed, with the supporting evidence somewhat weakened by contradictory behavior of the professional group.

The life-cycle model contains no specific predictions about the influence of education or occupation upon savings behavior (proposition 6). If there are no systematic differences in tastes for present over future consumption among socio-economic groups observed differences in savings propensities may be attributed to differences in interest rates or borrowing constraints, wealth holdings, or life expectancies among the groups. Thus two questions arise: first, to what extent are differences in savings bahavior between groups observed in the EH-4 sample; second, is it possible to distinguish between psychological (taste) and external (interest rate, wealth, life expectancy) influences on savings behavior?

Tables 12-15 present the available evidence of differences in MPC's between occupational and educational groups. Table 12 compares marginal consumption behavior between low and high education individuals within the same occupational grouping. A positive significant t-statistic indicates a higher MPC for low education levels and

Table 12

Tests for Differences in Marginal Propensities to Consume
Between Low and High Education Levels
Within Occupation and Age Groups

Group	t-statistic for Differences in MPC from:				N
	Y^*	$Y - Y^*$	Y_{WIND}	Wealth	
Professionals					
17-32	.58	2.99*	-1.38	-3.24*	109
33-50	- .15	-1.15	2.63*	2.47*	117
51-72	.42	1.70	1.25	-1.81	35
Managers					
17-32	- .00	.00	- .00	.00	24
33-50	.03	- .44	.85	- .70	41
51-72	2.35**	1.05	.71	1.97	14
Self-employed					
17-32	-2.84*	-7.46*	- .84	2.14*	129
33-50	-1.35	1.44	.19	.31	181
51-72	-1.60	.75	- .49	-5.21*	121
White-collar					
17-32	- .10	-2.90*	.16	.71	116
33-50	-1.03	-2.26*	.92	1.25	93
51-72	- .25	3.82*	.35	.96	28
Blue-collar					
17-32	- .84	-1.12	.45	-1.17	448
33-50	.07	- .05	.82	- .66	654
51-72	.00	- .00	.00	.00	208

*Significant at .01 (one-tail).

**Significant at .025 (one-tail).

Positive t-statistics indicate higher coefficient for the low education group.

vice versa for high levels. The distinctions between education groups are arbitrary, reflecting the need to maintain sufficient cell sizes for each age and occupation subgroup. For example, high-education professionals have completed university (low-education professionals are primarily elementary school teachers); high-education white-collar persons need only a secondary education. Given this problem of comparability Table 12 provides some interesting information. Considering the three types of income and wealth together, significant differences (at the 2.5 percent level) in MPC's are indicated in only 12 of 60 cases and these do not form a clear pattern. In fact, in 6 of the 12 significant cases, low-education persons had a lower MPC than high-education members of the same occupation and age group. For the variable y^* only 2 of 15 cases are significantly different and these have opposite signs. Residual income evidences significant differences in 5 of 15 cases but these show no clear pattern, nor does wealth, with two positive significant differences and two negative. Table 13 removes the distinctions among occupation groups and adds dummy variables to permit savings from permanent income to vary by family size. Once again the variation in savings behavior is not conclusive. Of the 18 hypothesis tests, significant differences (at the 2.5 percent level) were exhibited in seven cases; in six of these cases the high education group had a lower MPC. Four of these cases occur among the two proxies for transitory income ($y - y^*$ and y_{wind}). One may conclude that education is correlated with some other characteristics, such as knowledge of or access to capital markets, but that education per se does not strongly affect savings behavior.

Table 13

Hypothesis Tests for Differences in MPC Between Low and High Education Groups

	t-statistics		
	Age Group		
	< 30	31-50	> 50
1. Family size 1-3, MPC from y^*	.72	-1.74	.52
2. Family size 4-6, MPC from y^*	-1.61	-1.26	.85
3. Family size >6, MPC from y^*	-1.91	- .39	2.1 *
4. MPC from $y - y^*$	- .96	-2.1 **	2.0 **
5. MPC from y_{wind}	.31	2.7 *	3.1 *
6. MPC from wealth	3.9 *	3.0 *	.59

Notes: Positive t-statistics indicate a large coefficient for the low education group.

*Significant at one percent (one-tail).

**Significant at 2.5 percent (one-tail).

Tables 14 and 15 compare MPC's between professionals and other groups. Professionals are a useful comparison group since they have both the highest average income and the greatest variability in income over the life-cycle. Two types of consumption are considered in Table 14: "All-consumption" includes durable goods and home improvement expenditures, "non-durables" excludes these categories. Overall, Table 14 does not indicate the strong, consistent differences in savings behavior throughout the life-cycle one might expect if professionals had a lower rate of time-discounting or were more strongly influenced by the legacy motive. Of a total of 120 hypothesis tests only 20 indicated significant differences. The MPC from permanent income differed only in the two cases of 22 for which young self-employeds evidenced a higher MPC than professionals. Table 15 permits MPC from permanent income to vary by family size. Significant differences occur in only three of 36 cases, in two of which professionals have a higher MPC.

The tests do indicate systematic differences in savings propensities out of residual income and wealth for the young age group. In Table 14, for five of eight cases MPC from residual income was lower for professionals while MPC from wealth was greater for professionals in six of eight cases. The difference with respect to residual income is consistent with the life-cycle framework under the additional assumption that professionals and other high-income groups are able to borrow against future income more easily or at a lower rate than other groups. Following this hypothesis, since young non-professionals are liquidity-constrained, they tend to apply any temporary increases in income to current consumption; conversely

Table 14

Hypothesis Tests for Differences in Coefficients
Between Professionals and Other Groups
(t-statistics)

	Y^*	$Y - Y^*$	Y_{WIND}	Wealth
Age: <33				
Manager				
All-consumption	- .13	- 1.47	- .69	2.29*
Non-durables	.20	- 2.74*	.24	2.49*
Self-employed				
All-consumption	-2.3 *	-12.1 *	.09	8.0 *
Non-durables	-2.4 *	-12.7 *	.52	8.4 *
White-collar				
All-consumption	.82	- 5.5 *	2.8 *	5.4 *
Non-durables	.89	- 6.0 *	2.8 *	6.7 *
Blue-collar				
All-consumption	- .57	- 1.71	1.20	- .80
Non-durables	- .61	- 1.47	.88	- .89
Age: 33-50				
Managerial				
All-consumption	-1.38	- 1.99*	1.63	- .07
Non-durables	-1.22	- .143	1.47	- .29
Self-employed				
All-consumption	- .33	- .85	.96	.92
Non-durables	- .30	- .78	1.21	.99
White-collar				
All-consumption	.19	- 1.29	1.41	.82
Non-durables	- .21	- 1.27	1.48	1.04

Table 14 (continued)

	Y^*	$Y - Y^*$	Y_{WIND}	Wealth
Blue-collar				
All-consumption	- .60	.41	.83	- .33
Non-durables	- .37	.17	.75	- .41
Age: 50+				
Managerial				
All-consumption	.60	1.10	.63	.39
Non-durables	.61	.65	.64	.45
Self-employed				
All-consumption	.48	1.14	- .55	-2.56*
Non-durables	.72	.29	- .78	-2.57*
White-collar				
All-consumption	- .70	2.84*	.65	-1.14
Non-durables	- .53	2.57*	.01	- .93
Blue-collar				
All-consumption	- .56	.71	.21	- .31
Non-durables	- .40	.68	.11	- .33

Notes: Positive t-statistics indicate a larger coefficient for the professional group.

Table 15

Hypothesis Tests for Differences in MPC from Y^* Between Professionals and Other Occupations, Separated by Family Size (t-statistics)

	Family Size		
	1-3	4-6	6 or more
Age: <33			
Manager	1.19	.20	-1.21
Self-employed	-3.6 *	.54	-1.32
White-collar	-1.73	2.14**	.17
Blue-collar	- .43	.16	- .61
Age: 33-50			
Manager	- .15	- .43	- .22
Self-employed	- .18	- .47	- .40
White-collar	.55	-1.08	.26
Blue-collar	-1.07	.46	1.43
Age: >50			
Manager	- .59	1.55	1.15
Self-employed	- .63	1.95	1.00
White-collar	1.25	.14	- .98
Blue-collar	-1.17	3.05*	1.76

Notes: Positive t-statistics indicate larger coefficient for professional group.

H_o: MPC from y^* for professionals- MPC from y^* for other occupation = 0.

* indicates significance at the one percent confidence level (one-tailed).

** indicates significance at the 2.5 percent confidence level (one-tailed).

their consumption cannot easily be sustained by borrowing against future income if current income temporarily falls. One may speculate that by the middle years of the life span all groups have obtained sufficient liquid wealth so that they are able to suffer temporary income losses by reducing their own assets. This would explain the lack of significant differences in most cases by the middle and older age groups.[16] In the comparisons between low and high education groups in parts 4 and 5 of Table 12, the low education group again tends to evidence a higher MPC from transitory income, though only one significant difference occurs for MPC from permanent income.

Similar logic might explain the differences in MPC from wealth. If professionals receive a higher rate of return on wealth, due perhaps to better access to capital markets, an increase in wealth would provide them proportionately more income in each period and thus greater consumption opportunities, both now and in the future. Once again, it is possible that by middle-age other classes have obtained sufficiently remunerative assets, such as housing, that the differences disappear.[17] In any case, consumption behavior under capital market imperfections is complex and not well understood. The strongest inferences permitted by the present evidence are that if non-professionals and lower-education groups face higher borrowing and lower lending rates than professionals, their behavior is consistent with the life-cycle theory, and that differences in savings behavior do not necessarily reflect time-horizon myopia by the "lower classes."

Family size may also affect marginal consumption propensities, although the life-cycle model by itself provides no indication of the direction of the effect. A larger family size may increase the

marginal propensity to consume, both due to the need to feed, clothe and educate children who may support their parents in their old age. reducing the need to accumulate a retirement fund. The opposite effect may occur if some family members join the work force for the purpose of helping the family acquire durable goods or housing. In other words larger families may enable the family to increase its saving through self-finance. Table 15 presents an attempt to distinguish MPC's from permanent income by family size. The family size variables are crude since the age structure of the family also may be important. The definition of consumption in Table 16 is "all-consumption," that is, consumption of non-durables plus purchases of durables.[18] The columns headed y^* Fam 1 and y^*Fam 2 indicate the estimated coefficients of multiplicative dummy variables between family size (4-6 and 7 or more) and permanent income. The differences are significant in only two cases, both in the professional/young group. Among the non-significant variables the only apparent pattern of signs is an increasing frequency of positive coefficients for the older groups. Perhaps there is a slight tendency for older persons with large families to reduce their savings rate. One conclusion is that is is not necessary to distinguish by family size when performing the various hypothesis tests contained in the present chapter.

This chapter has presented a simple theory of life-cycle consumption behavior, adapted the theory to permit its empirical implementation and tested a number of implications of the model. The evidence of Tables 7-16 and Appendix 1 leads to a number of conclusions. The sample population in the DANE survey generally behaved in

Table 16

Consumption Functions for Occupation Groups with Marginal Consumption from Permanent Income Varying with Family Size

Group	Y^*	$Y - Y^*$	Y_{WIND}	Wealth	Y^*Fam (4-6)	Y^*Fam (>6)	Intercept	$\bar{R}^2$
I. Young (<33)								
Professional	.87 (13.3)	.74 (16.9)	.60 (4.3)	.83 (8.8)	- .05 (-2.4)	- .17 (-2.4)	5064 (1.83)	.87
Manager	.84 (8.5)	.87 (21.2)	.99 (4.0)	.59 (4.1)	- .04 (- .41)	.00 (.04)	3654 (1.32)	.93
Self-employed	.92 (12.2)	.98 (17.9)	.39 (2.5)	.47 (6.6)	.12 (1.6)	.03 (.39)	5395 (1.84)	.79
White-collar	1.37 (10.5)	1.33 (24.2)	- .22 (-1.1)	.33 (8.1)	- .06 (- .74)	- .03 (- .22)	- 2147 (- .57)	.78
Blue-collar	.97 (5.3)	.90 (31.3)	.56 (6.0)	.59 (19.9)	- .10 (- .99)	- .05 (- .40)	3379 (1.35)	.78
II. Middle-aged (33-50)								
Professional	.91 (7.9)	.71 (14.1)	.65 (2.3)	.51 (4.8)	- .09 (- .84)	.09 (1.07)	2823 (.74)	.77
Manager	.82 (6.7)	.87 (14.9)	.15 (.43)	1.06 (6.6)	.00 (.01)	.18 (1.66)	2908 (.82)	.81

Table 16 (continued)

Group	Y^*	$Y - Y^*$	Y_{WIND}	Wealth	Y^*Fam (4-6)	Y^*Fam (>6)	Intercept	$\bar{R}^2$
Self-employed	.92 (7.3)	.71 (13.3)	.41 (1.70)	.39 (3.9)	- .07 (- .62)	.16 (1.59)	5663 (1.35)	.67
White-collar	1.04 (5.5)	.83 (13.6)	.11 (.47)	.24 (2.5)	.01 (.05)	.10 (.78)	3676 (.71)	.59
Blue-collar	1.17 (11.2)	.83 (30.9)	.32 (2.7)	.71 (14.4)	- .17 (-2.3)	- .83 (-1.2)	1202 (.65)	.70
III. Older (>50)								
Professional	1.22 (8.8)	.91 (16.4)	- .51 (-2.1)	.16 (3.8)	.18 (1.29)	.07 (.62)	-4659 (-1.29)	.89
Manager	1.02 (9.0)	.68 (16.1)	- .81 (-3.9)	.32 (9.4)	- .17 (-1.4)	- .02 (- .20)	351 (.13)	.93
Self-employed	1.34 (8.7)	.93 (18.3)	.53 (2.26)	.11 (5.5)	.26 (1.61)	.03 (.26)	-5890 (-1.56)	.84
White-collar	1.32 (6.4)	.88 (15.4)	.67 (3.9)	.11 (5.5)	.08 (.41)	.03 (.19)	-4097 (- .92)	.75
Blue-collar	.72 (6.3)	.70 (18.1)	.40 (3.0)	.18 (10.9)	.05 (.53)	.13 (1.53)	7334 (3.9)	.85

Notes: The coefficient for each Y^*Fam variable indicates the difference in MPC from Y^* between that family size and family size 1-3.

accordance with the basic life-cycle theory. In particular, three important propositions derived from the theory were found to be consistent with the evidence: The marginal propensity to consume from permanent income is greater than zero and less than or equal to one; the marginal propensity to consume from transitory income is less than the MPC from permanent income, and the marginal propensity to consume from permanent income is constant or decreases with age. The evidence is also consistent with several less established implications of the theory, principally that MPC's do not differ systematically among education or occupation groups, except to the extent that differing borrowing or lending rates cause young persons to vary their desired consumption behavior. The evidence summarized in Tables 7 and 8 indicates that occupational groups appear to discount future income and consumption at reasonable, non-zero rates. No consistent differences in planning horizons or disposition toward providing for bequests or retirement are apparent. The life-cycle model appears to offer a fruitful approach to the study of savings behavior in Colombia.

FOOTNOTES

[1]In a multi-period model capital gains or losses on already existing assets or liabilities should be considered. The asymmetry remains since if interest rates rise, asset holders suffer a capital loss while debtors enjoy a gain.

[2]This statement is proved for the additive logarithmic utility function in proposition 2 below.

[3]This utility function is considered in W. H. Somermeyer and R. Bannink [26], Chapter 4. This utility function may be criticized for its extreme simplicity or unrealistic properties, such as constant relative risk-aversion as income varies. The position of this study is that it provides a simple testable version of the life-cycle model. If empirical results generally conform with the predictions of this simple version, a more complex utility function may be expected to strengthen the evidence for the life-cycle model.

[4]This analysis is pursued in J. Crockett and I. Friend [4].

[5]Lower case letters (y, c) are used to describe empirical variables, upper case letters for their theoretical analogs.

[6]This approach was first suggested by H. Watts in "An Objective Permanent Income Concept for the Household," Cowles Foundation Discussion Paper No. 99 (Nov. 1960).

[7]The age regression actually used distinguishes two education classes in all coefficients and three family-size classes in the intercept term for each occupation class, under the hypothesis (see Chapter 2) that education and family size affect incomes. It also includes a cubed term to permit more flexibility in age-income profiles. The estimated equation is:

$$y = a_o + a_1 \cdot \text{Age} + a_2\text{Age}^2 + a_3\text{Age}^3 + a_4\delta_4 \text{ (family size 4-6)}$$

$$+ a_5\delta_5 \text{ (family size 7+)},$$

where $\delta_i = 1$ for family size i, 0 otherwise.

[8]The unknown A_o is estimated from capital income by the relation

$$A_o = \text{YKAP}/r \qquad (15)$$

where YKAP is interest plus imputed rent net of estimated expenses and depreciation. Note that no information on liabilities is included explicitly so that A_o is overestimated, particularly for younger individuals.

[9]The age-income profile (and thus Y^*) is estimated separately for high- and low-education levels within each occupation group. To conserve degrees of freedom, r and s are not separately estimated for each occupation/education subgrouping. See below, Tables 6-9 for tests of the differences in behavior between education and occupation groups. See Chapter II for definitions of occupation/education groups.

[10]Experiments with interest rates as high as 200 percent and skill parameters as great as two indicate that $\bar{R}^2$ is maximized within the range presented here.

[11]Since the appropriate value of s is zero in most cases, s is assumed zero for all groups in the remainder of the chapter.

[12]Hill [9, 10] summarizes evidence on the actual interest rates faced by various groups. The estimates in Table 2 are generally less than those used by Hill.

[13]Proposition 3 (that APC falls as income increases) is not universally held in the literature. The seminal work of Friedman assumes that the legacy motive is insignificant so that APC is constant and equal to MPC (the proportionality hypothesis).

[14]This result depends to some extent on the choice of a planning horizon (L). If L is chosen as the (expected) remaining years until retirement, $\phi(Y^*)$ includes consumption during the retirement years so that b is positive; if L is remaining life span, planned yearly consumption (C^*) includes the retirement years (as indicated by equation 9) so that $\phi(Y^*)$ represents bequests only. In the empirical estimates the end of the time horizon is age 72 which is close to the expected life-span, implying that $\phi(Y^*)$ indicates only the legacy motive. (See footnote 15.)

[15]Algebraically, note that

$$\frac{\partial C^*_o}{\partial Y_o} = \frac{\partial C^*_o}{\partial Y^*} \cdot \frac{\partial Y^*}{\partial Y_o}, \quad \frac{\partial Y^*}{\partial Y_o} = 1 \Big/ \sum_{i=o}^{L} (1 + r)^{-i} > 0$$

and $$\frac{\partial^2 C^*_o}{\partial Y_o \partial L} = \frac{\partial^2 C^*_o}{\partial Y^* \partial L} \cdot \frac{\partial Y^*}{\partial Y_o} + \frac{\partial C^*_o}{\partial Y_o} \cdot \frac{\partial^2 Y^*}{\partial Y_o \partial L} \cdot$$

The first term has a positive sign (see proposition 5) indicating the effect of impending retirement; the second term has a negative sign

showing the effect of distributing the income over the entire life-span. The difference between the conventional result (decreasing MPC from transitory income) and the present primarily depends on the choice of the planning horizon (L). If L is the expected end of the life-span (and the bequest motive is insignificant) all wealth is consumed by the end of the L^{th} year, the "retirement motive" is zero and only the second term of

$$\frac{\partial^2 C^*_o}{\partial Y, \partial L}$$

remains. The difficulty with this approach is that L is unknown. Conversely if L is set arbitrarily at the expected retirement year chosen early enough so that most individuals expect to live beyond this year (although they may be wrong) the retirement effect is non-zero. If people frequently overestimate their expected life span the retirement effect will also be non-zero.

[16]The discussion concerns the difference in MPC from Y_o for groups facing a higher interest (borrowing) rate. As before,

$$\frac{\partial C^*_o}{\partial Y_o} = \frac{\partial C^*_o}{\partial Y^*} \cdot 1/ \sum_{i=o}^{L} (1 + r)^{-i}$$

so that

$$\frac{\partial^2 C^*_o}{\partial Y_o \partial r} > 0.$$

Note that the effect is stronger for young persons for whom L is large.

[17]Also, to the extent that young professionals have a higher incidence of home-ownership than others their wealth is overestimated since liabilities (mortgages) are not included in wealth.

[18]The results do not change significantly under narrower definitions of consumption.

Chapter V

SUMMARY AND CONCLUSIONS

This thesis applies the 1971 Colombian EH-4 cross-sectional household budget study to empirical formulations of the M-A-B life-cycle income-consumption model to contribute to economists' knowledge in four areas. First, although it is a potentially rich source of data, the EH-4 has not been applied previously to econometric analysis. It is of interest to learn if the information it contains is of sufficient quality to encourage further exploration of its properties. Second, the applicability of life-cycle model to developing countries is still under debate. This thesis offers evidence on the explanatory power of the model in Colombia. Third, the thesis examines the contention that marginal savings propensities vary with education, occupation, or income. Finally, it investigates in a preliminary fashion the possibility that differences in savings propensities between socio-economic groups depend on external market-related factors more than internal psychological factors.

Since any contribution to evidence concerning the last three topics offered by the EH-4 survey depends on the evidence for the first, it is encouraging to conclude that in at least one comparison the EH-4 survey provides results similar to those of the well-established ECIEL-CEDE survey. The evidence is provided by applying, to the extent possible, the same empirical model to both data sets (Chapter III, section 2). Table 8 in Chapter III indicates that the estimated coefficients of the Crockett and Friend normal income model vary

little between the two data sets. Of the 21 coefficients estimated (nine independent variables, three dependent variables) no significant variables differed in sign between the two studies and only two variables were significant in one data set but not the other. The estimated coefficient for the major variables (normal income and residual income) were quite similar, differing by more than 10 percent in only one case (an MPC for consumption of non-durables of .57 for the EH-4 survey and .66 for the ECIEL-CEDE survey data). Given the unavoidable differences in definitions and coverage between the studies the correspondence between the results is impressive.

The second goal of the thesis is to examine the applicability of the life-cycle model to Colombia. Two versions of the normal income version of the model and a more complex time-discounted version were estimated. As just mentioned, the results of the Crockett-Friend normal income version of the life-cycle model were replicated on the DANE EH-4 data. Section 3 of Chapter III tests a slightly more refined version of the model. The most important modifications were to use combination education/occupation groups, permit the weights of the components of normal income to vary between classes, add mean income by family size grouping variables in the estimation of normal income and estimate separately the influence of capital income on consumption. The major results were marginal increases in the adjusted coefficients of determination and substantial increases in the estimated marginal propensity to consume from normal income. In these regressions the marginal propensity to consume is close to the value of one predicted by the simple life-cycle model. In both the C-F and the modified version the marginal propensity to consume from estimated permanent

(normal) income is significantly greater than that from estimated transitory (residual) income. The difference is more pronounced in the modified version.

The normal income version of the life-cycle model embodies the important characteristics of the basic theory that consumption decisions depend on long-run trends in income and that the propensity to consume from permanent income is greater than from transitory income. However in the normal income model individuals are assumed to discount future income receipts at a zero rate, i.e., both the market and psychological discount rates are zero. As a consequence assumed time horizons are very long in the sense that expected income increases add equal amounts to present consumption no matter when they occur. In this model the marginal propensity to consume does not vary over the life cycle. These assumptions conflict with the original M-B-A formulation. It is of interest to examine the consequences of reducing the stringency of these assumptions.

The life-cycle model examined and tested in Chapter IV permits individuals to discount future income at a positive interest rate and offers predictions about variations in consumption over the life cycle which are consistent with the basic M-B-A life-cycle theory. In this simple model individuals solve an inter-temporal utility maximization problem. The assumption of an additive-logarithmic utility function provides a consumption function which depends on expected future income, initial wealth, desired wealth at the end of the planning horizon and market interest rates. Several predictions of the model are expressed as testable propositions.

To empirically implement the model expected future income is

estimated by regressing current income on a non-linear function of age and family size for each of ten occupation/educational groups. The end of the planning horizon is arbitrarily set at age 72, and initial wealth is estimated from current capital income. The remaining parameter, the discount rate, is chosen to maximize the adjusted coefficient of determination of the empirical consumption function. In this exercise the $\bar{R}^2$ is maximized for interest rates in the range of 5 to 15 percent with the best estimate for most occupation groups in the neighborhood of 7.5 percent. In these regressions borrowers (whose incomes are expected to increase in the future) are distinguished from lenders. In general, as may be expected, borrowers discount at a higher rate than lenders. The coefficients of determination are in the range (.65 to .88) with seven of ten above .75. It appears that the life-cycle theory assumption that individuals borrow at non-zero interest rates is appropriate. Since expected growth in income tends to reduce the estimated discount rate, the net real discount rate applied by most groups is probably over 10 percent.

Chapter IV also contains evidence on other major propositions of the life-cycle theory. Among the results are:

1. The marginal propensity to consume from permanent income is close to one.

2. The marginal propensity to consume from transitory income is less than the MPC from permanent but generally greater than zero.

3. With the exception of the professional group, the marginal propensity to consume from permanent income is constant or decreases with age.

4. The marginal propensity to consume from wealth is positive.

5. The intercept term in the consumption function is not significantly different from zero.

6. If wealth increases proportionately or more than proportionately with income, the average propensity to consume from permanent income will decrease, even though the marginal propensity is constant and the intercept term is zero.

These results are consistent with the version of the life-cycle theory presented in section 2 of Chapter IV.

The introductory chapter of this thesis lists three major features of the life-cycle theory: The rational individual considers future incomes and interest rates to plan his consumption over long time periods, he attempts to maintain a relatively constant consumption rate through his life and he re-allocates consumption over long periods when faced with unexpected income changes. The three versions of the life-cycle model examined empirically in Chapters III and IV imply that the respondents of the DANE EH-4 survey obey these basic precepts.

The last two goals of the thesis are to compare savings rates among socio-economic groups to determine the extent to which these rates vary and to distinguish between psychological and market forces as explanatory factors of any observed differences. According to the evidence of Chapter IV there are significant differences in savings behavior among some educational and occupational groups. In general these differences are not pervasive. For example, in comparisons between education levels within the same occupation groups 12 of 60 coefficients are statistically distinct. Without controlling for occupation, the high education groups show a lower MPC in 6 of 18 cases. In 120 comparisons of MPC's between professionals and other

occupations, significant differences occur in 20 cases. The conclusion is that differences do occur in some circumstances.

One explanation for the differences in MPC's which are observed is that some groups, presumably low income or educational groups, have a shorter time horizon than others. This may reflect the difficulties of planning for the future when individuals are close to a biologically minimum subsistence level or may indicate a difference in tastes. Perhaps some groups suffer chronically low incomes because they are unwilling to sacrifice present pleasure for future prosperity. The alternative explanation refers to market forces to assert that some groups must pay high interest rates to borrow and receive a low return on their savings. In these circumstances these groups are unable to fulfill the predictions of the perfect capital markets life-cycle model.

Under the short time horizon hypothesis MPC's for occupation and education groups with low income should tend to be high no matter in which form (permanent, transitory, return to wealth) the income change occurs. The fact that relatively few significant differences are observed between groups argues against this hypothesis. The capital markets imperfections assumption implies that low income groups should have higher MPC's from transitory income since current consumption is less than the desired level and low MPC's from permanent income due to borrowing constraints. The evidence from Tables 12-15 of Chapter IV mildly supports this hypothesis. Few significant differences among occupation or education groups occur in the MPC's from the proxy for permanent income. Differences in MPC from residual income (the proxy for transitory income) are more frequent. In 13 of 40

comparisons the low education or occupation group had a higher MPC from residual income. While certainly not conclusive, these results tend to favor the capital market constraints assumption.

Controversy over the degree to which the life-cycle theory applies to Colombia and other developing countries will undoubtedly continue. Discrepancies between the exact predictions of the original theory and the behavior recorded in survey data are probably inevitable. Whether these are attributable to difficulties in finding empirical proxies for the theoretical variables or due to violation of the assumptions of perfect capital markets, complete information on future incomes and rational utility maximization remains in contention. However the reasoning and empirical estimations of this thesis imply that Colombians do obey the basic tenets of the thesis. Two policy implications follow from this conclusion: First, the marginal propensity to consume from income changes which are expected to be permanent is substantially greater than that from temporary income changes or that predicted from current income models. Second, it is by no means certain that observed differences in savings rates between high and low income, occupation or education groups result from fundamental psychological factors. Reform of capital markets could substantially increase savings rates in the lower groups, while permanent income transfers to these groups may not have severe effects on total personal saving.

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APPENDIX A

ESTIMATES OF DISCOUNT RATES AND SKILL FACTORS

Table A.1

Estimates of r and S

A.1.1.--Professional

S=0	Y^*	$Y - Y^*$	Y_{WIND}	Wealth	$\bar{R}^2$	N
			Lenders			
r=0	.52 (2.28)	.65 (7.75)	.88 (2.68)	.29E-1 (4.65)	.719	58
r=.05	.75 (4.50)	.70 (6.49)	1.30 (3.84)	.16 (5.36)	.758	52
r=.1	.59 (3.08)	.61 (5.79)	1.02 (2.48)	.32E-1 (4.28)	.701	46
r=.15	.57 (2.65)	.56 (4.51)	1.30 (1.99)	.77E-2 (3.35)	.656	36
r=.2	.61 (2.92)	.57 (4.52)	1.26 (1.88)	.15E-2 (3.05)	.638	36
r=.25	.66 (3.22)	.59 (4.55)	1.17 (1.72)	.33E-3 (2.95)	.635	35
r=.3	.69 (3.42)	.59 (4.57)	1.16 (1.67)	.74E-4 (2.79)	.623	35
r=.35	.719 (3.58)	.60 (4.60)	1.14 (1.64)	.18E-4 (2.65)	.617	35
			Borrowers			
r=0	1.44 (11.9)	.76 (16.1)	.19 (.91)	.71E-2 (2.91)	.774	203
r=.05	1.15 (12.0)	.73 (16.8)	.22 (1.17)	.91E-1 (4.60)	.771	209
r=.1	1.15 (14.9)	.77 (16.8)	.28 (1.47)	.11E-1 (3.77)	.772	215
r=.15	1.16 (17.3)	.78 (17.3)	.24 (1.33)	.14E-2 (3.94)	.777	225

Table A.1 (continued)

S=0	Y^*	$Y - Y^*$	Y_{WIND}	Wealth	$\bar{R}^2$	N
r=.2	1.16 (18.6)	.78 (17.2)	.21 (1.15)	.19E-3 (3.88)	.777	225
r=.25	1.17 (19.4)	.77 (17.0)	.20 (1.05)	.26E-4 (3.78)	.776	226
r=.3	1.18 (19.9)	.77 (16.9)	.18 (.96)	.37E-5 (3.64)	.775	226
r=.35	1.18 (20.2)	.77 (16.8)	.18 (.93)	.56E-6 (3.45)	.775	226
S=.2	Y^*	$Y - Y^*$	Y_{WIND}	Wealth	$\bar{R}^2$	N
			Lenders			
r=0	.75 (4.28)	.68 (7.79)	.91 (2.49)	.28E-1 (4.74)	.746	64
r=.05	.81 (5.45)	.58 (6.23)	1.04 (2.95)	.164 (5.77)	.786	58
r=.1	.61 (3.35)	.64 (6.00)	1.45 (2.55)	.35E-1 (3.92)	.745	49
r=.15	.68 (3.76)	.62 (5.37)	1.32 (2.19)	.72E-2 (2.99)	.720	43
r=.2	.95 (5.88)	.73 (5.37)	1.02 (1.64)	.63E-3 (1.15)	.669	42
r=.25	.98 (6.57)	.72 (5.23)	1.09 (1.72)	.61E-4 (.58)	.665	43
r=.3	.99 (7.51)	.79 (5.06)	1.20 (2.00)	.25E-6 (.02)	.678	46
r=.35	.98 (7.63)	.81 (5.50)	1.27 (2.16)	-.97E-6 (-.37)	.691	48

Table A.1 (continued)

S=.2	Y^*	$Y - Y^*$	Y_{WIND}	Wealth	$\bar{R}^2$	N
			Borrowers			
r=0	1.53 (8.93)	.61 (7.45)	.12 (.61)	.62E-1 (2.30)	.767	197
r=.05	1.13 (10.22)	.66 (10.20)	.27 (1.43)	.91E-1 (4.37)	.776	203
r=.1	1.14 (13.79)	.69 (11.05)	.22 (1.19)	.11E-1 (3.96)	.771	212
r=.15	1.14 (16.08)	.70 (11.24)	.20 (1.09)	.14E-2 (3.80)	.770	218
r=.2	1.14 (17.18)	.68 (10.91)	.19 (1.01)	.19E-3 (3.71)	.767	219
r=.25	1.16 (18.08)	.67 (10.72)	.18 (.91)	.26E-4 (3.57)	.767	218
r=.3	1.17 (18.51)	.66 (10.65)	.17 (.84)	.36E-5 (3.38)	.765	215
r=.35	1.18 (18.78)	.64 (10.25)	.16 (.80)	.54E-6 (3.17)	.763	215
S=.4	Y^*	$Y - Y^*$	Y_{WIND}	Wealth	$\bar{R}^2$	N
			Lenders			
r=0	.92 (5.31)	.68 (7.29)	.99 (2.56)	.22E-1 (5.06)	.732	83
r=.05	.86 (6.94)	.49 (5.03)	1.86 (3.99)	.166 (5.86)	.791	73
r=.1	.82 (6.65)	.79 (6.66)	1.27 (2.69)	.16E-1 (2.29)	.740	64
r=.15	.95 (9.09)	.86 (6.34)	1.16 (2.47)	.10E-3 (.69)	.733	66
r=.2						

Table A.1 (continued)

S=.4	Y^*	$Y - Y^*$	Y_{WIND}	Wealth	$\bar{R}^2$	N
r=.25	.96 (9.65)	.85 (6.06)	1.18 (2.51)	.90E-5 (.45)	.734	67
r=.3	.99 (9.17)	.89 (5.51)	1.51 (3.03)	.61E-6 (.21)	.707	68
r=.35	.98 (9.52)	.89 (5.46)	1.49 (3.07)	.86E-7 (.20)	.706	71
			Borrowers			
r=0	.93 (4.58)	.84 (5.60)	.20 (.962)	.97E-2 (3.27)	.761	178
r=.05	.99 (7.51)	.67 (5.79)	.23 (1.22)	.10 (4.79)	.775	188
r=.1	1.09 (11.23)	.61 (5.94)	.16 (.82)	.13E-1 (3.98)	.757	197
r=.15	1.14 (15.18)	.53 (5.39)	.13 (.63)	.19E-3 (3.35)	.749	195
r=.2						
r=.25	1.15 (16.15)	.50 (5.11)	.11 (.53)	.26E-4 (3.22)	.749	194
r=.3	1.16 (17.09)	.49 (5.03)	.07 (.34)	.39E-6 (3.14)	.756	193
r=.35	1.17 (17.39)	.47 (4.81)	.07 (.35)	.57E-6 (3.08)	.755	190
S=.6	Y^*	$Y - Y^*$	Y_{WIND}	Wealth	$\bar{R}^2$	N
			Lenders			
r=0	.96 (5.71)	.70 (5.86)	.92 (2.51)	.20E-1 (5.09)	.744	94
r=.05	.84 (7.61)	.59 (5.05)	1.39 (3.45)	.14 (6.90)	.780	91

Table A.1 (continued)

S=.6	Y^*	$Y - Y^*$	Y_{WIND}	Wealth	$\bar{R}^2$	N
r=.1	.90 (8.10)	.74 (5.26)	1.44 (3.26)	.21E-1 (4.92)	.734	89
r=.15	.94 (9.18)	.81 (5.18)	1.40 (3.21)	.12E-2 (1.04)	.678	92
r=.2	1.00 (10.86)	.93 (5.60)	1.23 (2.96)	.55E-4 (.38)	.696	93
r=.25	1.00 (11.60)	.92 (5.38)	1.24 (3.02)	.44E-5 (.23)	.698	96
r=.3	1.01 (12.72)	.79 (4.56)	1.33 (3.50)	.71E-6 (.29)	.714	99
r=.35	1.01 (12.96)	.78 (4.43)	1.32 (3.50)	.97E-7 (.26)	.709	102
			Borrowers			
r=0	.63 (5.01)	1.14 (8.16)	.29 (1.36)	.12E-1 (4.35)	.762	167
r=.05	.78 (7.22)	.84 (6.00)	.34 (1.63)	.12 (5.00)	.765	170
r=.1	.88 (9.01)	.81 (5.09)	.22 (1.02)	.14E-1 (3.99)	.747	172
r=.15	.99 (11.13)	.64 (3.82)	.09 (.43)	.17E-2 (3.80)	.736	169
r=.2	1.05 (12.79)	.48 (2.89)	.06 (.29)	.21E-3 (3.31)	.732	168
r=.25	1.09 (13.76)	.37 (2.10)	.04 (.19)	.27E-4 (3.01)	.731	165
r=.3	1.10 (14.13)	.34 (1.87)	.01 (.05)	.38E-5 (2.82)	.721	162
r=.35	1.12	.28	.02	.55E-6	.720	159

Table A.1 (continued)

S=.8	Y^*	$Y - Y^*$	Y_{WIND}	Wealth	$\bar{R}^2$	N
			Lenders			
r=0	.92 (5.92)	.73 (5.15)	1.17 (2.77)	.19E-1 (5.16)	.735	112
r=.05	.87 (8.53)	.64 (4.70)	1.15 (3.34)	.13 (7.37)	.777	111
r=.1	.92 (9.42)	.68 (3.99)	1.10 (3.05)	.21E-1 (5.39)	.741	105
r=.15	1.00 (11.17)	.78 (3.95)	.96 (2.71)	.28E-2 (4.37)	.729	111
r=.2	1.06 (13.1)	.68 (3.2)	.94 (2.6)	.34E-4 (3.5)	.713	116
r=.25	1.12 (14.5)	.51 (2.22)	1.15 (3.2)	.37E-4 (2.59)	.710	116
r=.3	1.15 (14.3)	.49 (1.93)	1.10 (2.9)	.41E-5 (1.94)	.687	116
r=.35	1.17 (13.7)	.44 (1.54)	1.24 (3.1)	.47E-6 (1.45)	.652	113
			Borrowers			
r=0	.67 (8.21)	1.25 (9.99)	.30 (1.41)	.13E-1 (4.57)	.772	149
r=.05	.70 (8.79)	1.02 (6.91)	.43 (1.95)	.12 (5.02)	.756	150
r=.1	.73 (9.90)	1.23 (6.82)	.32 (1.45)	.17E-1 (4.74)	.743	156
r=.15	.80 (10.9)	1.15 (5.3)	.21 (.91)	.21E-2 (4.1)	.718	150
r=.2	.84 (11.5)	1.08 (4.3)	.14 (.56)	.26E-3 (3.7)	.708	145
r=.25	.87 (12.0)	.99 (3.6)	.07 (.29)	.34E-4 (3.4)	.701	143

Table A.1 (continued)

S=.8	Y^*	$Y - Y^*$	Y_{WIND}	Wealth	$\bar{R}^2$	N
r=.3	.90 (12.5)	.86 (2.9)	.04 (.16)	.47E-5 (3.2)	.699	145
r=.35	.92	.77	.03	.68E-6	.698	148
S=1.0	Y^*	$Y - Y^*$	Y_{WIND}	Wealth	$\bar{R}^2$	N
			Lenders			
r=0	1.04 (7.1)	.74 (4.2)	1.03 (2.27)	.19E-1 (4.8)	.721	128
r=.05	.82 (9.1)	.67 (4.6)	1.08 (3.5)	.14 (8.1)	.777	123
r=.1	.90 (10.2)	.92 (4.8)	.86 (2.7)	.21E-1 (5.9)	.745	124
r=.15	.98 (11.4)	.91 (3.9)	.75 (2.30)	.28E-2 (4.7)	.715	126
r=.2	1.03 (13.0)	.87 (3.2)	.81 (2.39)	.34E-3 (3.7)	.700	128
r=.25	1.10 (13.5)	.87 (2.8)	.63 (1.9)	.40E-4 (2.8)	.671	129
r=.3	1.12 (13.5)	.84 (2.4)	.70 (2.00)	.44E-5 (2.05)	.632	128
r=.35	1.12 (13.7)	.84 (2.22)	.70 (1.98)	.51E-6 (1.55)	.627	131
			Borrowers			
r=0	.73 (13.3)	1.19 (10.9)	.33 (1.62)	.12E-2 (4.5)	.785	133
r=.05	.72 (11.9)	1.14 (7.9)	.46 (2.04)	.12 (4.7)	.752	138
r=.1	.76 (13.4)	1.35 (7.7)	.38 (1.61)	.16E-1 (4.6)	.733	137

Table A.1 (continued)

S=1.0	Y^*	$Y - Y^*$	Y_{WIND}	Wealth	$\bar{R}^2$	N
r=.15	.80 (14.6)	1.50 (7.0)	.30 (1.24)	.22E-2 (4.5)	.724	135
r=.2	.83 (15.5)	1.58 (6.3)	.21 (.86)	.30E-3 (4.3)	.715	133
r=.25	.85 (15.7)	1.61 (5.7)	.17 (.67)	.40E-4 (4.0)	.705	132
r=.3	.86 (16.1)	1.64 (5.4)	.13 (.50)	.56E-5 (3.8)	.700	133
r=.35	.87 (15.8)	1.67 (4.9)	.10 (.38)	.84E-6 (3.5)	.690	130

A.1.2--Managers

S=0	Y^*	$Y - Y^*$	Y_{WIND}	Wealth	$\bar{R}^2$	N
			Lenders			
r=0	1.21 (5.0)	.80 (14.2)	.05 (.12)	.12E-1 (1.90)	.787	71
r=.05	.97 (5.0)	.71 (13.4)	.31 (.83)	.15 (4.5)	.805	65
r=.1	.80 (3.7)	.76 (12.8)	.33 (.24)	.2E-1 (1.97)	.770	59
r=.15	.61 (2.8)	.75 (10.8)	- .14 (- .35)	.22E-2 (2.30)	.738	50
r=.2	.64 (2.82)	.76 (10.5)	- .12 (- .28)	.30E-3 (1.91)	.729	49
r=.25	.65 (2.95)	.76 (10.4)	- .11 (- .25)	.42E-4 (1.62)	.723	49
r=.3	.65 (3.0)	.76 (10.3)	- .10 (- .22)	.67E-5 (1.39)	.719	49
r=.35	.66 (3.1)	.76 (10.2)	- .09 (- .21)	.11E-5 (1.22)	.716	49

Table A.1 (continued)

S=0	Y^*	$Y - Y^*$	Y_{WIND}	Wealth	$\bar{R}^2$	N
			Borrowers			
r=0	.29 (.85)	1.10 (5.1)	.92 (2.68)	.45E-2 (.40)	.921	8
r=.05	1.11 (2.01)	.87 (4.9)	.33 (.44)	.19 (1.32)	.846	14
r=.1	1.59 (2.72)	.67 (4.6)	.50 (.81)	.73E-1 (2.59)	.871	20
r=.15	1.79 (3.26)	.91 (10.11)	.64 (1.10)	- .77E-4 (- .27)	.827	29
r=.2	1.78 (3.6)	.92 (10.8)	.63 (1.14)	- .21E-3 (- .43)	.832	30
r=.25	1.75 (3.6)	.93 (11.1)	.63 (1.15)	- .53E-4 (- .62)	.836	30
r=.3	1.71 (3.6)	.92 (11.2)	.64 (1.17)	- .11E-4 (- .67)	.838	30
r=.35	1.70 (3.5)	.92 (11.4)	.64 (1.18)	- .21E-5 (- .64)	.838	30
S=.2	Y^*	$Y - Y^*$	Y_{WIND}	Wealth	$\bar{R}^2$	N
			Lenders			
r=0	.91 (5.3)	.74 (8.7)	.82 (2.9)	.66E-2 (1.63)	.689	64
r=.05	.84 (6.0)	.70 (9.0)	.80 (3.2)	.81E-1 (3.1)	.729	61
r=.1	.74 (5.3)	.67 (7.8)	.60 (2.29)	.79E-2 (1.67)	.614	56
r=.15	.74 (5.0)	.65 (6.9)	.63 (2.16)	.88E-3 (1.23)	.544	53
r=.2	.75 (5.8)	.64 (6.8)	.65 (2.26)	.12E-3 (1.07)	.542	54

Table A.1 (continued)

S=.2	Y^*	$Y - Y^*$	Y_{WIND}	Wealth	$\bar{R}^2$	N
r=.25	.82 (5.8)	.71 (7.2)	.65 (2.34)	.17E-4 (.96)	.563	54
r=.3	.87 (5.8)	.73 (7.5)	.73 (.27)	.27E-5 (.88)	.577	55
r=.35	.83 (6.1)	.74 (7.7)	.76 (2.79)	.51E-6 (.85)	.587	56
			Borrowers			
r=0	3.48 (2.03)	.08 (.22)	- .84 (- .79)	.48E-1 (1.30)	.804	15
r=.05	1.27 (1.31)	.51 (1.95)	.09 (.09)	.35 (2.7)	.829	18
r=.1	1.60 (2.15)	.57 (2.38)	- .16 (- .18)	.27E-1 (1.37)	.724	23
r=.15	1.58 (2.7)	.62 (3.0)	- .15 (- .19)	.27E-2 (.87)	.718	26
r=.2	1.61 (2.8)	.62 (2.9)	- .19 (- .24)	.27E-3 (.47)	.702	25
r=.25	1.75 (3.0)	.59 (2.7)	- .13 (- .16)	.42E-4 (.40)	.693	25
r=.3	2.43 (3.8)	.41 (1.86)	- .45 (- .59)	.96E-5 (.50)	.739	24
r=.35	2.57 (3.7)	.39 (1.72)	- .41 (- .52)	.23E-5 (.58)	.721	23

Table A.1 (continued)

S=.4	Y^*	$Y - Y^*$	Y_{WIND}	Wealth	$\bar{R}^2$	N
			Lenders			
r=0	.84 (4.8)	.71 (5.8)	.83 (2.9)	.55E-2 (1.28)	.634	63
r=.05	.84 (5.9)	.73 (6.8)	.54 (2.11)	.90E-1 (3.3)	.641	56
r= .1	.78 (5.5)	.75 (6.4)	.59 (2.17)	.80E-2 (1.74)	.590	56
r=.15	.79 (5.8)	.74 (6.2)	.62 (2.25)	.89E-3 (1.30)	.580	56
r=.2	.79 (5.8)	.71 (5.8)	.65 (2.33)	.12E-3 (1.12)	.564	55
r=.25	.80 (6.0)	.70 (5.7)	.66 (2.36)	.18E-4 (1.01)	.563	55
r=.3	.80 (6.1)	.69 (5.6)	.67 (2.39)	.30E-5 (.94)	.562	55
r=.35	.83 (6.4)	.67 (5.4)	.66 (2.36)	.36E-6 (.63)	.557	56
			Borrowers			
r=0	2.41 (1.64)	- .10 (- .15)	-1.10 (-1.03	.41E-1 (1.78)	.727	16
r=.05	1.52 (1.45)	.29 (.48)	.22 (.27)	.24 (2.61)	.740	23
r=.1	1.55 (1.56)	.30 (.46)	- .09 (- .10)	.29E-1 (1.42)	.679	23
r=.15	1.75 (2.05)	.16 (.26)	- .26 (- .29)	.27E-2 (.74)	.653	23
r=.2	1.83 (2.49)	.09 (.17)	- .31 (- .37)	.23E-3 (.40)	.656	24
r=.25	1.85 (2.7)	.07 (.13)	- .34 (- .38)	.20E-4 (.19)	.657	24

Table A.1 (continued)

S=.4	Y^*	$Y - Y^*$	Y_{WIND}	Wealth	$\bar{R}^2$	N
r=.3	1.84 (2.9)	.06 (.11)	- .33 (- .39)	.12E-5 (.06)	.658	24
r=.35	1.95	- .5 E-2	- .34	- .11E-5	.633	23

S=.6	Y^*	$Y - Y^*$	Y_{WIND}	Wealth	$\bar{R}^2$	N
			Lenders			
r=0	.84 (4.7)	.84 (4.5)	.87 (2.9)	.48E-2 (1.12)	.630	61
r=.05	.78 (5.6)	.75 (4.9)	.55 (2.18)	.89E-1 (3.2)	.636	57
r=.1	.74 (5.3)	.80 (4.8)	.59 (2.17)	.82E-2 (1.77)	.590	56
r=.15	.78 (5.9)	.85 (4.7)	.74 (2.64)	.87E-2 (1.29)	.583	54
r=.2	.80 (6.2)	.82 (4.5)	.75 (2.68)	.12E-3 (1.10)	.579	54
r=.25	.75 (5.7)	.73 (3.8)	.79 (2.84)	.19E-4 (1.06)	.510	53
r=.3	.74 (6.3)	.51 (2.90)	.83 (3.3)	.26E-5 (.96)	.514	53
r=.35	.74 (6.4)	.50 (2.79)	.83 (3.3)	.44E-6 (.87)	.514	53
			Borrowers			
r=0	.78 (1.03)	.67 (1.05)	- .48 (- .50)	.45E-1 (1.99)	.696	18
r=.05	.81 (1.16)	.64 (.84)	.33 (.40)	.25 (2.82)	.714	22

Table A.1 (continued)

S=.6	Y^*	$Y - Y^*$	Y_{WIND}	Wealth	$\bar{R}^2$	N
r=.1	.61 (.76)	1.00 (1.01)	.13 (.14)	.37E-1 (1.83)	.667	23
r=.15	.97 (1.39)	.61 (.64)	- .17 (- .20)	.38E-2 (1.08)	.646	25
r=.2	1.25 (1.78)	.23 (.22)	- .30 (- .33)	.34E-3 (.57)	.636	25
r=.25	1.43 (2.17)	- .10 (- .10)	- .48 (- .57)	.19E-4 (.18)	.629	26
r=.3	1.28 (1.74)	.47 (.04)	- .59 (- .70)	.80E-6 (.03)	.588	26
r=.35	1.43 (1.97)	- .19 (- .16)	- .62 (- .75)	- .91E-6 (- .17)	.593	26
S=.8	Y^*	$Y - Y^*$	Y_{WIND}	Wealth	$\bar{R}^2$	N
			Lenders			
r=0	.70 (4.4)	1.00 (3.8)	.89 (3.3)	.67E-2 (1.62)	.637	59
r=.05	.73 (5.7)	.98 (4.1)	.69 (2.64)	.81E-1 (3.0)	.639	55
r=.1	.74 (5.7)	1.08 (4.1)	.78 (2.85)	.78E-2 (1.74)	.610	54
r=.15	.77 (5.7)	1.00 (3.6)	.80 (2.89)	.85E-3 (1.29)	.558	52
r=.2	.74 (6.2)	.75 (2.8)	.84 (3.3)	.12E-3 (1.29)	.552	51
r=.25	.76 (6.4)	.68 (2.41)	.83 (3.3)	.14E-4 (.93)	.536	52
r=.3	.74 (6.1)	.60 (2.07)	.85 (3.3)	.24E-5 (.87)	.507	51
r=.35	.71 (6.1)	.56 (1.90)	.82 (3.2)	.43E-6 (.83)	.500	52

Table A.1 (continued)

S=.8	Y^*	$Y - Y^*$	Y_{WIND}	Wealth	$\bar{R}^2$	N
			Borrowers			
r=0	.67 (1.65)	.97 (1.66)	- .43 (.44)	.24 -1 (1.23)	.639	20
r=.05	.67 (2.32)	.86 (1.49)	.30 (.39)	.25 (2.9)	.729	24
r=.1	.54 (1.72)	1.39 (1.83)	.06 (.08)	.36E-1 (2.02)	.686	25
r=.15	.54 (1.62)	1.66 (1.78)	- .05 (- .07)	.45E-2 (1.44)	.663	22
r=.2	.49 (1.46)	1.94 (1.78)	- .21 (- .26)	.51E-3 (.91)	.640	28
r=.25	.37 (.92)	2.31 (1.72)	- .22 (- .27)	.11E-3 (.90)	.619	27
r=.3	.41 (.94)	2.31 (1.53)	- .26 (- .32)	.16E-4 (.68)	.617	28
r=.35	.46 (.95)	2.17 (1.24)	- .31 (- .38)	.24E-5 (.45)	.597	27
S=1.0	Y^*	$Y - Y^*$	Y_{WIND}	Wealth	$\bar{R}^2$	N
			Lenders			
r=0	.69 (5.6)	1.43 (4.3)	1.06 (4.0)	.66E-2 (1.66)	.669	57
r=.05	.68 (7.0)	1.35 (4.4)	.75 (3.0)	.78E-1 (2.9)	.657	56
r=.1	.66 (6.2)	1.26 (3.8)	.83 (3.4)	.85E-2 (2.13)	.590	51
r=.15	.69 (6.6)	1.25 (3.4)	.85 (3.5)	.10E-2 (1.72)	.575	51
r=.2	.70 (6.8)	1.23 (3.0)	.87 (3.5)	.14E-3 (1.51)	.567	51

Table A.1 (continued)

S=1.0	Y^*	$Y - Y^*$	Y_{WIND}	Wealth	$\bar{R}^2$	N
r=.25	.78 (7.8)	1.66 (3.8)	.91 (3.8)	.18E-4 (1.23)	.604	51
r=.3	.79 (7.8)	1.62 (3.5)	.92 (3.8)	.27E-5 (1.07)	.596	51
r=.35	.80 (7.9)	1.57 (3.3)	.91 (3.8)	.46E-6 (.94)	.591	51
			Borrowers			
r=0	.71 (3.4)	1.03 (2.13)	- .49 (- .53)	.24E-1 (1.32)	.665	22
r=.05	.67 (4.2)	.96 (1.78)	.21 (.26)	.24 (2.73)	.726	23
r=.1	.67 (4.8)	1.60 (2.63)	- .13 (- .01)	.34E-1 (2.03)	.697	28
r=.15	.70 (5.1)	2.00 (2.64)	- .11 (- .15)	.40E-2 (1.36)	.674	28
r=.2	.73 (5.5)	2.32 (2.55)	- .18 (- .23)	.47E-3 (.89)	.664	28
r=.25	.75 (5.4)	2.19 (2.15)	- .20 (- .25)	.74E-4 (.85)	.634	28
r=.3	.76 (5.6)	2.40 (2.07)	- .23 (- .29	.14E-4 (.63)	.631	28
r=.35	.78 (5.7)	2.59 (2.02)	- .25 (- .31)	.23E-5 (.47)	.629	28

Table A.1 (continued)

A.1.3--Self-Employed

S=0	Y^*	$Y - Y^*$	Y_{WIND}	Wealth	$\bar{R}^2$	N
			Lenders			
r=0	.77 (4.4)	.83 (12.9)	.34 (1.72)	.14 (7.6)	.819	60
r=.05	1.11 (6.3)	.85 (13.3)	.57 (2.9)	.78E-1 (7.8)	.828	57
r=.1	1.03 (6.3)	.93 (13.9)	.49 (2.7)	.11 (8.2)	.883	52
r=.15	.88 (3.7)	1.04 (10.8)	.34 (1.28)	.23E-1 (2.5)	.749	52
r=.2	.80 (3.0)	1.04 (9.8)	.31 (1.12)	.11E-1 (1.83)	.733	50
			Borrowers			
r=0	1.32 (11.7)	1.04 (21.4)	.19 (.91)	.77E-2 (3.6)	.644	371
r=.05	1.27 (11.5)	.99 (20.1)	.18 (.89)	.70E-1 (4.8)	.654	374
r=.1	1.30 (11.8)	1.01 (20.9)	.22 (1.10)	.97E-2 (4.0)	.642	379
r=.15	1.32 (12.0)	1.02 (21.2)	.22 (1.08)	.11E-2 (3.6)	.639	379
r = .2	1.33 (12.2)	1.03 (21.3)	.21 (1.06)	.19E-3 (3.3)	.638	381

Table A.1 (continued)

S=.2	Y^*	$Y - Y^*$	Y_{WIND}	Wealth	$\bar{R}^2$	N
			Lenders			
r=0	1.01 (5.8)	1.02 (9.0)	.33 (1.92)	.11 (7.6)	.711	64
r=.05	1.27 (9.0)	.77 (8.0)	.64 (4.6)	.76E-1 (11.2)	.826	58
r=.1	1.04 (6.3)	.97 (8.1)	.37 (2.3)	.11 (8.7)	.781	49
r=.15	.97 (3.8)	1.10 (5.7)	.25 (.92)	.19E-1 (2.5)	.474	48
r=.2	1.01 (3.8)	1.06 (5.2)	.32 (1.13)	.21E-2 (1.13)	.416	49
			Borrowers			
r=0	1.32 (11.7)	.96 (15.5)	.19 (.93)	.76E-2 (3.5)	.640	367
r=.05	1.28 (11.6)	.91 (14.5)	.18 (.90)	.17E-1 (4.8)	.652	373
r=.1	1.33 (12.2)	.94 (15.1)	.20 (.96)	.94E-2 (3.9)	.647	382
r=.15	1.34 (12.4)	.95 (15.1)	.19 (.95)	.13E-2 (3.5)	.645	383
r=.2	1.35 (12.5)	.96 (15.0)	.19 (.92)	.18E-3 (3.2)	.643	382
S=.4	Y^*	$Y - Y^*$	Y_{WIND}	Wealth	$\bar{R}^2$	N
			Lenders			
r=0	1.42 (7.3)	.88 (5.7)	.40 (1.81)	.78E-1 (4.6)	.445	106
r=.05	1.66 (9.1)	.61 (4.2)	.68 (3.5)	.82E-1 (8.1)	.622	92

Table A.1 (continued)

S=.4	Y^*	$Y - Y^*$	Y_{WIND}	Wealth	$\bar{R}^2$	N
r=.1	1.26 (6.6)	.89 (6.0)	.36 (1.80)	.85E-1 (6.5)	.550	89
r=.15	1.32 (5.7)	.98 (5.3)	.37 (1.46)	.93E-2 (1.91)	.369	85
r=.2	1.39 (5.9)	.91 (4.9)	.50 (2.01)	.88E-4 (.75)	.342	85
			Borrowers			
r=0	1.30 (10.9)	.91 (8.9)	.21 (.97)	.74E-2 (3.2)	.636	325
r=.05	1.28 (11.1)	.83 (8.3)	.20 (.96)	.69E-1 (4.5)	.650	339
r=.1	1.33 (11.4)	.84 (8.0)	.20 (.95)	.91E-2 (3.5)	.639	342
r=.15	1.35 (11.7)	.84 (7.9)	.20 (.95)	.11E-2 (3.2)	.637	346
r=.2	1.36 (11.7)	.84 (7.7)	.20 (.92)	.19E-3 (3.0)	.636	346

A.1.4--White-Collar

S=0	Y^*	$Y - Y^*$	Y_{WIND}	Wealth	$\bar{R}^2$	N
			Lenders			
r=0	.71 (2.9)	.81 (15.2)	.31 (1.50)	.15E-1 (3.8)	.751	108
r=.05	.83 (3.3)	.77 (11.4)	.33 (1.2)	.50E-1 (1.99)	.745	72
r=.1	.55 (2.2)	.71 (8.3)	.22 (.85)	.11 (4.2)	.786	50

Table A.1 (continued)

S=0	Y^*	$Y - Y^*$	Y_{WIND}	Wealth	$\bar{R}^2$	N
r=.15	.60 (2.2)	.73 (7.0)	.17 (.60)	.52E-1 (3.5)	.737	40
r=.2	.75 (2.2)	.80 (5.6)	.52 (1.60)	.57E-2 (.47)	.658	29
			Borrowers			
r=0	.91 (4.5)	.95 (13.7)	.27 (1.4)	.33E-2 (6.4)	.657	129
r=.05	.89 (6.1)	.94 (16.1)	.22 (1.3)	.41E-1 (7.1)	.687	165
r=.1	.91 (7.2)	.89 (17.9)	.27 (1.71)	.45E-2 (6.9)	.695	187
r=.15	.95 (8.1)	.90 (19.1)	.26 (1.65)	.48E-3 (6.6)	.702	197
r=.2	.96 (8.3)	.90 (19.4)	.20 (1.27)	.51E-4 (6.0)	.690	208
S=.2	Y^*	$Y - Y^*$	Y_{WIND}	Wealth	$\bar{R}^2$	N
			Lenders			
r=0	.80 (3.6)	.88 (13.7)	.15 (.76)	.20E-1 (5.3)	.752	106
r=.05	.89 (4.5)	.81 (9.7)	.23 (1.06)	.16 (5.4)	.760	70
r=.1	.66 (3.2)	.70 (7.0)	.50 (2.3)	.56E-1 (3.6)	.666	57
r=.15	.70 (3.1)	.76 (6.4)	.82 (2.6)	.14E-1 (2.7)	.570	48
r=.2	.73 (3.2)	.84 (5.7)	.70 (2.16)	.25E-2 (1.93)	.571	41

Table A.1 (continued)

S=.2	Y^*	$Y - Y^*$	Y_{WIND}	Wealth	$\bar{R}^2$	N
			Borrowers			
r=0	.81 (3.4)	.93 (11.4)	.34 (1.77)	.32E-2 (5.9)	.695	131
r=.05	.88 (5.2)	.85 (12.6)	.27 (1.56)	.38E-1 (6.3)	.700	167
r=.1	.90 (6.4)	.90 (13.4)	.22 (1.30)	.45E-2 (6.4)	.701	180
r=.15	.94 (7.4)	.90 (13.9)	.21 (1.33)	.48E-3 (6.3)	.703	189
r=.2	.98 (8.1)	.88 (13.6)	.22 (1.39)	.51E-4 (5.8)	.691	196
S=.4	Y^*	$Y - Y^*$	Y_{WIND}	Wealth	$\bar{R}^2$	N
			Lenders			
r=0	.86 (4.3)	.98 (11.5)	.21 (1.13)	.16E-1 (4.1)	.711	109
r=.05	.74 (4.2)	.67 (7.3)	.41 (2.3)	.15 (6.5)	.731	73
r=.1	.74 (4.0)	.89 (7.6)	.68 (2.6)	.31E-1 (4.2)	.636	62
r=.15	.81 (4.2)	.89 (6.9)	.64 (2.2)	.37E-2 (3.2)	.592	60
r=.2	.76 (4.3)	.72 (5.3)	.95 (3.4)	.48E-3 (2.9)	.560	55
			Borrowers			
r=0	.91 (4.0)	.87 (7.3)	.25 (1.27)	.32E-2 (5.6)	.692	128
r=.05	.90 (5.4)	.86 (7.7)	.23 (1.30)	.37E-1 (6.0)	.701	161

Table A.1 (continued)

S=.4	Y^*	$Y - Y^*$	Y_{WIND}	Wealth	$\bar{R}^2$	N
r=.1	.98 (7.2)	.83 (7.6)	.22 (1.34)	.45E-2 (6.2)	.699	175
r=.15	1.01 (7.7)	.82 (7.1)	.21 (1.3)	.48E-3 (6.0)	.695	177
r=.2	1.01 (8.0)	.83 (7.0)	.17 (1.10)	.50E-4 (5.6)	.682	182

A.1.5--Blue-Collar

S=0	Y^*	$Y - Y^*$	Y_{WIND}	Wealth	$\bar{R}^2$	N
			Lenders			
r=0	2.07 (3.2)	1.52 (8.4)	1.23 (5.2)	.48E-2 (4.4)	.652	53
r=.05	.96 (2.8)	.83 (8.8)	1.12 (9.1)	.77E-1 (12.4)	.856	64
r=.1	1.16 (2.3)	1.04 (9.1)	1.03 (6.7)	.65E-2 (5.8)	.670	84
r=.15	1.25 (2.7)	1.04 (9.7)	1.00 (6.8)	.65E-3 (5.9)	.657	97
r=.2	1.39 (3.0)	1.06 (10.5)	.97 (6.7)	.72E-4 (5.9)	.663	100
			Borrowers			
r=0	1.19 (16.8)	.86 (41.1)	.40 (5.6)	.50E-2 (19.1)	.679	1257
r=.05	1.13 (17.6)	.83 (41.2)	.41 (6.1)	.76E-1 (23. 5)	.712	1246
r=.1	1.16 (16.9)	.86 (40.4)	.39 (5.5)	.71E-2 (19.4)	.680	1220

Table A.1 (continued)

S=0	Y^*	$Y - Y^*$	Y_{WIND}	Wealth	$\bar{R}^2$	N
r=.15	1.17 (16.7)	.86 (40.0)	.39 (5.3)	.73E-3 (18.4)	.672	1213
r=.2	1.18 (16.6)	.87 (39.9)	.38 (5.1)	.83E-3 (18.1)	.670	1210
S=.2	Y^*	$Y - Y^*$	Y_{WIND}	Wealth	$\bar{R}^2$	N
			Lenders			
r=0	1.58 (2.6)	1.25 (6.9)	1.03 (4.9)	.50E-2 (4.7)	.495	90
r=.05	1.16 (2.8)	.84 (6.5)	1.03 (7.3)	.97E-1 (12.0)	.751	99
r=.1	2.00 (3.6)	1.32 (7.6)	1.04 (5.6)	.80E-2 (5.9)	.539	105
r=.15	2.03 (3.5)	1.29 (7.1)	1.01 (5.1)	.69E-3 (4.8)	.474	108
r=.2	2.00 (3.6)	1.28 (7.1)	1.01 (5.3)	.73E-4 (4.7)	.463	115
			Borrowers			
r=0	1.17 (15.8)	.79 (25.5)	.39 (5.6)	.49E-2 (18.8)	.674	1220
r=.05	1.14 (17.1)	.75 (25.9)	.42 (6.1)	.76E-1 (23.1)	.707	1211
r=.1	1.17 (16.9)	.78 (25.9)	.41 (5.6)	.71E-2 (19.2)	.676	1205
r=.15	1.18 (17.0)	.79 (25.8)	.40 (5.5)	.73E-3 (18.4)	.671	1202
r=.2	1.18 (16.8)	.79 (25.7)	.39 (5.3)	.83E-4 (18.1)	.668	1195

Table A.1 (continued)

S=.4	Y^*	$Y - Y^*$	Y_{WIND}	Wealth	$\bar{R}^2$	N
			Lenders			
r=0	1.27 (3.6)	1.03 (5.1)	1.04 (6.0)	.52E-2 (5.5)	.533	106
r=.05	1.41 (3.8)	1.00 (6.6)	1.05 (8.4)	.11 (12.7)	.738	105
r=.1	1.45 (3.1)	1.02 (5.2)	1.06 (6.5)	.81E-2 (6.5)	.494	116
r=.15	1.54 (3.2)	1.01 (4.9)	1.05 (6.2)	.71E-3 (5.4)	.448	116
r=.2	1.49 (3.1)	.99 (4.8)	1.03 (6.1)	.73E-4 (5.1)	.429	119
			Borrowers			
r=0	1.11 (15.0)	.71 (12.4)	.39 (5.3)	.49E-2 (18.6)	.670	1204
r=.05	1.12 (17.3)	.64 (12.2)	.41 (6.1)	.75E-1 (23.2)	.707	1205
r=.1	1.13 (16.8)	.68 (12.6)	.40 (5.5)	.71E-2 (19.1)	.673	1194
r=.15	1.15 (16.9)	.68 (12.4)	.39 (5.4)	.73E-3 (18. 3)	.667	1194
r=.2	1.15 (16.8)	.68 (12.3)	.39 (5.2)	.84E-4 (18.0)	.665	1191

Table A.2

Age-related Consumption Function

Professionals						
S=0	Y_N	$Y - Y_N$	Y_W	W	Constant	$\bar{R}^2$
			Age < 32 (N = 104)			
r=0	1.04 (6.8)	.66 (13.1)	.52 (4.9)	2.7 (11.7)	368 (.11)	.903
r=.05	.86 (15.0)	.68 (14.8)	.36 (3.6)	.13 (12.9)	-1524) (- .48)	.915
r=.1	.83 (20.2)	.71 (15.1)	.21 (2.04)	.9 E-2 (12.2)	-2946 (- .89)	.910
r=.15	.83 (20.8)	.74 (14.9)	.09 (.11)	.8 E-3 (11.0)	-4388 (-1.26)	.898
			Age 33-49 (N = 122)			
r=0	1.51 (5.6)	.63 (9.9)	.80 (2.2)	1.14 (3.7)	-7920 (- .94)	.753
r=.05	1.13 (7.5)	.66 (10.0)	.72 (1.89)	.08 (2.3)	-5721 (- .64)	.732
r=.1	1.02 (10.2)	.71 (10.7)	.75 (1.92)	.4 E-2 (.93)	-5702 (- .62)	.719
r=.15	.97 (12.6)	.72 (11.1)	.78 (1.98)	.59E-4 (.10)	-7125 (- .77)	.715
			Age 50+ (N = 35)			
r=0	1.70 (5.6)	.86 (7.5)	.58 (.88)	.26 (1.61)	-13144 (- .99)	.803
r=.05	1.31 (6.8)	.85 (6.9)	.68 (.97)	.12 (1.48)	-7189 (- .58)	.795
r=.1	1.15 (7.5)	.90 (7.0)	.51 (.71)	.03 (.85)	313 (.03)	.782

Table A.2 (continued)

S=0	Y_N	$Y - Y_N$	Y_W	W	Constant	$\bar{R}^2$
r=.15	1.10 (8.2)	.93 (7.3)	.38 (.52)	.4 E-2 (.37)	3566 (.32)	.775
			Young (<32) (N=406)			
r=0	1.08 (4.2)	.83 (23.2)	.55 (6.0)	2.12 (20.1)	2110 (1.10)	.762
r=.05	.95 (8.7)	.83 (23.6)	.53 (5.8)	.07 (20.5)	2352 (1.09)	.762
r=.1	.90 (13.6)	.83 (23.8)	.52 (5.6)	.3 E-2 (20.6)	2686 (1.34)	.763
r= .15	.88 (17.4)	.84 (24.0)	.50 (5.5)	.2 E-3 (20.6)	2882 (1.34)	.763
			Middle (33-49) (N=696)			
r=0	1.30 (9.2)	.76 (28.8)	.25 (2.26)	1.53 (14.8)	1880 (1.10)	.689
r=.05	1.08 (13.7)	.75 (28.1)	.22 (2.01)	.19 (14.5)	841 (.47)	.686
r=.1	.96 (17.8)	.78 (28.1)	.23 (2.00)	.02 (12.1)	1917 (1.04)	.660
r=.15	.92 (21.5)	.80 (28.2)	.25 (2.08)	.3 E-2 (9.9)	2631 (1.40)	.639
			Older (50+) (N=208)			
r=0	1.36 (6.1)	.84 (19.3)	.76 (5.2)	.20 (9.9)	- 891 (- .28)	.810
r=.05	1.22 (8.0)	.77 (18.8)	.77 (5.9)	.16 (13.1)	-2386 (- .86)	.847
r=.1	.94 (9.4)	.77 (18.1)	.75 (5.6)	.07 (12.0)	1616 (.62)	.835
r=.15	.83 (9.7)	.82 (18.0)	.72 (4.9)	.02 (9.4)	5212 (1.97)	.802

APPENDIX B

ESTIMATED WEIGHTS FOR COMPONENTS OF NORMAL INCOME

Table B.1

Estimated Weights for Components of Normal Income

Independent Variable	Dependent Variable					
	Labor Income		Labor Income and Capital Income		Labor Income and Capital Income and Imputed Rent	
Occupation:	Estimated Coefficient	T-Ratio (Std. Error)	Estimated Coefficient	T-Ratio (Std. Error)	Estimated Coefficient	T-Ratio (Std. Error)
Prof/Low	Residual variable					
Prof/High	.610**	16.00 (.038)	.609**	15.3 (.040)	.621**	16.2 (.038)
Mngr/Low	.076	.468 (.162)	.063	.367 (.171)	.013	.073 (.079)
Mngr/High	.413	6.11 (.068)	.410**	5.77 (.071)	.407**	4.72 (.071)
White/Low	- .212	- .174 (1.22)	- .205	- 1.62 (.127)	- .197	- .157 (.125)
White/Med.	.128	1.88 (.068)	.148	2.14 (.069)	.146	2.09 (.069)
White/High	.361	4.16 (.087)	.361**	3.98 (.091)	.367**	4.07 (.090)
Blue/Low	-1.59**	-7.72 (.205)	-1.43 **	- 7.11 (.202)	-1.47 **	- 7.12 (.205)

Table B.1 (continued)

Independent Variable	Dependent Variable					
	Labor Income		Labor Income and Capital Income		Labor Income and Capital Income and Imputed Rent	
Occupation:	Estimated Coefficient	T-Ratio (Std. Error)	Estimated Coefficient	T-Ratio (Std. Error)	Estimated Coefficient	T-Ratio (Std. Error)
Blue/Med.	- .771**	- 9.38 (.082)	- .763**	- 8.93 (.085)	- .744**	- 8.70 (.086)
Blue/High	.139	.977 (.142)	.115	.752 (.152)	.122	.802 (.152)
Self/Low	-1.40 **	- 5.11 (.275)	-1.44**	- 4.96 (.291)	-1.46 **	- 4.87 (.300)
Self/Med.	- .470**	- 4.96 (.095)	- .461	- 4.69 (.098)	- .455**	- 4.58 (.099)
Self/High	.176*	2.62 (.067)	.206**	3.04 (.068)	.216**	3.19 (.068)
Farm owners/Low	-1.53 **	- 5.55 (.276)	-1.62**	- 5.39 (.300)	-1.70 **	- 5.46 (.312)
Farm owners/High	- .029	- .336 (.087)	- .023	- .257 (.090)	- .011	- .123 (.089)
Farm workers/Low	-1.44 **	- 4.67 (.308)	-1.56 **	- 4.68 (.333)	-1.68**	- 4.91 (.343)

Table B.1 (continued)

Independent Variable	Dependent Variable					
	Labor Income		Labor Income and Capital Income		Labor Income and Capital Income and Imputed Rent	
Occupation:	Estimated Coefficient	T-Ratio (Std. Error)	Estimated Coefficient	T-Ratio (Std. Error)	Estimated Coefficient	T-Ratio (Std. Error)
Farm workers/High	- 1.23 **	- 5.81 (.211)	-1.29 **	- 5.70 (.227)	-1.36 **	- 5.75 (.236)
Other/Low	- 4.06 **	- 5.23 (.776)	-2.41 **	- 4.51 (.535)	-2.08 **	- 4.44 (.469)
Other/Med.	- 1.49 **	- 6.55 (.228)	-1.09	- 5.52 (.197)	- .932**	- 5.11 (.182)
Other/High	- .005	- .039 (.123)	.114	1.01 (.113)	.143	1.30 (.109)
Tenancy:						
Own	Residual variable					
Buying	.017	.281 (.062)	- .012	- .182 (.065)	- .010	- .168 (.062)
Rent	.041	.986 (.041	.002	.004 (.043)	- .135	- 2.95 (.046)
Own	- .280	2.21 (.126)	- .355*	- 2.69 (.132)	- .414*	- 3.20 (.130)

Table B.1 (continued)

Independent Variable	Dependent Variable					
	Labor Income		Labor Income and Capital Income		Labor Income and Capital Income and Imputed Rent	
	Estimated Coefficient	T-Ratio (Std. Error)	Estimated Coefficient	T-Ratio (Std. Error)	Estimated Coefficient	T-Ratio (Std. Error)
Family Size:						
1-3	Residual variable					
4-6	.260**	4.73 (.055)	.254**	4.54 (.056)	.247**	4.42 (.056)
7 or more	.470**	10.7 (.044	.448**	9.76 (.046)	.432**	9.40 (.046)
Region:						
Atlantic	Residual variable					
Eastern	- .189	- 2.26 (.084)	- .129	- 1.54 (.184)	- .089	- 1.07 (.084)
Bogotá	.099	1.88 (.052)	.133	2.09 (.054)	.188**	3.63 (.052)
Central	- .011	- .203 (.056)	.025	.445 (.069)	.061	1.06 (.057)

Table B.1 (continued)

Independent Variable	Dependent Variable					
	Labor Income		Labor Income and Capital Income		Labor Income and Capital Income and Inputed Rent	
	Estimated Coefficient	T-Ratio (Std. Error)	Estimated Coefficient	T-Ratio (Std. Error)	Estimated Coefficient	T-Ratio (Std. Error)
Pacific	- .006	- .089 (.067)	.010	.141 (.056)	.027	.395 (.070)
	F = 36.36		F = 32.7		F = 34.5	
	$\bar{R}^2$ = .256		$\bar{R}^2$ = .243		$\bar{R}^2$ = .253	

* Significant at .01 (t = 2.33)

** Significant at .005 (t - 3.29)