Consumption and Saving Across the Life Cycle

by

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Abstract

This thesis consists of three essays. In the first, I test implications of a certainty equivalence life cycle model for the marginal propensity to consume across ages. I find that the data is generally supportive of the prediction that, given the time series properties of individual income, marginal propensity to consume should decline with age. In the second, I look for evidence that some households do not act in accordance with the life cycle model due to liquidity constraints. The results show that wealthier households alter consumption less in response to income shocks than do poorer ones, supporting the hypothesis that some poorer households may be liquidity constrained. Lastly, I present evidence in favor of a bequest motive, showing that elderly households in states with high inheritance taxes give more inter vivos gifts.

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Lastly, it is no exaggeration to say that without my wife, Leslie, this thesis would never have been completed. Her love and emotional support kept me sane and focused through my last two years. I dedicate this thesis to her.

Contents

Chapter 1

Marginal Propensity to Consume Across the Life Cycle

1.1 Introduction

Though consumption and saving are among the most fundamental economic acts, the decision process that underlies them is not completely understood. There are sharp disagreements over what model best describes consumption behavior. Some researchers find support for the idea that consumers (or at least the vast majority of them) rationally smooth consumption over their entire lifetimes subject only to a budget constraint, given expectations of lifetime income (see for example Hall and Mishkin, 1982; Altonji and Siow, 1990). Others, however, report results that call the simple models of intertemporal maximization into serious question, suggesting that many consumers are liquidity constrained (Zeldes, 1989; Shea, 1993; Carroll and Summers, 1991;) or that planning horizons may be much shorter than a lifetime (Carroll 1993).

This paper contributes to an understanding of consumer decision-making by examining a hitherto neglected question: How does consumption behavior change over the life cycle? A great deal of theoretical and empirical work on consumption has assumed infinite lifetimes. This effectively restricts the decision rules that govern behavior to be constant over time. When models are enhanced by the inclusion of finite lives and retirement, however they predict that certain aspects of consumption behavior should vary systematically over the life cycle. In this paper I will test these predictions, using a simple certainty equivalence life cycle model as a baseline.

As early as 1954 Modigliani and Brumberg pointed out that their life-cycle theory of savings implied finite-lived consumers would respond differently to unexpected changes in income depending on their age. The changing response is due to the fact that a given shock to income can sustain different permanent (in the sense of lasting until death) changes in the level of consumption, depending on an individual's position in the life cycle. This effect can be separated into two parts.

First, the annuity value of a given change in lifetime wealth will rise with increasing age because there are a different number of years of remaining life over which to spread out the increment to wealth. According to the life-cycle theory (without a bequest motive) someone near death, for example, would likely spend a great deal of a one-time lottery prize, while a younger person would save most of it. I will refer to this as the "annuity effect". This effect unambiguously implies that the annuity value of a purely temporary shock to income, and thus the marginal propensity to consume out of that shock, should rise with age.

Second, the change in total lifetime wealth implied by a persistent shock to earnings will fall with age because there are a different number of working years over which the shock may be received. A permanent (in the sense of lasting until retirement) raise means far less total income to someone who is about to retire than for someone with their entire career remaining. I refer to this as the "wealth effect". A permanent shock to income is subject to both the wealth and annuity effects, but given a non-zero retirement period the wealth effect is more important. This implies that the marginal propensity to consume out of a permanent shock to income should fall with age. Moreover, given empirical estimates of the average ratio of permanent to temporary components in income shocks, the consumption response to overall income shocks should fall with age. I will refer to these implications as predictions of the life cycle hypothesis, or LCH.

Note that the wealth effect can have an impact on consumption only if consumers are very forward-looking. They must form some kind of estimate of earnings all the way up to retirement and must explicitly plan for retirement in determining consumption. Evidence in favor of the wealth effect, which I find in this study, thus has important implications for consumer behavior in general.

In this work I use data from the Panel Study of Income Dynamics to examine the direct relationship of changes in consumption to changes in income at different ages. I find a pattern consistent with the predictions of the LCH as described above. The response to overall income shocks declines significantly as individuals age, clearly (and perhaps not surprisingly) rejecting the predictions of an infinite horizon model. This result is robust to a variety of restrictions and functional forms. Furthermore, the age profile of the declining mpc is close to that predicted by the LCH. Examination of alternative explanations indicates that they cannot account for the observed pattern. Finally, an attempt to separate more and less permanent shocks to income suggests that mpc declines faster with age in the case of more permanent shocks, as predicted.

Although the theoretical effects of age on consumption under the LCH have long been known,[1] there has been relatively little empirical investigation of these implications, especially since longitudinal data sets became available. Landsberger (1970) examined the effect of windfall income such as inheritances and lottery winnings on consumption, and finds that in a majority of cases the effect increases with increasing age, as the LCH predicts for temporary income. Rasche (1972) finds no consistent pattern across ages in the effect of assets on consumption. Both these studies, however, examine effects on the level of, rather than the marginal change in, consumption. Hall and Mishkin (1982) mention testing for a differential response to temporary income across ages and report finding no effect, although they do not present results.[2]

Each of these three studies looked only for evidence of the annuity effect, or the rising response to temporary shocks with age. I will show below that the decline in response to permanent shocks with age predicted by the theory is actually far

[1]Deaton (1992) provides a valuable summary of the simple LCH and its implications for consumption behavior across ages.

[2]In their study the marginal consumption out of permanent shocks was restricted to be one at all ages, as predicted in the LCH with no retirement.

greater. This may partially explain why previous studies have found relatively little evidence of life-cycle effects. No empirical work I am aware of examines the response to permanent income shocks across the life cycle.

While the predictions of the LCH provide the framework for this paper, the results are also important for the interpretation of aggregate data. Recent theoretical work has suggested that the differing marginal propensities to consume predicted by the LCH can contribute to an explanation of excess smoothness, the apparently insufficient response in consumption to aggregate income changes correlated over time (Clarida, 1990; Gali, 1990).[3]

The theoretical prediction of heterogeneous behavior across ages, however, has not been investigated with micro data. One view of this paper is that it is a test of the empirical relevance of the theoretical presentations of Clarida (1990) and Gali (1990). In the context of these particular macroeconomic implications, the source of heterogeneity is less important than its existence and level. Thus in addition their possible behavioral implications, the facts about propensities to consume are interesting in their own right.

I now turn to a discussion of the data used in this study; proceed with a brief exposition of a simple version of the life-cycle theory; examine whether the data match the predicted pattern; explore alternative explanations of the results; and conclude with a brief summary.

1.2 Data

This paper uses income and food consumption data from the 1968-1987 Panel Study of Income Dynamics (PSID). I use waves only from 1976 on because several important variables are unavailable in prior surveys. The greatest drawback to the PSID for studies on consumption is that data is available only on food consumption. To directly extrapolate from this information to conclusions about consumption in general

[3]Clarida (1990) in particular presents the same model of behavior as in this paper, but concentrates on its implications when aggregated across a population with different ages.

requires that the utilities from food and other consumption be both additively separable and homothetic, very strong assumptions. More narrowly, to interpret evidence on how marginal propensity to consume varies with age as indicative of a similar pattern for total consumption, the proportion of a marginal dollar of total consumption which is devoted to food must be close to constant across ages (independent of factors such as family size). Data from the Consumer Expenditure Survey presented below suggests that this is true. Even if these assumptions do not hold exactly, however, the results on food consumption may be somewhat informative in and of themselves.

Following Zeldes (1989), I divide the reported dollar values for food purchased with cash or food stamps in a store and restaurant food purchases by the March CPI-W (see discussion of timing below) for food consumed at home and restaurant food, respectively, and sum them to get total food expenditures in constant dollars. To rule out values of consumption change which appear unreasonable I discard observations in which consumption more than quadruples or falls by more than three quarters.[4] In addition, I discard all observations for which consumption or income was imputed, and observations for which the head of household has changed from the previous year.

Any study using income and consumption data from the PSID faces awkward issues of timing. The consumption question asked in the survey is somewhat ambiguous. It simply asks (for example) "How much do you spend on food that you use at home in an average week?" without specifying a time period. (Surveys are typically conducted during early spring). It seems likely that respondents weight recent weeks heavily in answering this question. Questions concerning income, on the other hand, clearly refer to the previous calendar year. Should consumption in a given survey be matched with the previous year's income (elicited in the same survey), or the income from the same calendar year (taken from the following year's survey)? There are strong a priori reasons for thinking that the consumption reported should be matched with the previous year's income. Unanticipated events of the type that might lead to revision of income expectations, such as job changes, illness, etc. which

[4]Substitution of alternative thresholds for eliminating extreme values did not substantially affect the results.

occur later in the year will not affect consumption this spring, but very well may affect consumption next spring. Furthermore, in the data consumption change from spring of year t to spring of year t+1 is most highly correlated with the income change from year t-1 to year t. For both empirical and theoretical reasons I therefore match consumption data to income (and other yearly variables) from the previous year.

I take total reported family income (including transfers), subtract income taxes (as estimated by the survey), an estimate of social security taxes (from labor income and self-employment data), and a measure of capital income and divide by the overall yearly CPI to yield real after-tax non-capital disposable income. I use disposable income in the analysis because consumption should depend on income actually received. If the effect on income of a spell of unemployment is partially offset by unemployment insurance, for example, the change in consumption should also be attenuated. Capital income is subtracted because the theory described below pertains to changes in earned income. All observations for which any component of income was imputed were discarded.

The consumption numbers I use are in levels rather than logs. Levels are used to facilitate comparison with the predictions of the theory, which are also in levels (assuming utility is quadratic in consumption). All tests of significance reported use White standard errors to correct for the heteroskedasticity which may be present due to the use of levels.

In order to eliminate expected consumption and income changes I regress changes in both real consumption and income on a cubic in age, educational attainment of the family head and change in number of adults, number of children over five and number of children under five and use the residuals as the income and consumption variables in the remainder of the paper. I use fixed effects estimation to control for different average growth rates of consumption across families. This allows for the possibility of heterogeneous discount rates. The regressions take the form

$$\Delta A_{it} = \beta X_{it} + \mu_i + \epsilon_{it}$$

where ΔA_{it} is change in real income or consumption, X_{it} is a matrix of the demographic variables, μ_{it} is a household specific effect, and ϵ_{it} is a distrubance term.

The residual income changes that result from this method are of course not necessarily complete surprises to the recipient. The procedure followed essentially denotes any sharp changes in income not associated with a change in family structure as "surprise" changes. This, however, is the best the data allows. Moreover, some contamination of the income variable with anticipated changes will not lead to a spurious correlation between age and mpc unless there is reason to believe that response to anticipated changes in income should change with age. Under the LCH, this response should be identically zero.

The results of the regressions used to generate the income and consumption residuals appear in Table 1. Note that long term trends in consumption and income change are not identical. There is a significant (at the 5% confidence level) correlation between age and both change in income and change in consumption. The coefficients, however, are consistently opposite in sign.[5] This evidence conflicts somewhat with that presented by Carroll and Summers (1990), who find that consumption closely tracks income across occupational groups and countries.

The R^2 of .052 from the regression generating the residuals suggests that, as argued above, not all of the residual income changes are surprises. It seems unlikely that only 5% of all income variation is expected as the R^2 implies.

A final issue is that the PSID is a household-based survey, while the predictions of the simple life-cycle model I will present apply to individuals. I have attempted to control for the effects of family size on income and consumption by including measures of family structure in the above regressions. It is also necessary to assign a single age to the household in order to make cross-age comparisons. I simply use the age of the head of household. While this measure is not perfect, it should roughly capture the effects of age on mpc, especially in the case in which the head is the primary wage

[5]To interpret the coefficients properly recall that the consumption measure includes only food consumption; if total consumption change matched income change one for one, the coefficients in the consumption regression would be equal to those in the income regression divided by the ratio of total consumption to food consumption, a factor estimated by Hall and Mishkin (1982) to be .107

earner. Using an average of both ages for dual-headed households had little impact on the results.

1.3 Theory

I will now present a simple version of the life-cycle theory that formally illustrates the effects of changing age on propensity to consume. Assume an individual has time-invariant utility quadratic in consumption. She anticipates (with certainty) retirement at age R and death at age T. The discount rate and interest rate are equal to r. The consumer's problem in year t is then

$$\max_{c} E\left(\sum_{i=t}^{T}(1/1+r)^{i}(\alpha c_i + \beta c_i^2)\right)$$

$$s.t. \sum_{i=t}^{R}\frac{y_i}{(1+r)^i} = \sum_{i=t}^{T}\frac{c_i}{(1+r)^i}$$

where c_t and y_t are consumption and labor income in year t.

The solution is to equalize expected marginal utility subject to the budget constraint. With quadratic utility, this leads to the familiar result that the consumer desires a constant level of expected consumption each period.

Assume in addition that there are unpredictable shocks to income which are of two types: permanent shocks μ which raise expected income in each successive period, and temporary shocks ϵ which last only for one period. Thus income in year t is

$$y_t = y_0 + \epsilon_t + \sum_{i=0}^{t}\mu_i \qquad (1.1)$$

This is admittedly a strong assumption on the income process. Hall and Mishkin (1982) found that changes in income are best described by the sum of a permanent shock and a temporary shock that dies out over two periods.[6] Only a small fraction

[6]MaCurdy (1982) and Abowd and Card (1987) find individual income to be well approximated by an MA(2) process, which is the univariate analog to the form used by Hall and Mishkin (1982); in both cases the portion of an income shock that persists beyond two periods is permanent. In the univariate process there is only one type of shock, however, which does not seem reasonable for

of the temporary shock persists for more than one period, however. For simplicity I therefore restrict the process to be the sum of a random walk and white noise. Adding one-period persistence of the temporary component does not significantly change the predictions generated.

It is, of course, impossible to distinguish a permanent shock from one with an arbitrarily slow reversion to trend with data over a finite period. In the context of a consumer with a finite working life, however, this distinction is not crucial. A "permanent" shock in this case is simply one that persists (barring offsetting shocks) until retirement, while the remainder of an income shock is "temporary". If the income process includes shocks that die out slowly over time, the proportion of income shocks which are permanent by this definition will rise over time as retirement approaches. This effect can be mimicked, however, by simply allowing the parameters in the simpler income process to change with age. (I investigate the possibility that the income process changes with age below, but find little effect.)

A permanent shock to income μ_t received at age t will alter expected lifetime income by

$$\sum_{i=t}^{R} \frac{\mu}{(1+r)^i} = \left(\frac{1+r}{r}\right)\left(1 - \frac{1}{1+r}^{R-t+1}\right)\mu_t \tag{1.2}$$

which declines monotonically in t. A temporary shock ϵ changes lifetime income by ϵ at any age.

Given quadratic utility and equal discount and interest rates the consumer will desire to revise consumption by the same amount ΔC in each remaining year of life. The present discounted value (in year t) of all these consumption changes is

$$\sum_{i=0}^{T-t} \frac{\Delta C}{(1+r)^i} = \left(\frac{1+r}{r}\right)\left(1 - \frac{1}{1+r}^{T-t+1}\right) \tag{1.3}$$

Setting equations 2 and 3 equal (income equals consumption from the budget constraint and non-satiation) and solving for ΔC yields

individual income. I present evidence below that supports the idea that individuals are subject to different types of shocks with different time series properties.

$$\Delta C_t = \left(\frac{1 - \frac{1}{1+r}^{R-t+1}}{1 - \frac{1}{1+r}^{T-t+1}} \right) \mu_t \tag{1.4}$$

which falls with age for $R < T$ and

$$\Delta C_t = \left(\frac{r}{1+r} \right) \left(\frac{1}{1 - \frac{1}{1+r}^{T-t+1}} \right) \epsilon_t \tag{1.5}$$

which clearly rises with t.[7]

Table 2 provides examples of the ratio of change in income to change in consumption in the case of a temporary shock to income (the number multiplying ϵ_t in equation 5) at different ages and discount rates. (As will be seen below, it is the discount rate that determines the mpc out of temporary income, although its effect is only implicit in equation 0.4 where $r = \rho$). In making these calculations I assume retire ent at age 62 and a lifetime of 75 years, approximately the average values for US men. Reading across a row one can see that at a given age the propensity to consume is higher the greater the discount and interest rates (i.e. the more impatient the consumer). Reading down columns, the mpc rises with age in all cases.

Table 3 shows the mpc out of permanent income surprises (the coefficient multiplying μ_t in equation 4) at different interest rates under the same assumptions. The mpc out of shocks to permanent income is much higher than that out of temporary income for the young, but it declines over time for an individual, becoming equal to that out of temporary at age 62 (when permanent and temporary changes both last only a year). In this case the variation across ages is greater for more impatient consumers.

Because this model assumes a finite lifetime it is possible to examine the more general case in which the rates of interest and discount differ. In this case present

[7] The derivative of eq. 4 with respect to age is

$$\left(\frac{1}{1+r}^{T-t+1} - \frac{1}{1+r}^{R-t+1} \right) \log(\frac{1}{1+r})$$

which is negative for $R < T$ and $r > 0$.

value of income shocks remains as in equation 2. Instead of desiring a constant stream of consumption, however, the consumer now maximizes utility when consumption grows at a steady rate $\frac{1+r}{1+\rho}$. Thus if consumption changes by ΔC_t in year t, the total discounted value of the change in consumption will be

$$\sum_{i=0}^{T-t} \left(\frac{1+r}{1+\rho}\right)^i \frac{\Delta C_t}{(1+r)^i} = \left(1 - \frac{1}{1+\rho}^{T-t+1}\right)\left(\frac{1+\rho}{\rho}\right)$$

Canceling the $(1+r)^i$, and setting the value of consumption change equal to the value of the income shock yields

$$\Delta C_t = \left(\frac{1 - \frac{1}{1+r}^{R-t+1}}{1 - \frac{1}{1+\rho}^{T-t+1}}\right)\left(\frac{(1+r)\rho}{(1+\rho)r}\right)\mu_t \tag{1.6}$$

and

$$\Delta C_t = \left(\frac{1}{1 - \frac{1}{1+\rho}^{T-t+1}}\right)\left(\frac{\rho}{1+\rho}\right)\epsilon_t \tag{1.7}$$

Table 4 presents the values of mpc out of permanent income from equation 6 at different discount rates, assuming an interest rate of 3 percent. The most impatient consumers will desire to increase consumption by more than the amount of a permanent shock. Although it is not shown in the table, very patient consumers facing very high interest rates may have an mpc out of permanent shocks which increases with age (due to a steeply rising desired path of consumption). For an individual with a 1 percent rate of discount, this would occur only at interest rates in excess of 50 percent. Such consumers would desire to more than double their consumption every two years. Thus the theoretical prediction remains that mpc out of permanent income changes should decline with age, at least for reasonable parameter values. Equation 7 is identical to 5 for the same values of the discount rate.

While I have assumed a consumer receives zero income after retirement (other than interest on assets), the results for responses to income changes will be identical regardless of the level of post-retirement income as long as that income is not affected by shocks to earned income during the working life. In actuality, because social security benefits are based in part on earnings, even a transitory shock will have effects that persist after retirement. In the case of social security, however, this effect is very small due to the fact that benefits are based on average earnings over the entire working life (less five years). Furthermore, as the consumer nears the retirement period, the present value of the stream of benefits increases, strengthening the increase in mpc out of temporary shocks with age.

The social security system has two offsetting effects on the response to permanent shocks with age. First, the approach of retirement increases the present value of any increase in benefits resulting from an income shock. Second, a shock that comes later will be received fewer times and thus have less impact on average earnings, which determine benefits. At an interest rate of three percent the second effect dominates (given statutory rules on social security) during most years of life, and thus strengthens the decrease in consumption response to permanent shocks with age. Regardless of its direction, the effect of social security is very small compared with the basic life-cycle effects I am looking for.

Figure 1 shows a diagram of the response to permanent and temporary shock at different ages when the interest and discount rates are 3 percent. Note that the fall in mpc out of permanent shocks with increasing age is far greater than the rise in mpc out of temporary shocks. The change in mpc out of temporary income is so slight that it is perhaps unsurprising that previous studies have failed to find it, especially given the quality of consumption data used.

1.4 Results

I begin by showing the basic pattern of marginal propensity to consume (mpc) versus age that I find. Figure 2 contains a scatter plot of the marginal propensity to consume at different ages (measured by the coefficient on change in income in a regression of change in consumption on change in income at a particular age), together with a best fit line which is cubic in age. The coefficients used to form this line appear in Table

5, column 3.[8]

The scatter plot provides a non-parametric check on the relationship between age and mpc. While there is a great deal of noise in the data, the is a clear trend downward with age. The parametric estimates confirm this impression. In Table 5, column 1, the coefficient on the age-income interaction term in extremely significant, with a t-statistic of over 6. This general result is robust to alternative restrictions and functional forms. Older individuals change their consumption less when their income changes than do younger ones. There are, of course, many possible causes of this simple pattern. In the remainder of this paper I will investigate whether the downward trend in mpc can be ascribed to the life cycle effects described above.

Is it possible to reconcile the results shown in Figure 2 with the predictions in Figure 1? The answer depends on several key parameters. One of these is the mix of permanent and temporary shocks that comprise the overall income changes used to estimate propensity to consume in Figure 2.

For simplicity I will again assume that the income process is the sum of a random walk and white noise as in equation 1, meaning income change $\Delta Y_t = \mu_t + \epsilon_t - \epsilon_{t-1}$. This implies that $\sigma^2_{\Delta Y} = \sigma^2_\mu + 2\sigma^2_\epsilon$, where σ^2 denotes the variance of the subscripted variable, and $cov(\Delta Y_t, \Delta Y_{t-1}) = -\sigma^2_\epsilon$.

The variance of income changes in my sample is $8.8x10^6$, while the covariance of income change with its first lag is $-2.7x10^6$. These values, when substituted into the equations above, imply $\sigma^2_\epsilon = 2.7x10^6$ and $\sigma^2_\mu = 3.4x10^6$. [9] Let $mpc_\mu(age)$ and

[8]Each dot in Figure 2 is the β from a regression of the form $\Delta C_i = \beta \Delta Y_i + \epsilon_i$ run on the subset of households in the sample whose heads are of a particular age. The regressions in Table 5 are based on a formulation $\Delta C_{it} = (\alpha + \beta X_{it})\Delta Y_{it} + \mu_i + \epsilon_{it}$ where $\alpha + \beta X_{it}$ = marginal propensity to consume by household i in year t, X_{it} is powers of the age of head of household, γ_i is an household-specific fixed effect, and ϵ_{it} is a random disturbance. The values for consumption and income are residuals the construction of which is described in the Data section. (While ΔC_{it} and ΔY_{it} have already been purged of individual effects, the interaction terms have not, so the μ_i term is not simply zero). Note that because only "unanticipated" consumption and income are used in the regressions, the standard errors do not have to be adjusted for the use of generated regressors (Pagan, 1984).

[9]The covariances calculated match well with those estimated by MaCurdy (1982) and Abowd and Card (1989). I also find, as do these researchers, that the second lag of income change is significantly related to current income change, which strictly speaking rejects the hypothesis that the transitory component of income lasts only one period. The covariance with the second lag is very small, however, and the theoretical effect on consumption of the small part of the transitory shock that persists for more than a period is negligible, so I ignore it.

$mpc_\epsilon(age)$ denote theoretical predictions of the mpc out of permanent income and temporary income, respectively. Then $\Delta C_t = mpc_\mu \mu_t + mpc_\epsilon \epsilon_t$ and the predicted value for mpc out of total income will be

$$\frac{cov(\Delta Y, \Delta C)}{var(\Delta Y)} = \frac{mpc_\mu \sigma_\mu^2 + mpc_\epsilon \sigma_\epsilon^2}{\sigma_{\Delta Y}^2}$$

Substituting in the values calculated for the variances yields the predicted total marginal propensity to consume, given the observed income process. To compare the empirical results with theoretical predictions, however, I also require an estimate of the ratio of marginal food consumption to marginal total consumption. Hall and Mishkin (1982) find this ratio to be .107, an estimate supported by evidence from the Consumer Expenditure Survey reported below. I divide the empirical estimates of propensity to consume food by this number to yield an estimate for total consumption.

Figure 3 shows the mpc predicted by the life cycle model adjusting for the composition of income changes and the ratio of food to total mpc as described above, along with the mpc estimated from the data (the smooth line from Figure 2). While the slope of the estimated mpc appears close to correct, the level is clearly too low at all ages. There are several possible explanations for the discrepancy. The income changes that I treat as surprises are probably contaminated with expected changes, which should bias the estimate of the mpc toward zero. It is, however, very difficult to better estimate the surprise component of income shocks. There is also almost certainly a great deal of measurement error in the income change variable. I will attempt to deal with this problem with an instrumenting strategy below.

An obvious objection to interpreting the falling mpc observed in the data as evidence of the life-cycle effects is that it may be due simply to changing patterns of food consumption with age. Due to changes in tastes, for example, older individuals may simply not eat as much. To examine this conjecture I take the level of real food consumption and regress it on a cubic in age and family composition variables (to control for the effects of family size). Table 6 shows the results of this regression, while Figure 4 plots the fitted values for a one-person household versus age. Food consumption follows a hump-shaped pattern with age with its peak at about age 45. Whether its source is in changing preferences or imperfect controls for family size, this non-monotonic variation of food consumption with age certainly cannot by itself explain the steady decline in mpc with age, most of which occurs during the years the level of food consumption is increasing.

Of course Figure 4 describes the level of food consumption, whereas the results on mpc are determined by marginal food consumption. The decline in mpc could possibly be due to an independent decline in the portion of a marginal dollar of consumption which is spent on food. Data from the Consumer Expenditure Survey, however, shows that idiosyncrasies particular to food consumption at the margin cannot explain the negative age-mpc relation either. Table 7 shows the ratio of changes in total consumption to changes in food consumption across age groups.[10] The pattern is once again hump-shaped, and does not show a steady decline across ages. The estimates shown in Table 7 also confirm that the value of approximately .11 used earlier for the ratio of food to total consumption is of the right general magnitude.

Alternatively, the portion of a marginal dollar of income spent on food might decline with income due to the Engel curve relation. Under the null hypothesis of the LCH, this relationship should only hold for differences in lifetime income across individuals. Under alternative models, however, variation in current income for a single individual could lead to changes in the marginal propensity to consume food. Because income tends to rise with age, this could lead to a spurious negative correlation between age and mpc.

Table 8 investigates the income-mpc relationship. From column 2 it is clear that mpc does indeed decline with income. There is remains, however, a strong independent effect of age.

A second possibility is that due to liquidity constraints, those with greater wealth can better insulate themselves from income shocks, and that their shifts in consumption will therefore be smaller. Column 3 of Table 8 shows once again that although

[10]I am grateful to Annamaria Lusardi for providing me with the calculations shown in Table 7.

there appears to be a negative correlation between wealth and mpc, this cannot account for all of the observed effect of age. Furthermore, the coefficient on wealth is difficult to interpret, because any individuals who for any reason (e.g. a low discount rate) consume less will also amass more wealth.

As described above, the LCH implies that propensity to consume should depend not only on age, but also on the mix of temporary and permanent shocks that affect an individual. Where shocks on average are more permanent, the recipients should change consumption by a greater amount in response, but the level of response should also decline more quickly with age. I use two strategies in order to test this prediction. First, I attempt to separate the sources of shocks into groups which are more or less permanent, and examine the responses to these different types of shocks. Second, I separate individuals into groups which on average appear to face income shocks of differing duration, and compare the corresponding changes in consumption across groups.

The PSID contains several variables that provide possible clues about the duration of income changes. For example, shocks to earnings due to sickness or unemployment may tend to be more temporary, while changes in wages may be more persistent. Based on this a priori judgment, I assign the variables which measure changes in hours lost due to illness or unemployment to one group, and changes in wages to the other. I then regress changes in income on the entire set of variables. Table 9 shows the results of this regression. As expected, wage changes are positively correlated with income changes, while changes in hours unemployed or ill have a negative effect on income change. Using the coefficients from Table 9 I then create separate fitted values for income change from each of the two groups. One fitted value consists of the coefficients on wage changes times the actual wage changes reported for each household (I will refer to this as "permanent" change in income), and the other of the coefficients on the hours change variables times the reported changes in hours ill or unemployed ("temporary" change in income). Using the fitted values normalizes wage and hours changes into dollar terms and makes it possible to combine the effects of several variables to create more powerful measures of predicted income change.

It is of course necessary to check the actual properties of the fitted values in order to determine whether the classifications as permanent and temporary are justified. Table 10 shows the correlation of the fitted values with their one period lags. Once again using the approximation that the income process can be decomposed into a random walk and white noise, the estimates imply that the variance of the permanent component of the "temporary" fitted values is 18 percent of the total variance, while that of the "permanent" fitted values is 33 percent of the total. This appears to confirm the intuition that hours changes have a more temporary effect on income than do wage changes.

I now examine whether the mpc's out of the different types of shocks conforms to predictions. Table 11, column 1 shows that there is a higher propensity to consume out of the more permanent shock, as expected. The estimates in column 2 show that propensity to consume out of the more permanent changes also falls more quickly with age. Figure 5 shows the pattern of responses with age (as estimated in Table 11, column 3), together with the theoretical predictions of the life cycle model used previously, given the estimates of permanence from Table 10. The measured mpc out of the more permanent shocks to income (denoted by triangles in Figure 5) is indeed greater than that out of temporary shocks (circles) at all ages, as the model predicts. The two propensities also approach one another as retirement nears, as predicted. Neither measured mpc declines monotonically, however, and both are below the level predicted by theory (dots and circles, respectively, in Figure 5). There is undoubtedly error in the measurement of both hours and wages, and this may contribute to the low measured values. Nevertheless, the essential predictions of the LCH, a higher propensity to consume and a steeper decline with age for the more permanent shocks, are born out by this experiment.

As a second check on the effects of differing degrees of permanence on mpc, I separate households into groups based whether the head of household has a college degree, on the theory that individuals with different levels of education may have different income processes.[11] According to the estimates in Table 12, shocks received

[11]The level of education is of course endogenously chosen by individuals, which could lead to

by the college-educated group tend to be more permanent. The variance of the permanent component of their income shocks is 52 percent of the total variance, as opposed to 32 percent for those with less than a college degree. This implies that college educated consumers should respond more to shocks to income, but that their response should decline more steeply with age.

In Table 13 I investigate these predictions by adding interaction terms with a dummy variable for college education to the regression of change in consumption on change in income and income-age interactions. Column 1 shows that, as expected, college educated consumers change consumption more in response to changes in income than do the rest of the sample, and that the difference is significant at the 5 percent confidence level. Column 2 shows that, as implied by the theory, the propensity to consume of those with a college degree also falls faster with age (the difference is once again statistically significant). The graphic evidence presented in Figure 6 is less satisfactory. The mpc of the college educated (squares) falls below that of the rest of the sample (dots) after age 55, and indeed becomes negative. The measured values for both groups are below the theoretical predictions (triangles and circles), given the estimates of permanence of income shocks for each group. Still, the central predictions of the life cycle hypothesis are supported by the evidence.

1.5 Conclusion

The multiplicity of factors that could (and likely do) affect consumption makes it difficult to come to any firm conclusions based on the results I have found. At a minimum I feel I have demonstrated that there are important and systematic differences in consumption behavior across ages. Determination of the exact causes of this heterogeneity should be a fruitful area for future research.

In addition, two further tests, splitting income shocks into more and less per-

problems. Those who defer income in order to gain additional schooling may, for example, tend to have lower discount rates than others (Lawrance, 1991, finds evidence that this is true). This, however, would imply that the college educated sample should respond less to income shocks, the opposite of the empirical finding below.

manent components, and splitting the sample into groups affected by more and less permanent shocks on average, confirm the basic predictions of the life cycle model-that when shocks to income are more permanent, consumers 1) change consumption by a greater amount in response and 2) reduce the size of the consumption revision more quickly with increasing age.

Together these findings support the view that a large number of consumers, at least, behave in a manner consistent with rational intertemporal optimization. In view of the difficulty inherent in formulating a lifetime consumption plan, and the failure of introspection (in the case of this author, at any rate) to reveal a conscious strategy, this was by no means a foregone conclusion.

At this time there is no perfect theory explaining all consumer behavior. In view of the results established in this paper, however, any such theory must surely take account of the effects of aging on consumption decisions.

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Table 1

Regressions generating consumption and income residuals

	Dependent variable:	
	Change in income	Change in consumption
Age	-268.5	31.71
	(3.09)	(2.39)
Age^2	7.098	-.9546
	(2.99)	(2.76)
Age^3	-.0597	.0086
	(2.93)	(2.99)
College	470.9	45.21
	(3.68)	(2.18)
High School	37.03	26.25
	(0.56)	(2.08)
Dadult	384.4	140.4
	(10.63)	(20.64)
Doldkid	147.1	125.2
	(4.17)	(17.63)
Dyoungkid	-19.16	76.88
	(0.66)	(10.46)
R^2	.0516	.0842
N	51622	51583

Asymptotic t-statisics appear in parentheses. Standard errors are heteroskedasticity robust. Estimation controls for fixed effects within individuals.

Table 2

Predicted Marginal Propensity to Consume Out Of Temporary Income Shock				
Age	r=p=.01	r=p=.03	r=p=.05	r=p=.1
25	.0249	.0374	.0519	.0916
35	.0296	.0415	.0551	.0928
45	.0373	.0485	.0610	.0959
55	.0525	.0630	.0743	.1051
60	.0673	.0773	.0879	.1162
62	.0761	.0859	.0962	.1234

Calculations assume individuals retire at age 62 and die at age 75. r = the real interest rate; p = the discount rate.

Table 3

Predicted Marginal Propensity to Consume Out Of Permanent Income Shock				
Age	r=p=.01	r=p=.03	r=p=.05	r=p=.1
25	.7911	.8667	.9198	.9809
35	.7529	.8015	.8614	.9497
45	.6178	.6877	.7497	.8652
55	.4058	.4554	.5041	.6168
60	.1998	.2252	.2513	.3179
62	.0761	.0859	.0962	.1234

Calculations assume an individuals retire at age 62 and die at age 75. r = the real interest rate; p = the discount rate.

Table 4

Predicted Marginal Propensity to Consume Out Of Permanent Income Shock (r=.03)				
Age	p=.01	p=.03	p=.05	p=.1
25	.5764	.8667	1.2031	2.1226
35	.5712	.8015	1.0643	1.7930
45	.5284	.6877	.8652	1.3586
55	.3796	.4554	.5371	.7600
60	.1960	.2252	.2560	.3358
62	.0761	.0859	.0962	.1234

Calculations assume individuals retire at age 62 and die at age 75. r = the real interest rate; p = the discount rate.

Table 5

	1	2	3
Change in income	.0289 (8.35)	.0399 (2.17)	.0108 (0.21)
Change in income x age x 10^{-3}	-.537 (7.59)	-1.09 (1.46)	1.20 (0.31)
Change in income x age^2 x 10^{-3}		.00667 (0.74)	-.0513 (0.53)
Change in income x age^3 x 10^{-6}			.468 (0.60)
R^2	.0674	.0674	.0674
N	47,155	47,155	47,155

Dependent variable is change in consumption. Absolute value of asymptotic t-statistics are in parentheses (standard errors are heteroskedasticity robust). Estimation controlled for fixed effects within 6409 individuals.

Table 6

How the Level of Food Consumption Varies With Age

	1	2
Age	-14.16	20.93
	(1.19)	(1.91)
Age2	2.463	.4744
	(7.77)	(1.63)
Age3	-.0332	-.0104
	(12.35)	(4.26)
Adult		261.9
		(60.43)
Oldkid		137.8
		(46.53)
Youngkid		48.48
		(11.46)
R^2	.1082	.2659
N	51,622	51,622

Dependent variable is level of consumption. Absolute value of asymptotic t-statistics are in parentheses (standard errors are heteroskedasticity robust). Adult is the number of adults in the household; Oldkid is the number of children over five; and Youngkid is the number of children under five.

Table 7

Ratio of Change in Food Consumption to Change in Total Consumption Across Ages

Age	18-30	31-40	41-50	51-60
Dfood/ Dcons	.119	.176	.112	.103

Values shown are the means of change in food consumption divided by change in total consumption from the 1981-1987 Consumer Expenditure Survey. Calculations courtesy of Annamaria Lusardi.

Table 8

	1	2	3
Change in income	.0289 (7.01)	.0261 (7.29)	.0257 (7.19)
Change in income x age x 10^{-3}	-.537 (7.59)	-.442 (5.76)	-.412 (5.35)
Change in income x income level x 10^{-6}		-.00981 (3.17)	-.0121 (3.84)
Change in income x wealth x 10^{-6}			-.0220 (4.13)
R^2	.0674	.0676	.0680
N	47,155	47,155	47,155

Dependent variable is change in consumption. Absolute value of asymptotic t-statistics are in parentheses (standard errors are heteroskedasticity robust). Estimation controlled for fixed effects within 6409 individuals.

Table 9

	1
dhdwage	269.90
	(25.74)
dwfwage	317.20
	(21.56)
dhdhrsill	-.3133
	(4.89)
dwfhrsill	-.0365
	(0.37)
dhdunmpl	-1.158
	(17.56)
dwfunmpl	-.3197
	(4.30)
R^2	.0356
N	42,340

Dependent variable is change in income. dhdwage is change in real wage of head of household; dwfwage is change in real wage of wife (see text for PSID definition of "head" and "wife"); dhdhrsill is change in hours of work missed by head due to illness; dwfhrsill is change in hours of work missed by wife due to illness; dhdunmpl is change in hours of unemployment for head; and dwfunmpl is change in hours of unemployment for wife.

Table 10

	pdy	tdy
Variance	3.27×10^5	1.84×10^5
Covariance with one period lag	-1.09×10^5	-7.52×10^4
Correlation coefficient with one period lag	-.3281	-.3964
N	33,403	47,155

tdy is estimated "temporary" change in income (generated using coefficients on changes in hours from Table 9); pdy is estimated "permanent" change in ncome (generated using coefficients on changes in wages).

Table 11

	1	2	3
tdy	.0068 (0.64)	.0044 (0.12)	.0788 (0.15)
tdy x age		-.00032 (0.31)	-.00493 (0.11)
tdy x age^2 x 10^{-3}			.0772 (0.07)
tdy x age^3 x 10^{-6}			.291 (0.03)
pdy	.0102 (1.86)	.0504 (2.84)	-.0240 (0.90)
pdy x age		-.00099 (-1.83)	-.00536 (0.20)
pdy x age^2 x 10^{-3}			.172 (0.25)
pdy x age^3 x 10^{-6}			-1.49 (0.26)
R^2	.1010	.1011	.1011
N	31,572	31,572	31,572

Dependent variable is change in consumption. pdy and tdy are estimates of more and less permanent shocks to income based on the regressions in Table9 (see text for details). Absolute values of asymptotic t-statistics are in parentheses (standard errors were adjusted for heteroskedasticity).Estimation controlled for fixed effects within 5602 individuals.

Table 12

	college	non-college
Variance	2.03×10^7	2.31×10^7
Covariance with one period lag	-4.84×10^6	-7.88×10^6
Correlation coefficient with one period lag	-.2171	-.3232
N	33,403	47,155

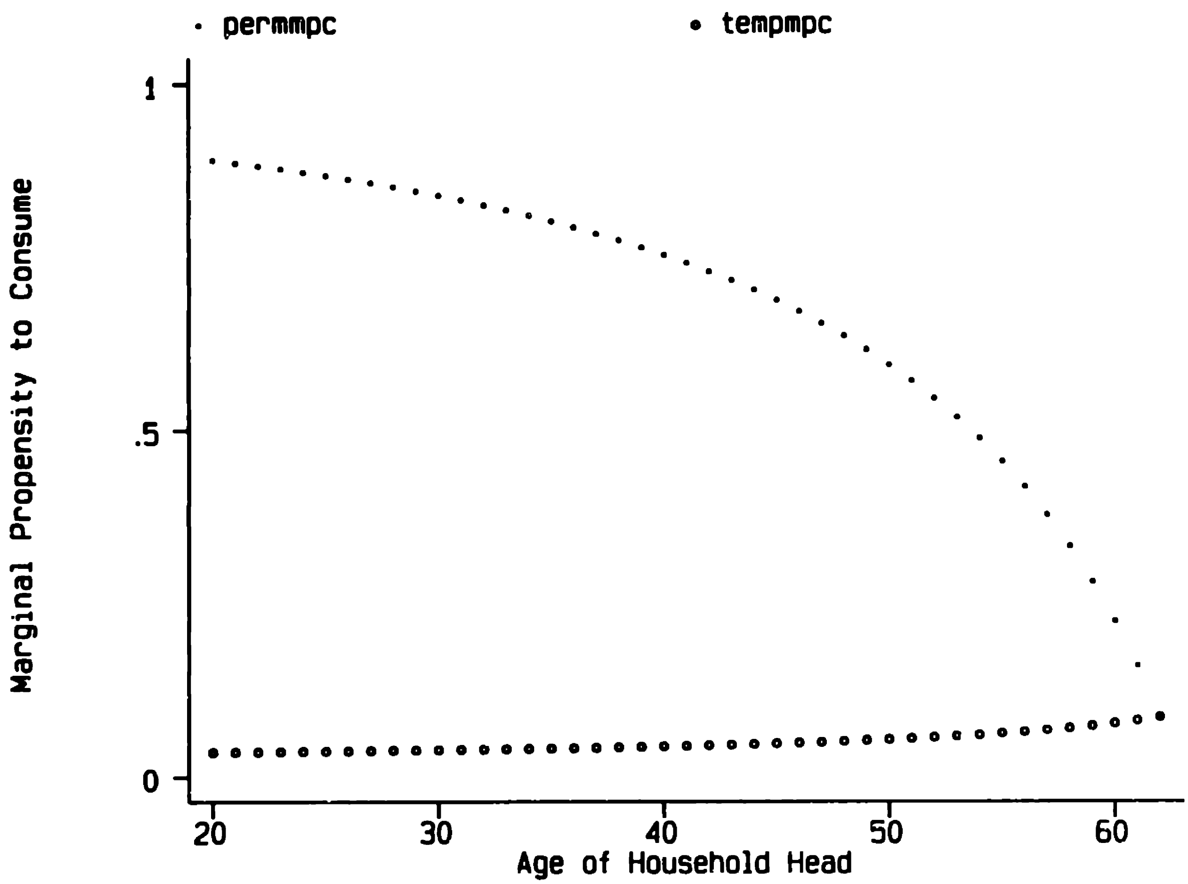
Variable analyzed is change in income. Column headed "college" contains statistics on change in income for households whose heads have a college degree or more education; column headed "non-college" contains statistics on change in income for households whose heads have less than a college degree.

Table 13

	1	2	3
Change in income	.00254 (4.39)	.0258 (2.17)	-.00398 (0.08)
Change in income x coll	.00366 (2.52)	.0194 (2.55)	.142 (1.14)
Change in income x age x 10^{-3}		-.477 (6.38)	2.91 (0.72)
Change in income x age x 10^{-3} x coll		-.375 (2.33)	-11.7 (1.26)
Change in income x age^2 x 10^{-3}			-.111 (1.09)
Change in income x age2 x 10^{-3} x coll			.327 (1.44)
Change in income x age^3 x 10^{-6}			1.09 (1.32)
Change in income x age3 x 10^{-6} x coll			-2.49 (1.64)
R^2	.0009	.0025	.0029
N	47,155	47,155	47,155

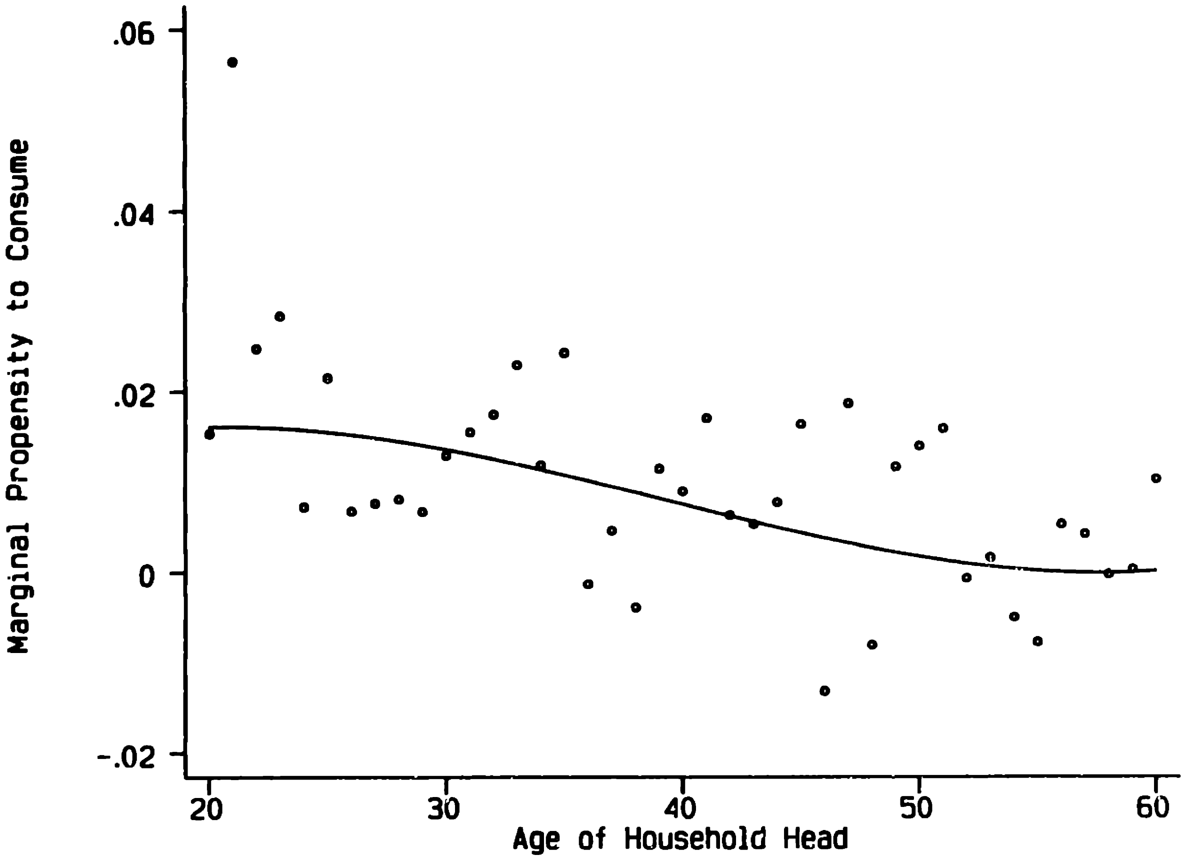
Dependent variable is change in consumption. coll is a dummy variable equal to one if the head of household has a college degree and zero otherwise. Absolute value of asymptotic t-statistics are in parentheses (standard errors are heteroskedasticity robust).

Figure 1



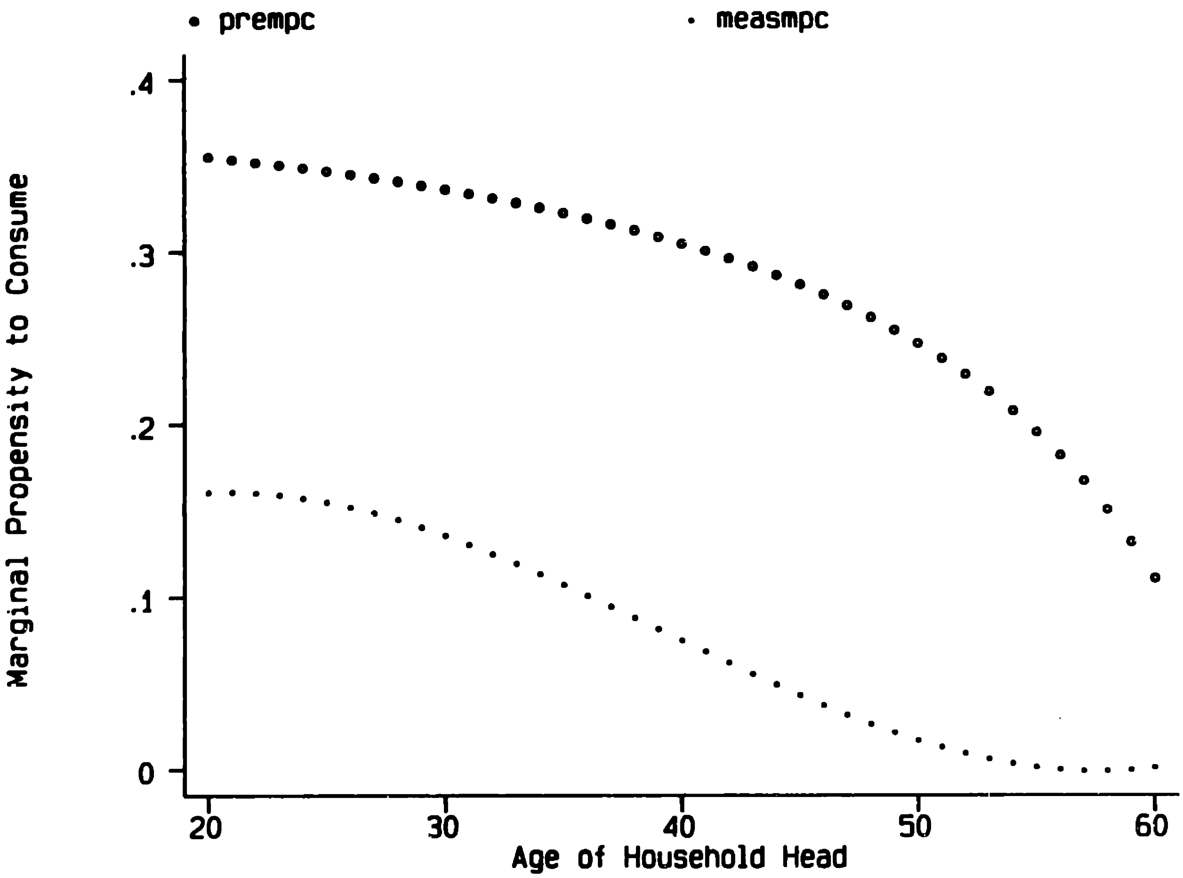
permmpc is the marginal propensity to consume out of a permanent shock predicted by the LCH. tempmpc is the mpc out of one period temporary shocks predicted by the theory.

Figure 2



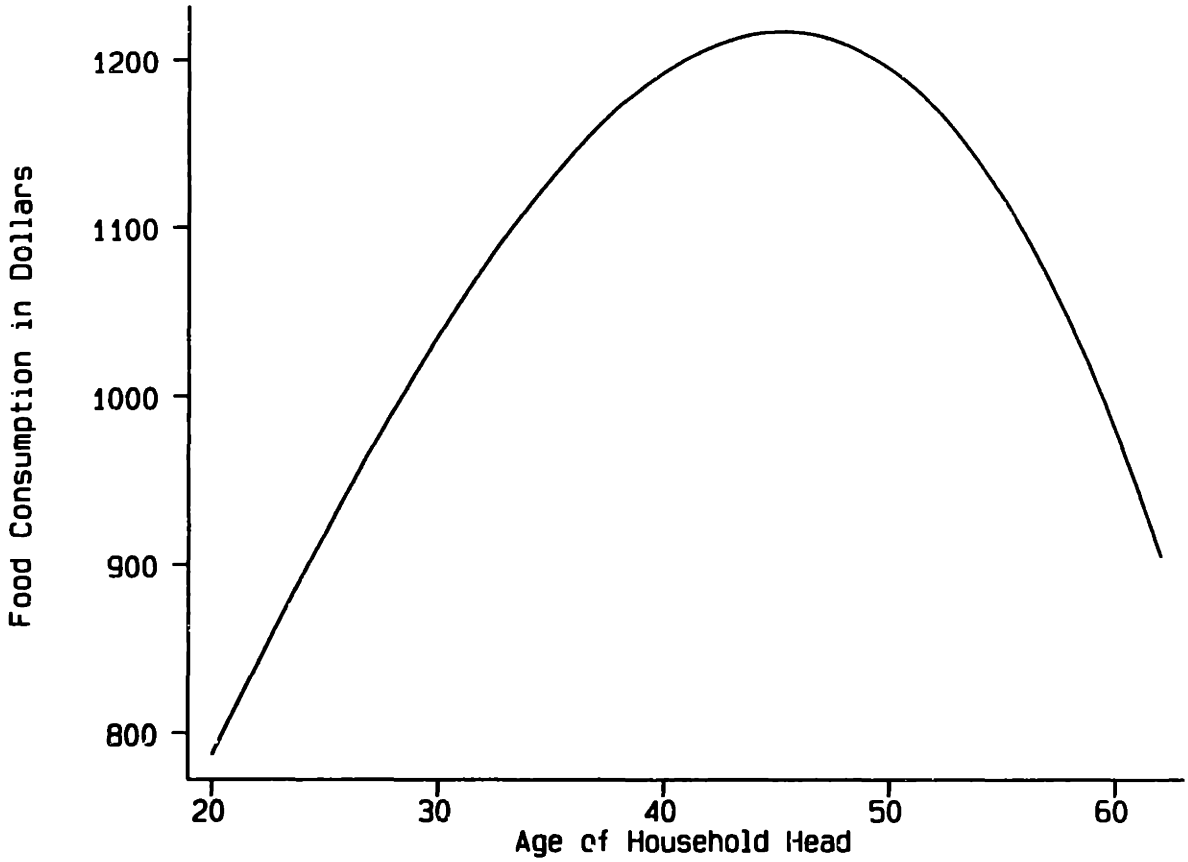
Small circles represent mpc calculated separately for each age. The line is mpc estimated as a cubic function of age (the coefficients are from Table 5, column 3).

Figure 3



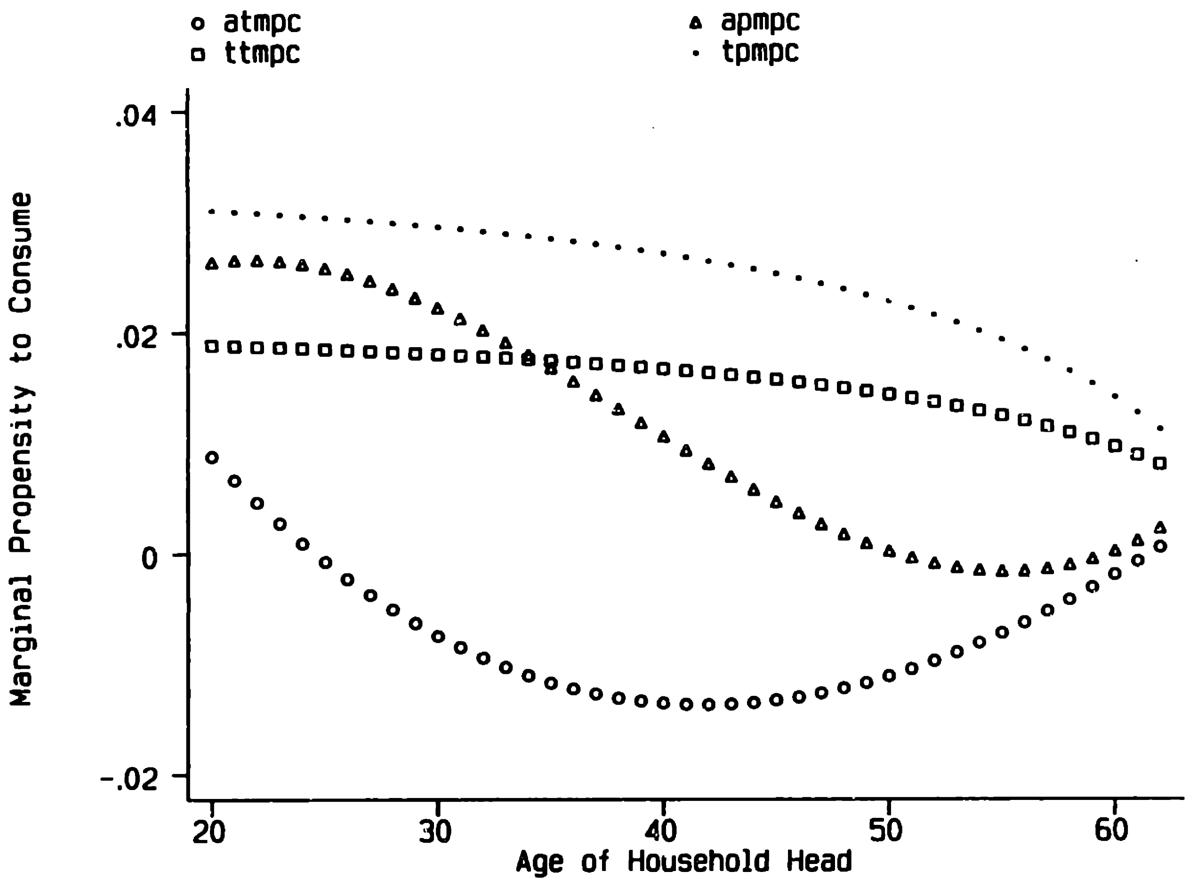
prempc is the overall mpc predicted by the LCH, given estimates of the average persistence of income shocks. measmpc is the mpc actually found in the data.

Figure 4



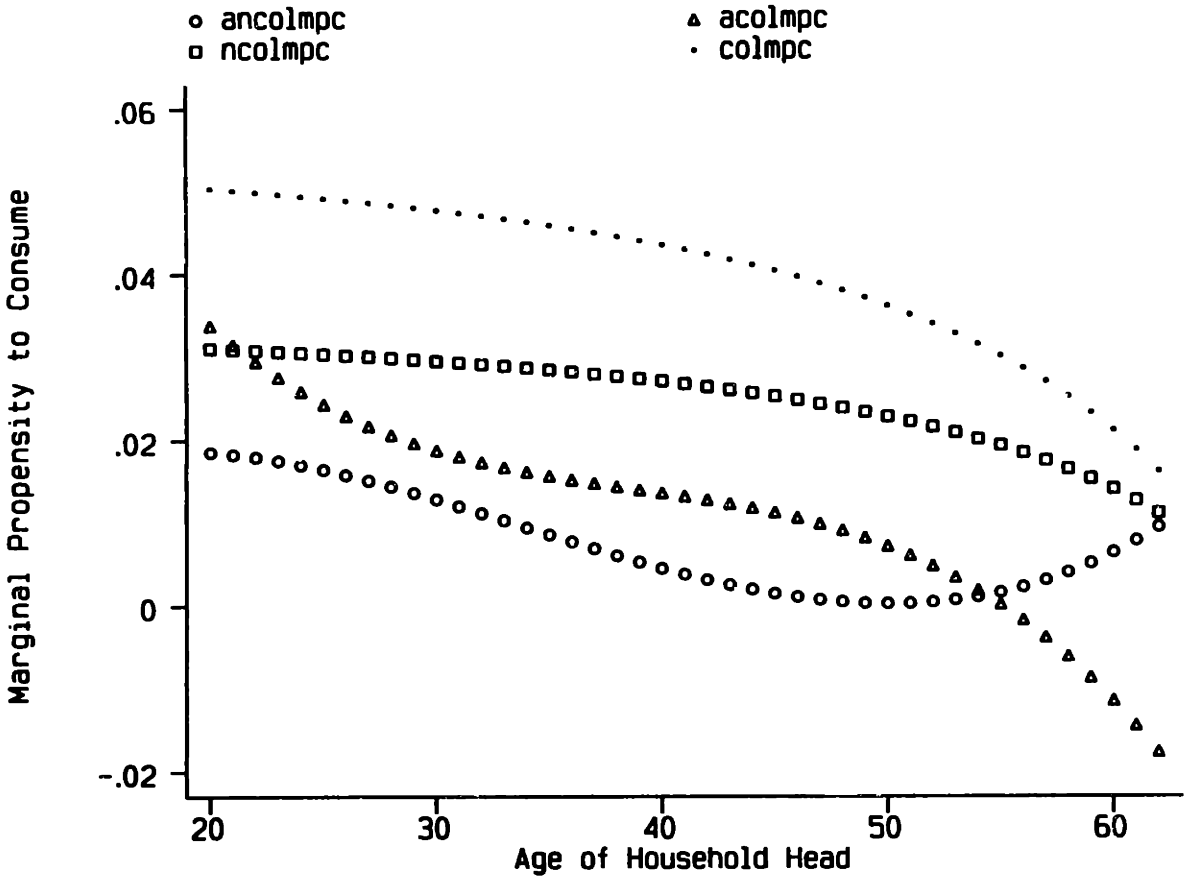
Graph plots dollars spent on food versus age, assuming a single-headed household.

Figure 5



apmpc and atmpc are the measured propensities to consume out of the more and less permanent (respectively) shocks to income constructed using the coefficients from Table 11, column 3. tpmpc and ttmpc are the values predicted by the LCH for mpc out of the two types of shocks, given the degrees of permanence in each type estimated from the covariances reported in Table 10.

Figure 6



ancolmpc and acolmpc are the measured propensities to consume for those who do not have a college degree and those who do, respectively, based on the coefficients in Table 12, column 3. ncolmpc and colmpc are the corresponding values predicted by the LCH, given the estimates of the average persistence of income shocks for each group based on the covariances in Table 12.

Chapter 2

Liquidity Constraints and the Marginal Propensity to Consume

2.1 Introduction

The simple certainty equivalence life cycle model has formed the basis for a great deal of work using both micro and macroeconomic data. It appears, however, that consumer behavior deviates from the predictions of this model in some important ways. For example, the model predicts that individuals whose desired rate of growth of consumption is less than their rate of growth of income should amass large debts financing consumption during their early years, slowly paying them off as they age. There is little evidence of this pattern. This could simply mean, however, that consumers are sufficiently patient (or income growth rates are sufficiently low) that this situation rarely arises.

More difficult to explain is the fact, pointed out by Carroll and Summers (1991), that average consumption growth rates tend to parallel income growth rates across countries and occupational groups. (Self-selection into occupations with given income growth could account for the latter finding, but not the former). Providing further evidence against the simple LCH, Hall and Mishkin (1982) find that individual consumption responds more than predicted to transitory shocks in income. Hall and Mishkin (1982), Zeldes (1989a), and others have also found that consumption behavior violates the Euler equation restrictions implied by unconstrained intertemporal maximization.

One explanation which has been advanced in response to these puzzles is that some fraction of consumers may be liquidity constrained, facing constraints which prevent them from borrowing against future earnings.[1] In this paper I will test whether individuals face liquidity constraints by investigating whether the degree to which individuals change consumption in response to changes in income declines with the level of wealth they hold.

Individuals who are liquidity constrained are limited by current income to a level of consumption below that which they would choose if they could borrow. Unexpected changes in income (which shift the constraint) will therefore have a relatively large effect on consumption. Those who are unconstrained, on the other hand, will spread the effect of shocks to income over their entire lifetime, leading to a much smaller change in current consumption. In other words, liquidity constrained individuals will have a greater marginal propensity to consume (mpc) out of income shocks than those who are not constrained.[2]

In the case of quadratic utility of consumption, an individual facing a binding liquidity constraint will in some cases alter consumption one for one with temporary changes in income, while a thirty year old who expects to live to 67 will consume only a little over 4 cents out of each marginal dollar (assuming a real interest rate of 3 percent).

In their simplest form, liquidity constraints would bind only on those with zero assets. In actuality, however, consumers need to maintain some liquid assets to purchase goods. In addition, individuals may wish to hold some assets as a precaution against future uncertainty. Furthermore, the externally imposed constraint need not be fixed

[1]This is only one possible form that borrowing constraints might take. A variant would restrict the interest demanded on consumption loans to be greater than that offered for savings (Hayashi 1987). For simplicity I concentrate on the more straightforward case of quantity constraints.

[2]Note that this prediction applies to surprise changes in income. An additional implication of liquidity constraints is that expected changes in income can lead to changes in consumption. Expected income changes should not affect the consumption of an unconstrained consumer (this is an implication of the Euler equation restrictions mentioned above).

at zero assets; there are many individuals with negative assets. Positive wealth need not imply the presence, nor negative wealth the absence, of liquidity constraints. This makes it difficult to positively identify liquidity constrained consumers.

At the least, however, one would expect liquidity constraints to be binding more often for those with a lower level of assets. A study by Japelli (1990) confirms this intuition, finding that the probability of (self-reported) restrictions on borrowing is significantly and negatively related to the amount of wealth held. Thus those with lower wealth are more likely to be liquidity constrained, and those who are liquidity constrained should have a higher mpc. Together, these suppositions imply that if liquidity constraints affect behavior, the marginal consumption out of changes in income should be greater on average for those with less wealth. Using panel data on individuals I find clear evidence in support of this prediction.

Unfortunately, there is a simple alternative explanation for this finding. Any individual who saves a lot will both consume less out of income shocks and ultimately build up more wealth. To put it another way, the problem is that the level of wealth is endogenous, and could be affected by some parameters (such as the rate of time preference) that also affect the propensity to consume.

To deal with the problem of endogeneity, I use a proxy for the level of wealth that is available over time in the data set I use. This allows a form of estimation which utilizes only the variation in wealth over time for a given individual. As long as preferences are constant for an individual, endogeneity of wealth should not bias the results in this case. As an additional check I also try using inherited wealth as an (arguably) exogenous instruments for the level of wealth, but this strategy yields inconclusive results.

A second alternative explanation for the observed correlation between wealth and mpc is that the income processes for the wealthy and poor differ. In particular, if changes in income for the wealthy tend to be more temporary than those for the poor, one would expect the wealthy to alter consumption by a smaller amount. Examination of autocorrelations of income changes at different levels of wealth indicates that this is not the case. Finally, I look for asymmetric responses to positive and negative income shocks, which might help distinguish between the endogeneity and liquidity constraints explanations for the initial results, but find little evidence of difference in responses.

In the remainder of this paper I will briefly review previous research on liquidity constraints, describe the data used, present a simple theory of consumer behavior with and without liquidity constraints, describe my results, and end with a brief conclusion.

2.2 Previous Research

A great deal of research on consumption, beginning with Hall (1978), has focused on tests of Euler equation restrictions. The Euler equations will be satisfied in the case of rational intertemporal maximization in the absence of liquidity constraints. Simply put, if a consumer is able to maximize fully in each period, given current expectations, only new information should influence current consumption. In practice this implication is generally tested by regressing changes in current consumption on current and lagged variables. Significant coefficients on lagged variables are interpreted as a rejection of the hypothesis of unconstrained, rational maximization. Hall and Mishkin (1982) implement this type of test using panel data and reject the restrictions.[3] One interpretation of this rejection is that at least some portion of the population faces binding liquidity constraints. This is essentially the interpretation that Hall and Mishkin choose, although they conclude based on other evidence that most consumers are unconstrained.[4]

Altonji and Siow (1987) criticize Hall and Mishkin for failing to allow for measurement error in income (they do allow for a form of measurement error in consumption). They claim errors in the income variable could lead to a spurious rejection of the or-

[3]The same restrictions are decisively rejected in my sample, which is taken from the same survey used by Hall and Mishkin (although it covers a different time period).

[4]Hall and Mishkin do not explicitly model liquidity constraints, but hypothesize that some percentage of the population simply consumes current income. (Under some circumstances binding liquidity constraints could lead to this behavior.) They conclude that approximately 20 percent of the population behaves in this manner, with the rest acting as though unconstrained.

thogonality conditions. After correcting for these errors, they fail to reject the Euler equation restrictions.[5]

The two studies mentioned above rely on the fact that lagged changes in income, because they are already known, should have no effect on current consumption. In contrast, Carroll (1994) attempts to isolate expected future changes in income, using average rates of income growth for different occupations. He then tests whether these affect the level of current consumption, as the life cycle theory implies. He finds that those with higher expected future incomes do not have a significantly higher level of current consumption.

Shea (1993) uses union contracts to provide a more precise measure of expected income. Multi-year union contracts allow individuals to predict future income with a high degree of confidence. Consumption by an unconstrained individual should be affected only by the total amount of income promised over the life of the contract, and not by the distribution of income across years. In particular, contracts that provide for a higher rate of growth of income should not lead to a higher rate of growth in consumption in the absence of liquidity constraints, since the changes in income are fully anticipated. In fact, however, Shea finds that expected changes in income have a large and significant effect on changes in consumption. (This result could be due in part to the fact that even contracted income is not certain until it is received due to the risk of layoff, injury, etc. It seems unlikely, however, that these small risks could lead to the observed results unless risk aversion is extremely high). Both Carroll (1994) and Shea (1993) imply a rejection of the traditional model of intertemporal maximization in the absence of liquidity constraints.

In none of the above tests, however, is there anything that directly ties the rejection of the unconstrained model to the existence of liquidity constraints. Zeldes (1989a)

[5]Deaton (1992) points out that measurement error in the income variable could not by itself lead to violation of the restrictions; the failure to reject using the same data could be due to using a different time period and different restrictions on the observations used. Potentially more serious than measurement error in income are the errors in consumption data. If current income carries information about current consumption (which seems likely, given the high correlation between these variables), then the measurement error in consumption could be correlated with income. This could lead to a correlation between, for example, lagged income and change in consumption, the variables most commonly used on Euler equation tests.

attempts to rectify this problem by splitting his sample into two groups, one which holds a low level of wealth and thus is more likely to be liquidity constrained, and one which holds a high level of wealth. He finds that in at least some cases, the Euler equation restrictions are rejected for the low wealth part of the sample and accepted for the high wealth part.

Runkle (1991), however, has criticized Zeldes for not properly allowing for the possibility of aggregate shocks. Using the same data set and slightly different methodology, he fails to reject the Euler equation restrictions for the whole sample as well as for a low-wealth sub-sample.

Closer in spirit to this work is work by Klein (1954). Klein regresses savings rates (over a year) on a variety of variables including the ratio of liquid assets (in the initial year) to income. The asset to income ratio is found to have a significant negative effect on the savings rate.[6] Moreover, this effect is most pronounced in the casein which income falls over the period examined. The author suggests the results may imply that individuals with assets can buffer negative income shocks by running down assets (resulting in a lower savings rate) while those without assets cannot borrow to accomplish the same result. In other words, low asset consumers may be liquidity constrained.

The results, however, are inconclusive due to many alternative explanations. For example, any unexpected windfall the previous year would raise the initial level of assets, and also increase the current year's consumption, thereby lowering the savings rate. Moreover, change in liquid assets is one component of the measure of saving used. If liquid assets are reported with error, there will be a spurious negative correlation between initial assets and saving.

All in all the evidence from previous research on liquidity constraints is far from definitive. There is thus ample scope for this study to shed some additional light on the issue.

[6] This methodology is not directly comparable to mine because it examines the average rather than marginal savings rate.

2.3 Data

This paper uses income and food consumption data from the 1976-1987 waves of the Panel Study of Income Dynamics (PSID). The greatest drawback to the PSID for studies on consumption is that data is available only on food consumption. To directly extrapolate from this information to conclusions about consumption in general requires that the utilities from food and other consumption be both additively separable and homothetic, very strong assumptions. The use of food consumption data in this paper could lead to biased results if the percentage of consumption devoted to food varied systematically with wealth. It does appear in the data that the average propensity to consume declines with a household's wealth, suggesting (as seems reasonable) that wealthier families devote a smaller portion of their income to food. I attempt to control for this relationship by including average propensity to consume as an independent variable in some regressions.

Following Zeldes (1989a), I divide the reported dollar values for food purchased with cash or food stamps in a store and restaurant food purchases by the March CPI-W for food consumed at home and restaurant food, respectively, and sum them to get total food expenditures in constant dollars. To rule out values of consumption change which appear unreasonable I discard observations in which consumption more than quadruples or falls by more than three quarters.[7] In addition, I discard all observations for which consumption was imputed, and observations for which the head of household has changed from the previous year. I match consumption reported in a given survey with income measures from the same survey (see the Data section in "Marginal Propensity to Consume Across the Life Cycle" for a discussion of timing problems).

I take total reported family income (including transfers), subtract income taxes (as estimated by the survey), an estimate of social security taxes (from labor income and self-employment data), and a measure of capital income and divide by the overall

[7]Substitution of alternative thresholds for eliminating extreme values did not substantially affect the results.

yearly CPI to yield real after-tax non-capital disposable income. I use disposable income in the analysis because consumption should depend on income actually received. If the effect on income of a spell of unemployment is partially offset by unemployment insurance, for example, the change in consumption should also be attenuated. Capital income is subtracted because the theory described below pertains to changes in earned income. All observations for which any component of income was imputed were discarded.

Following Hall and Mishkin (1983), Pischke (1993), and others, I use values of consumption and income in levels rather than logs. All tests of significance reported use White standard errors to correct for the heteroskedasticity which may be present due to the use of levels.

In order to eliminate expected consumption and income changes I regress changes in both real consumption and income on a cubic in age, educational attainment of the family head and change in number of adults, number of children over five and number of children under five, and use the residuals as the "surprise" income and consumption variables in the remainder of the paper. I use fixed effects estimation to control for different average growth rates of consumption across families. This allows for the possibility of heterogeneous discount rates. The form of the regression is[8]

$$\Delta C_{it} = \beta X_{it} + \mu_i + \epsilon_{it}$$

The residual income changes are of course not necessarily complete surprises to the recipient. The procedure followed essentially denotes any sharp changes in income not associated with a change in family structure as unexpected changes. This, however, is the best the data allows. Expected changes in income would lead to particular patterns in consumption behavior, which I will discuss in the following section.

The PSID is a household-based survey, while the predictions of the simple model

[8]If consumption is measured with error (as it almost certainly is), the error term ϵ_{it} will exhibit MA(1) serial correlation. However OLS on the consumption equation should still be consistent. Since the purpose of this preliminary stage is simply to generate unpredictable income change, I use OLS.

I will present apply to individuals. I have attempted to control for the effects of family size on income and consumption by including measures of family structure in the above regressions. It is also necessary to assign a single age to the household in regressions that include age. I simply use the age of the head of household in these cases. While this measure is not perfect, it should roughly capture the effects of age on mpc, especially in the case in which the head is the primary wage earner.

In 1984 the PSID asked detailed questions about the level of wealth held by a family. Separate questions were asked about assets held in the form of cash, stocks, bonds, real estate (excluding the primary home), automobiles, and privately held businesses, in addition to the level of liabilities. The value of the primary residence and the outstanding mortgage are ascertained in separate questions asked each year. A thorough review of this data (Curtin, Juster and Morgan, 1989) determined that they were as reliable as more detailed data in the Survey of Consumer Finances, and an improvement over most past studies. I use the sum of assets minus liabilities, in addition to home value net of mortgage as my primary wealth variable. (In addition I subtract the net or gross value of the primary home in some regressions, on the grounds that that category of wealth is relatively illiquid, but the results are very similar). Unfortunately, only one observation on this wealth variable is available.

In order to utilize the panel nature of the data, and reduce possible bias in the regression due to the endogeneity of wealth, I also use a constructed wealth variable. Following Zeldes (1989), I take the reported value for asset income (a question that is asked each year) and "blow it up" into assets by dividing by the interest rate (on three month T-bills) in each year. This proxy for wealth allows estimation based on wealth changes within a household, thereby eliminating the problem of individual heterogeneity.

The 1984 survey also asks a question on the amount of money that a household has inherited during its lifetime. This is appears to be an exogenous component of wealth and should provide a good instrument for wealth (barring the possibility of inherited tastes). Unfortunately, relatively few of the households report any inheritance, and this test proves inconclusive.

2.4 Theory

I now present a simple life cycle model with quadratic utility (i.e. a certainty equivalence model) to demonstrate some of the potential effects of liquidity constraints on consumption behavior.

The consumer in this model lives three periods, and faces uncertainty in the level of income in just one of them. Given utility quadratic in consumption, he must solve the problem

$$\max_{c} E\left(\sum_{i=1}^{3}(1/1+r)^{i}(\alpha c_i+\beta c_i^2)\right)$$

$$s.t. \sum_{i=1}^{s}\frac{y_i}{(1+r)^i}\geq\sum_{i=1}^{s}\frac{c_i}{(1+r)^i}$$

for s=1 to 3, where c_t and y_t are consumption and labor income in year t and the other variables are as described above. Because of the liquidity constraint, the budget constraint must be satisfied for each subset of consecutive periods that includes the first.

In addition, assume that income is described by

$$y_1 = 1$$

$$y_2 = \begin{cases} 1 & \text{with probability} \quad .25 \\ 2 & \text{with probability} \quad .5 \\ 3 & \text{with probability} \quad .25 \end{cases}$$

$$y_3 = 3$$

The optimal consumption plan in the absence of liquidity constraints would be to consume two in period one, and $(2+y_2)/2$ in periods two and three.

I will define an "unexpected shock" as the difference between expected income (or consumption) and its realization. In this case expected income in period two is

2. Income of 3 or 1 in period two represents an income shock of plus or minus 1. A shock of this magnitude shifts consumption by one half from its expected value of two. The mpc in this unconstrained case is one half.

In the liquidity constraint case, however, first period consumption will be one. If second period income is 3 or lower, consumption will equal income. In other words, consumption will move one for one with income, for an mpc of one. The mpc is greater in the presence of a binding liquidity constraint.

This assumes, of course, that the individual enters the first period with zero assets. An individual who entered period 1 with wealth of six would desire expected consumption of four each period. After consuming four in period one, he would enter period two with wealth of two. If period two income differed from expectation by one, consumption would be altered only by one-half, as opposed to one in the zero-wealth case. The presence of assets means that the liquidity constraint does not bind in this case. In the absence of liquidity constraints, the presence of assets is irrelevant- mpc will be one half in any case. In this simple example, then, holdings of wealth lead to a lower mpc if and only if there are liquidity constraints.

Additional feature of consumption behavior in the presence of liquidity constraints can be seen if the model is altered to allow for larger shocks to income. Suppose that period two income is now described by

$$y_2 = \begin{cases} 0 & \text{with probability} \quad .25 \\ 2 & \text{with probability} \quad .5 \\ 4 & \text{with probability} \quad .25 \end{cases}$$

An individual facing this distribution of income, holding no assets, and facing a liquidity constraint, will once again consume all of period one income. Thus if period two income falls to zero (a shock of -2), consumption must also fall to zero. If, however, period 2 income equals 4 (a shock of +2), only 3 1/2 units will be consumed (as some of the windfall is saved for consumption in period three). The change in consumption is smaller in the case of a positive shock than in the case of a negative shock.[9]

The intuition is simple: a large enough positive income shock can raise an individual out of liquidity constrained status; conversely, a large negative shock can make a liquidity constraint binding. Thus on average if there are liquidity constraints the mpc out of positive shocks to income may be smaller than that out of negative shocks. Because this effect is due only to liquidity constraints, one would expect to find it only at low levels of wealth.

Unfortunately this prediction relies on the proper separation of unexpected from expected changes. In the example above, an expected rise in income from 1 to 2 (between periods 1 and 2) will lead to a one for one rise in consumption in the presence of liquidity constraints. An expected decrease, however, would lead to no response in consumption at all- the consumer would smooth consumption between the first and second periods. The propensity to consume out of positive expected changes is therefore greater than that out of negative changes. In this case the intuition is that the constraint is only against borrowing, not lending, so it can only be binding when income is rising, not falling (assuming the consumer desires constant consumption). The direction of consumption asymmetry one finds in the data will therefore depend on the degree to which expected changes can be purged from the data.

To summarize, when there are borrowing constraints, the response in consumption to an unexpected change in income will be higher for those without assets. When constraints do bind, consumption behavior will be asymmetrical; negative income shocks may cause a greater change in consumption than positive ones (although the opposite is true for expected changes in income).

In the simple model I have presented, liquidity constraints bind only in periods in which assets equal zero (at the end of the period). The real world, however, is more complex. Consumers require some transactions balances as both income and purchases are lumpy rather than continuous. In addition, consumers may desire

[9]Calculation of the exact mpc in this case is a little tricky because of the definitions I am using. Because of the asymmetry in consumption, expected consumption in this case is 1 7/8 rather than two. Thus mpc out of the negative shock is 1 7/8 $\div$ 2 or 15/16, and that out of the positive shock is 1 5/8 $\div$ 2 or 13/16.

to hold some assets as a precaution against possible unexpected negative income shocks in the future.[10] Furthermore, it is undeniably true that some individuals fall below zero assets; it is not strictly true that everyone must hold positive assets with probability one. These facts make it difficult to identify those who are liquidity constrained.[11]

I will follow the approach of Japelli (1990) in assuming that the probability of being liquidity constrained is a function of observable characteristics. In a large sample, behavior associated with (unobserved) liquidity constraints should then also be related to the observable factors that increase the likelihood of being constrained (in this case, wealth held). In other words, those who hold more wealth should have a lower mpc, on average, due to the lower likelihood of being constrained.

The same implication arises out of precautionary savings models like those of Zeldes (1989b), Deaton (1991) and Carroll (1990). In these models consumers save partly to insure against future uncertainty in income. Those with a greater stock of assets can better protect themselves from income fluctuations- in other words, their consumption will change less in response to income shocks. This is very similar to the effect of wealth in the case of liquidity constraints, except that mpc should vary smoothly with wealth for an individual, in contrast to a sharp dividing with liquidity constraints. The econometric implications for the relation of wealth to mpc are, however, almost identical to the case in which the probability of liquidity constrained status is a smooth negative function of wealth.

In addition, all the above models contain an analog to liquidity constraints. In Deaton (1991), the constraints are explicit; in Zeldes (1989) and Carroll (1990), consumers will never borrow because marginal utility of consumption rises to infinity at zero and there is a non-zero probability of income falling to zero. (Of these three

[10] The simple quadratic form of utility that I assume does not allow for this type of precautionary savings motive. See Kimball (1990), Skinner (1988), Zeldes (1989b) and others for a description of how the presence of a precautionary motive might change the behavior of consumers.

[11] An alternative which allows for some of these complexities is a model with differential rates for borrowing and lending. The different rates lead to a kink point in the intertemporal budget constraint at zero assets. Some fraction of consumers will optimize by remaining at the kink point, i.e. consuming changes in income one for one, as long as those changes are not so great as to drive them off of the kink. This behavior will mirror closely that predicted by the model presented above.

examples only Deaton (1991), includes explicit liquidity constraints, can explain the violations of Euler equations commonly seen in the data).

Moreover, at least some of the policy implications match closely those of liquidity constraints: consumers will consume much more out of temporary changes in income than unconstrained models would imply, and events far in the future may have little influence on current behavior. (Liquidity constraints do have the unique implication that reforms of the financial system that relaxed the constraints could be welfare improving). For these reasons, I will not attempt to differentiate between liquidity constraints and "precautionary" behavior, but rather between either of these and traditional models of unconstrained consumers.

2.5 Empirical Formulation and Results

The simplest empirical measure of marginal propensity to consume is the coefficient β from a regression of the form $\Delta C_i = \beta \Delta Y_i + \epsilon_i$, where ΔC_i and ΔY_i are the residual (or "surprise") changes in income described in the data section. In order to allow mpc to change with variables such as wealth, I use a formulation $\Delta C_{it} = (\alpha + \beta X_{it}) \Delta Y_{it} + \gamma_i + \epsilon_{it}$ where $\alpha + \beta X_{it}$ = marginal propensity to consume by household i in year t, X_{it} includes wealth as well as other variables such as age which in theory should influence mpc, and ϵ_{it} is a random disturbance. In practice this consists of including wealth (and other variables) times change in income in the regression. A significant coefficient on the wealth-income interaction term indicates that the null hypothesis that wealth has no affect on mpc is rejected.

Table 1 shows the results of performing this regression with wealth data from 1984 and consumption and income changes from 1985 (since wealth should affect subsequent changes in consumption). Column 1 shows that there is a negative correlation between wealth and mpc which is significant at the 5 percent confidence level. As detailed in "Marginal Propensity to Consume Across the Life Cycle", however, mpc should decline with age. I therefore include a cubic in age in column 2. The effect of wealth is no longer measured precisely enough to be significant, but the magnitude is almost the same. The third column indicates that the relationship between wealth and mpc appears to be highly non-linear; when higher powers of wealth are included they enter significantly. Figure 1 shows graphically how mpc varies with wealth. This non-linear pattern is not repeated with larger samples, however, and is likely an artifact of the single year chosen in this case.

Tables 2 and 3 include a larger number of observations, using data from the years surrounding 1985 on the theory that wealth in the immediately surrounding years is probably highly correlated with wealth in 1984. Table 2 shows the results using years 1984-1986, while Table 3 uses data from 1983-1987. In both cases the effect of wealth on propensity to consume is much larger, and in the case of the 1983-1987 sample, the effect of wealth just misses being significant at the 5 percent level, even controlling for a cubic in age. Figures 2 and 3 show that with the larger samples, it appears that the relationship of wealth to mpc is monotonic and close to linear. Table 4 and Figure 4 utilize the entire sample, and show that in this data, the correlation between wealth and mpc is significant at the 5 percent level. (Note that this is what one would expect of a testing a false null hypothesis on noisy data- as the sample size increases the coefficient estimates do not change much, but the level of significance rises).

Table 5 shows the effect of subtracting net or gross value of housing from the wealth variable. The results do not change dramatically.

More information may be gained by eliminating the restriction that mpc vary continuously with wealth or a cubic in wealth. Table 6 shows the results of allowing mpc to vary with dummy variables for different levels of wealth, using data from 1983-1987. The coefficients in columns 1 and 2 show that the propensity to consume declines with each rising wealth level, except for a jump upwards in the $50,000 to $200,000 category. (Those with over $200,000, the omitted category, have an implied coefficient of zero). The results using data from the full sample are similar, as shown in Table 7, except that the coefficients now decline monotonically for all wealth categories.

Theory suggests that wealth relative to income may be more important in signalling liquidity constraints than absolute wealth. Table 8 shows the results of regressions using wealth divided by the average income (over the sample period) as a substitute wealth variable. As shown in column 2, mpc does not vary significantly with this measure of wealth, controlling for age. The pattern of variation of propensity to consume with the wealth ratio is quite similar to that with the level of wealth, as shown in Figure 5.

As discussed in the Data section, the use of food consumption data in these regressions could lead to problems because the percentage of income spent on food, and thus presumably the percentage of income changes spent on food, declines with increasing wealth. This could lead to a spurious negative correlation between mpc (for food) and wealth. In Table 9 I attempt to correct for this problem by introducing average propensity to consume (mean consumption over mean income over the sample period) as an independent variable. The coefficient on wealth is negative and significant at the 5 percent level in each of three different sample periods.

Unfortunately, the results of the above regressions are not definitive, since wealth is endogenous and could be affected by variables that also affect mpc. For example, those with a high discount rate would tend to save less (preferring present consumption) but would also have a higher mpc. More broadly, any factor which leads an individual to have high consumption could cause both low wealth and a high mpc.

One possible means of dealing with this problem is to find an instrument realted to the level of wealth but independent of the behavioral variables that might also influence propensity to consume. A promissing candidate is the amount of inheritance received. It certainly should influence the level of assets held by a household, but through no direct action of their own. Table 10 shows the results of a two-stage least squares regression using total inheritance received as an instrument for net wealth in 1984. Wealth no longer is significantly related to mpc. This may be due to the fact that inheritance is not a very good predictor of wealth- the R^2 of the first stage regression is only .0026 .

Another strategy for dealing with the problem of endogeneity is to subtract individual means from all variables (a "within" regression). Results from this type of regression are identified only off of variations within an individual over the sample period, rather than cross-sectional variation. As long as preferences are constant over the sample period, this should eliminate the type of endogenous relation between wealth and propensity to consume described above.

Using this method, however, requires multiple observations on wealth to provide variation from the individual mean, and wealth was measured explicitly in the PSID in only one year. In each year, however, the PSID asks respondents to report the level of capital income they receive. I use this data, together with information on interest rates, to create an estimate of wealth over time as described in the Data section. The constructed wealth measure is a highly significantly correlated with actual wealth, and explains more than 8% of the cross-sectional variation of wealth in 1984. (While this proxy for wealth is imperfect, any measurement error in the wealth variable will bias the test against finding any effect of wealth on mpc).

Table 11 shows the results of using this constructed variable. The magnitude of the effect of wealth is almost double that obtained previously, suggesting that the constructed variable underestimates wealth. Column 2 shows that the effect of wealth is highly significant. In column 3 average propensity to consume is added as an independent variable, and the cefficient on wealth remains significant at the 1 percent level. As seen in Figure 6, the pattern of variation of propensity to consume with the estimated wealth variable is quite similar to that with actual wealth shown previously.

Table 12 repeats the experiment of dividing wealth by income using the new constructed wealth variable. In this case propensity to consume declines significantly with increasing wealth/income ratios. Figure 7 shows the pattern of the decline, which is once again monotonic.

In addition to the endogeneity arguments detailed above, there is another alternative explanation to the results reported thus far. The response in consumption to changes in income will depend in part on the nature of the income process. Long lasting shocks to income will generate greater changes in current consumption than will transitory shocks. If for any reason the changes in income of the wealthy tended to be more transitory than those of the poor, measured mpc would be lower for the wealthy even in the absence of liquidity constraints. This might be true, for example, if the income of the wealthy depended more on bonuses or the profits of businesses, and these were more variable than wages.

To investigate this possibility I regressed change in income on its one and two period lags for different categories of wealth. If income is highly transitory, there should be a relatively large negative coefficient on the lagged changes, as any positive shock will be followed by a negative change (and vice versa) as income reverts to its mean. On the other hand, to the extent changes are permanent (i.e. income is a random walk), the coefficients on the lagged changes should be small.

The results in Table 13 show that in fact it appears that income changes are more permanent for those with more than $10,000 than for those with less (excepting the small number with more than $200,000), as the coefficients on the lagged values are closer to zero for the former. Moreover, there is no clear pattern of variation in the size of the coefficients for those with less than or equal to $10,000. This indicates that differing income processes cannot explain the correlation between wealth and mpc.

Finally, I test the implications of liquidity constraints for asymmetric consumption behavior by separating income changes into positive and negative components. I create two new variables, one equal to change in income if the change is positive and zero otherwise, and the other equal to income change if it is negative and zero otherwise. The coefficient estimates in Table 14, column 3 show that at zero wealth, mpc is slightly higher out of positive income shocks than out of negative shocks, and that mpc out of negative shocks declines slightly faster. None of these differences, however, are statistically significant. This does not conform to the predictions of the model of liquidity constraints presented above. There are several possible explanations for this, however.

First, the differential effect applies only to those entering or leaving liquidity constrained status. If these individuals form only a small portion of the total population (i.e. those who are liquidity constrained tend to stay constrained and vice versa), the asymmetry may be difficult to detect. Second, because those who are liquidity constrained may change consumption in response to positive expected changes in income, but not to negative expected changes, contamination of the income change residuals with anticipated income changes could confound the results.

Another possibility is that the relation found between wealth and mpc may be the effect of either endogeneity or some omitted variable which has a symmetric effect on propensity to consume.

2.6 Conclusion

This study has shown that there exists a significant relationship between the level of wealth held by a household and its marginal propensity to consume. This relationship holds using several different measures of wealth and functional forms. The relationship does not appear to be due to differences in income processes at different levels of wealth, or to differences in preferences that remain constant over time for a given individual. One possible explanation for this correlation is the existence of some form of liquidity constraints, which are more likely to bind for those with lower levels of assets. More definitive confirmation of this hypothesis will have to await further research into consumption behavior.

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Table 1

	1	2	3
Change in income	.00938 (4.21)	.219 (0.78)	.303 (1.05)
Change in income x wealth x 10^{-9}	-7.66 (2.50)	-6.69 (0.91)	225 (2.12)
Change in income x wealth^2 x 10^{-15}			-714 (-3.35)
Change in income x wealth^3 x 10^{-21}			351 (3.75)
Change in income x age		-.0156 (0.79)	-.0231 (1.02)
Change in income x age^2 x 10^{-3}		.372 (0.65)	.580 (1.01)
Change in income x age^3 x 10^{-6}		-2.87 (0.61)	-4.72 (1.01)
R^2	.0022	.0027	.0058
N	3,311	3,311	3,311

Dependent variable is change in consumption. Absolute value of asymptotic t-statistics are in parentheses (standard errors are heteroskedasticity robust). Income and consumption changes from year 1985 only were included in the sample. Wealth measure is real net wealth in 1984.

Table 2

	1	2	3
Change in income	.0133 (6.11)	.199 (1.08)	.199 (1.08)
Change in income x wealth x 10^{-9}	-11.7 (2.98)	-5.43 (1.14)	-7.92 (0.16)
Change in income x wealth^2 x 10^{-15}			-1.49 (0.03)
Change in income x wealth^3 x 10^{-21}			1.73 (0.19)
Change in income x age		-.0146 (1.02)	-.0146 (1.02)
Change in income x age^2 x 10^{-3}		.374 (1.05)	.375 (1.05)
Change in income x age^3 x 10^{-6}		-3.13 (1.10)	-3.13 (1.10)
R^2	.0045	.0050	.0050
N	10,015	10,015	10,015

Dependent variable is change in consumption. Absolute value of asymptotic t-statistics are in parentheses (standard errors are heteroskedasticity robust). Income and consumption changes from years 1984-1986 were included in the sample. Wealth measure is real net wealth in 1984.

Table 3

	1	2	3
Change in income	.0124 (5.01)	.113 (0.83)	.113 (0.83)
Change in income x wealth x 10^{-9}	-12.8 (3.61)	-8.89 (1.94)	-6.02 (0.15)
Change in income x $wealth^2$ x 10^{-15}			-5.45 (0.15)
Change in income x $wealth^3$ x 10^{-21}			2.23 (0.30)
Change in income x age		-.00736 (0.69)	-.00740 (0.70)
Change in income x age^2 x 10^{-3}		.178 (0.68)	.179 (0.68)
Change in income x age^3 x 10^{-6}		-1.44 (0.68)	-1.44 (0.69)
R^2	.0038	.0041	.0041
N	16,835	16,835	16,835

Dependent variable is change in consumption. Absolute value of asymptotic t-statistics are in parentheses (standard errors are heteroskedasticity robust). Income and consumption changes from years 1983-1987 were included in the sample. Wealth measure is real net wealth in 1984.

Table 4

	1	2	3
Change in income	.0123 (7.53)	.135 (1.58)	.113 (0.83)
Change in income x wealth x 10^{-9}	-10.6 (3.33)	-8.31 (2.39)	-52.3 (1.94)
Change in income x wealth^2 x 10^{-15}			42.2 (1.66)
Change in income x wealth^3 x 10^{-21}			-9.47 (1.51)
Change in income x age		-.00884 (1.31)	-.00855 (1.27)
Change in income x age^2 x 10^{-3}		.208 (1.22)	.206 (1.21)
Change in income x age^3 x 10^{-6}		-1.61 (1.17)	-1.62 (1.18)
R^2	.0033	.0035	.0036
N	36,518	36,518	36,518

Dependent variable is change in consumption. Absolute value of asymptotic t-statistics are in parentheses (standard errors are heteroskedasticity robust). Income and consumption changes from years 1976-1987 were included in the sample. Wealth measure is real net wealth in 1984.

Table 5

	1	2
Change in income	.113 (0.83)	.113 (0.83)
Change in income x wealth x 10^{-9}	-9.33 (1.97)	-10.7 (2.17)
Change in income x age	-.00739 (0.70)	-.00739 (0.69)
Change in income x age^2 x 10^{-3}	.179 (0.68)	.174 (0.66)
Change in income x age^3 x 10^{-6}	-1.44 (0.68)	-1.38 (0.65)
R^2	.0041	.0046
N	16,835	16,835

Dependent variable is change in consumption. Absolute value of asymptotic t-statistics are in parentheses (standard errors are heteroskedasticity robust). Income and consumption changes from years 1983-1987 were included in the sample. Wealth measure in column 1 is real net wealth in 1984 excluding the net value of the primary home.Wealth measure in column2 is real net wealth in 1984 excluding the gross value of the primary home.

Table 6

	1	2
Change in income x ($nw \leq 0$)	.0224 (3.42)	.0990 (0.70)
Change in income x ($0 < nw \leq 1000$)	.0181 (2.72)	.0949 (0.68)
Change in income x ($1000 < nw \leq 10,000$)	.0142 (4.43)	.0916 (0.65)
Change in income x ($10,000 < nw \leq 50,000$)	.00826 (1.50)	.0865 (0.62)
Change in income x ($50,000 < nw \leq 200,000$)	.0109 (2.61)	.0901 (0.64)
Change in income x ($200,000 < nw$)	-.00540 (1.13)	.0784 (0.55)
Change in income x age		-.00596 (0.55)
Change in income x age^2 x 10^{-3}		.151 (0.56)
Change in income x age^3 x 10^{-6}		-1.28 (0.60)
R^2	.0041	.0043
N	16,835	16,835

Dependent variable is change in consumption. Absolute value of asymptotic t-statistics are in parentheses (standard errors are heteroskedasticity robust). Income and consumption changes from years 1983-1987 were included. Expressions in parentheses represent dummy variables equal to one if the expression is true; nw is real net wealth in 1984.

Table 7

	1	2
Change in income x $(nw \leq 0)$	.0252 (4.79)	.114 (1.30)
Change in income x $(0 < nw \leq 1000)$	.0250 (4.12)	.113 (1.29)
Change in income x $(1000 < nw \leq 10,000)$	.0144 (5.68)	.103 (1.17)
Change in income x $(10,000 < nw \leq 50,000)$	.0105 (3.65)	.0997 (1.14)
Change in income x $(50,000 < nw \leq 200,000)$	.00352 (0.96)	.0931 (1.04)
Change in income x $(200,000 < nw)$	-.00123 (0.29)	.0900 (1.02)
Change in income x age		-.00704 (1.02)
Change in income x age^2 x 10^{-3}		.180 (1.04)
Change in income x age^3 x 10^{-6}		-1.49 (1.06)
R^2	.0041	.0043
N	36,518	36,518

Dependent variable is change in consumption. Absolute value of asymptotic t-statistics are in parentheses (standard errors are heteroskedasticity robust). Income and consumption changes from years 1976-1987 were included. Expressions in parentheses represent dummy variables equal to one if the expression is true; nw is real net wealth in 1984.

Table 8

	1	2	3
Change in income	.0123 (4.51)	.128 (0.95)	.114 (0.83)
Change in income x wealth/aveinc x 10^{-3}	-.621 (1.86)	-.313 (1.19)	-1.14 (1.31)
Change in income x $(\text{wealth/aveinc})^2$ x 10^{-6}			20.7 (1.71)
Change in income x $(\text{wealth/aveinc})^3$ 10^{-9}			-62.6 (0.42)
Change in income x age		-.00882 (0.83)	-.00767 (0.72)
Change in income x age^2 x 10^{-3}		.225 (0.85)	.196 (0.74)
Change in income x age^3 x 10^{-6}		-1.91 (0.90)	-1.65 (0.79)
R^2	.0032	.0039	.0041
N	16,835	16,835	16,835

Dependent variable is change in consumption. Absolute value of asymptotic t-statistics are in parentheses (standard errors are heteroskedasticity robust). Wealth/aveinc is real net wealth in 1984 divided by the average household income in the sample period. Data from 1983-1987 included in the regression.

Table 9

	1	2	3
Change in income	.403 (0.71)	.284 (1.69)	.154 (1.18)
Change in income x wealth x 10^{-9}	-20.6 (2.51)	-10.9 (1.96)	-12.0 (2.37)
Change in income x apc	-.193 (4.08)	-.0785 (1.54)	-.0422 (1.18)
Change in income x age	-.0286 (1.68)	-.0204 (1.56)	-.0100 (0.99)
Change in income x age^2 x 10^{-3}	.722 (1.64)	.525 (1.61)	.244 (0.97)
Change in income x age^3 x 10^{-6}	-5.84 (1.60)	-4.36 (1.68)	-1.96 (0.98)
R^2	.0077	.0059	.0043
N	3311	10,015	16,835

Dependent variable is change in consumption. Absolute value of asymptotic t-statistics are in parentheses (standard errors are heteroskedasticity robust). Wealth measure is real net wealth in 1984. apc is average propensity to consume over the sample period. Column 1 includes income and consumption changes from 1985; column 2, from 1984-1986, and column 3, from 1983-1987.

Table 10

	1
Change in income	.188 (0.24)
Change in income x wealth x 10^{-9}	-22.7 (0.05)
Change in income x age	-.0138 (0.19)
Change in income x age^2 x 10^{-3}	.356 (0.16)
Change in income x age^3 x 10^{-6}	-3.08 (0.14)
R^2	.0003
N	36,212

Dependent variable is change in consumption. Absolute value of asymptotic t-statistics are in parentheses (standard errors are heteroskedasticity robust). Income and consumption changes from years 1976-1987 were included in the sample. Regression is 2-stage least squares with total inheritance received by household used as an instrument for wealth. Wealth measure is real net wealth in 1984.

Table 11

	1	2	3	4
Change in income	.00354 (6.04)	-.00952 (0.19)	.0460 (0.71)	-.0108 (0.17)
Change in income x wealth x 10^{-9}	-19.4 (2.88)	-18.8 (3.71)	-16.3 (2.58)	-21.3 (0.72)
Change in income x wealth^2 x 10^{-15}				2.61 (0.04)
Change in income x wealth^3 x 10^{-21}				.808 (0.03)
Change in income x apc			.0699 (4.49)	
Change in income x age		.00275 (0.57)	-.00274 (0.54)	.00268 (0.60)
Change in income x age^2 x 10^{-3}		-.0883 (0.74)	.0527 (0.42)	-.0913 (0.77)
Change in income x age^3 x 10^{-6}		.757 (0.79)	-.351 (0.37)	.783 (0.82)
R^2	.0664	.0677	.0039	.0677
N	47,155	47,155	47,155	47,155

Dependent variable is change in consumption. Absolute value of asymptotic t-statistics are in parentheses (standard errors are heteroskedasticity robust). Wealth measure constructed from data on asset income in years 1976-1987. apc is average propensity to consume in the sample period. Individual means subtracted from all variables (except in column 3; see text for details).

Table 12

	1	2	3
Change in income	.00341 (2.28)	.00285 (0.05)	-.00518 (0.82)
Change in income x wealth/aveinc x 10^{-3}	-.387 (3.06)	-.411 (3.69)	-.926 (1.31)
Change in income x $(\text{wealth/aveinc})^2$ x 10^{-6}			21.4 (0.73)
Change in income x $(\text{wealth/aveinc})^3$ 10^{-9}			-153 (0.57)
Change in income x age		.00168 (0.34)	.00235 (0.48)
Change in income x age^2 x 10^{-3}		-.0585 (0.48)	-.0759 (0.62)
Change in income x age^3 x 10^{-6}		.492 (0.50)	.639 (0.79)
R^2	.0663	.0677	.0677
N	47,155	47,155	47,155

Dependent variable is change in consumption. Absolute value of asymptotic t-statistics are in parentheses (standard errors are heteroskedasticity robust). Wealth/aveinc is wealth constructed from asset income divided by the average household income in the sample period. Data from 1976-1987 included in the regression.

Table 13

Wealth Category	dY_{-1}	dY_{-2}	N
$(nw \leq 0)$	-.1723 (14.23)	-.0865 (7.69)	3116
$(0 < nw \leq 1000)$	-.1550 (9.99)	-.0502 (3.61)	2222
$(1000 < nw \leq 10,000)$	-.2040 (20.19)	-.0768 (8.11)	5426
$(10,000 < nw \leq 50,000)$	-.0863 (11.44)	-.0433 (7.69)	4765
$(50,000 < nw \leq 200,000)$	-.0646 (5.10)	-.0188 (2.01)	1166
$(200,000 < nw)$	-.2617 (2.88)	.2177 (2.22)	1251

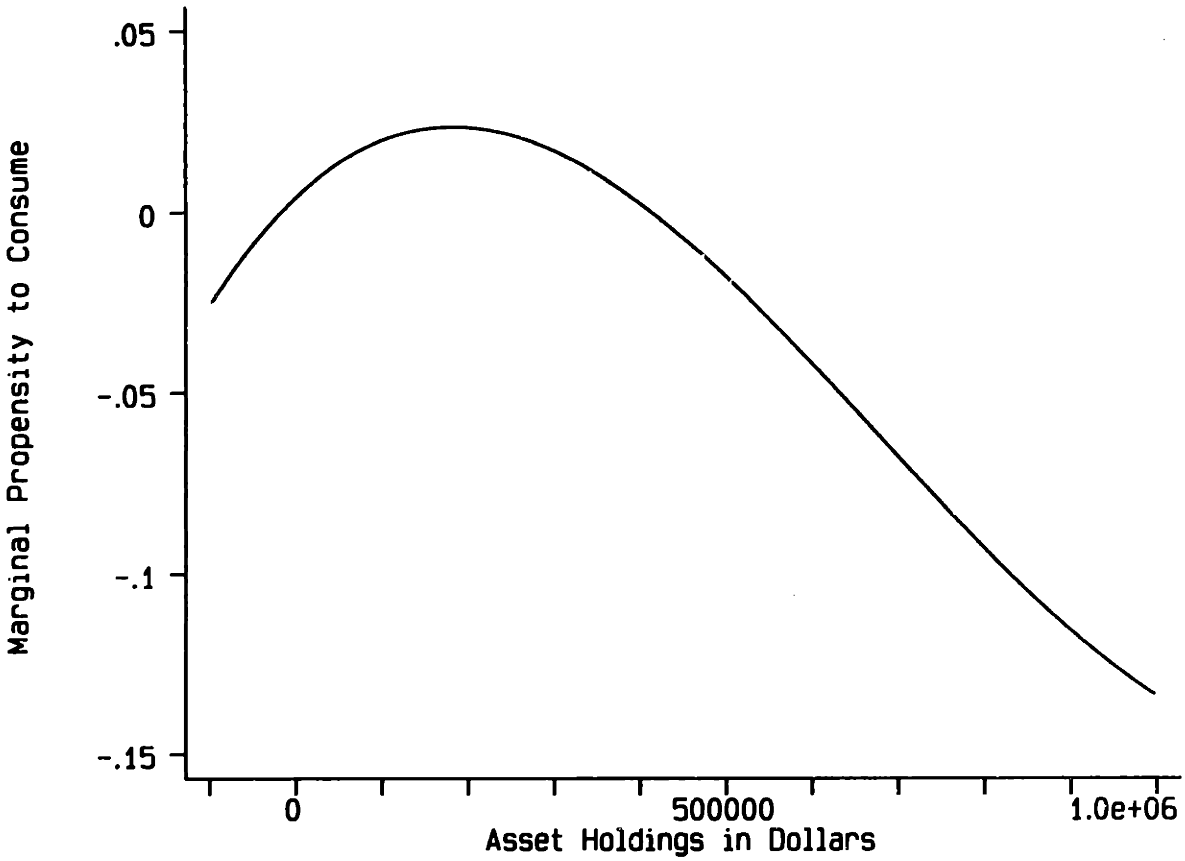
Dependent variable is change in income. Absolute value of asymptotic t-statistics are in parentheses (standard errors are heteroskedasticity robust). Data from years 1983-1987 were included. nw is real net wealth in 1984. dY_{-1} and dY_{-2} are the one and two-period lags of change in income. Dependent variable is change in income.

Table 14

	1	2	3
Posdy	.0122 (3.58)	.0163 (3.52)	.113 (0.84)
Negdy	.00323 (1.12)	.00858 (2.75)	.105 (0.78)
Posdy x wealth x 10^{-9}		-12.6 (3.01)	-9.40 (1.92)
Negdy x wealth x 10^{-9}		-15.1 (6.02)	-11.4 (2.52)
Change in income x age			-.00712 (0.49)
Change in income x age^2 x 10^{-3}			.172 (0.66)
Change in income x age^3 x 10^{-6}			-1.38 (0.67)
R^2	.0025	.0042	.0044
N	20,284	16,385	16,385

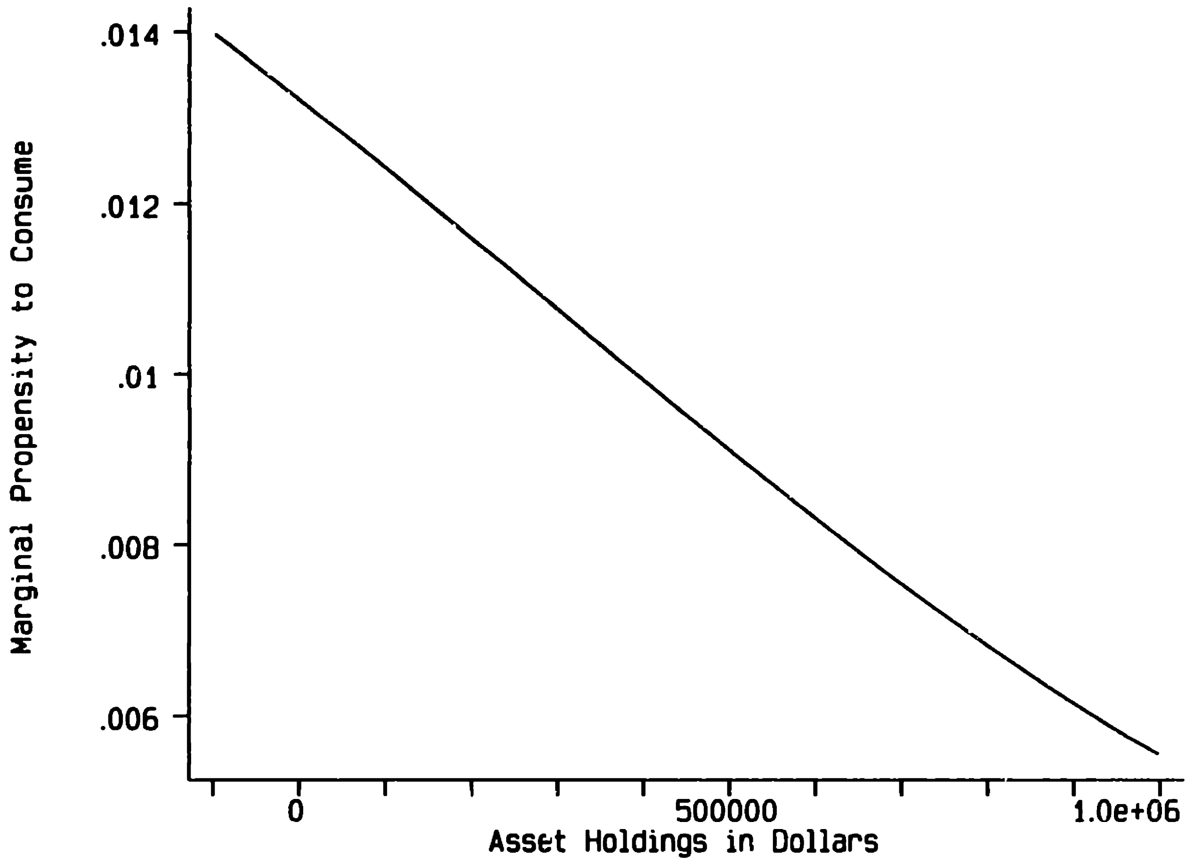
Dependent variable is change in consumption. Absolute value of asymptotic t-statistics are in parentheses (standard errors are heteroskedasticity robust).Posdy=change in income if change was positive, zero otherwise; Negdy=change in income if change was negative, zero otherwise. Data from years 1983-1987 were included in the sample. Wealth measure is real net wealth in 1984.

Figure 1



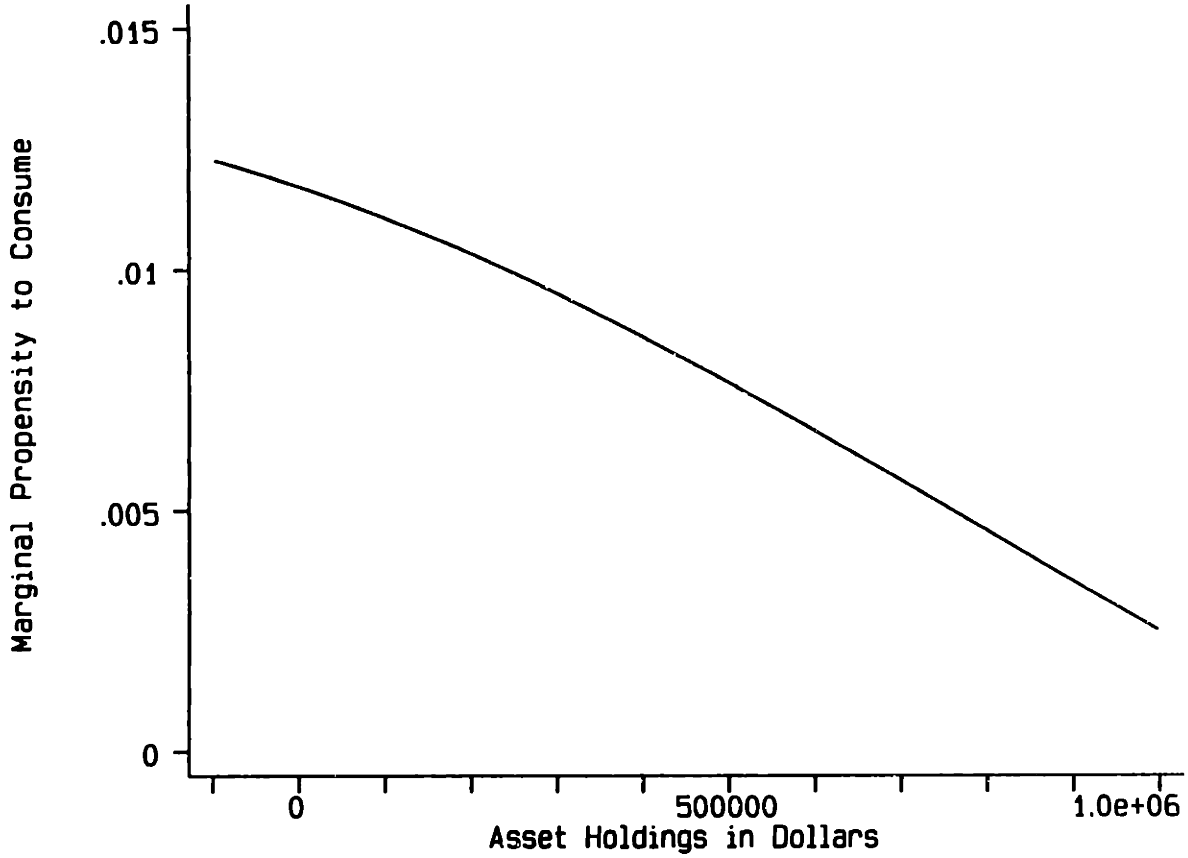
Wealth variable is real net wealth in 1984. MPC is calculated at the sample mean age using coefficients from Table 1. Data from 1985 only included.

Figure 2



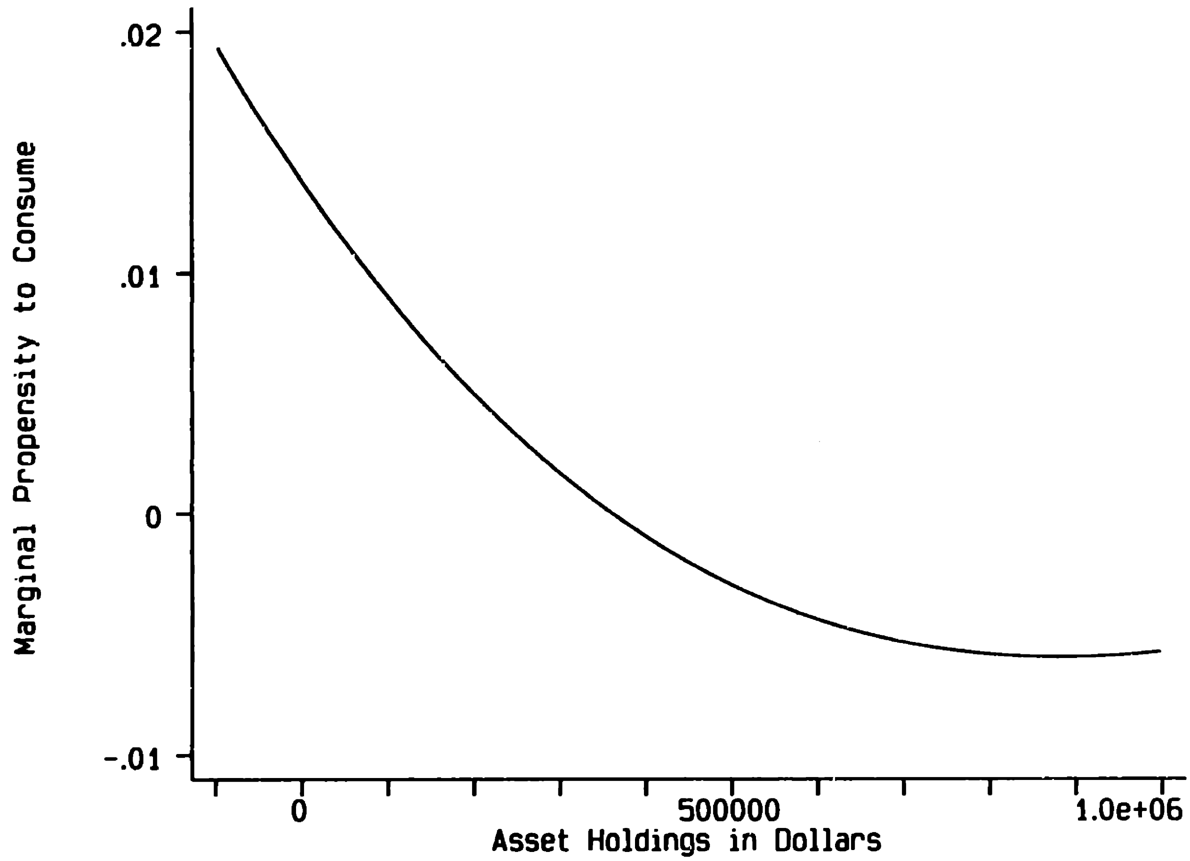
Wealth variable is real net wealth in 1984. MPC is caculated at the sample mean age using coefficients from Table 2. Data from 1984-1986 included.

Figure 3



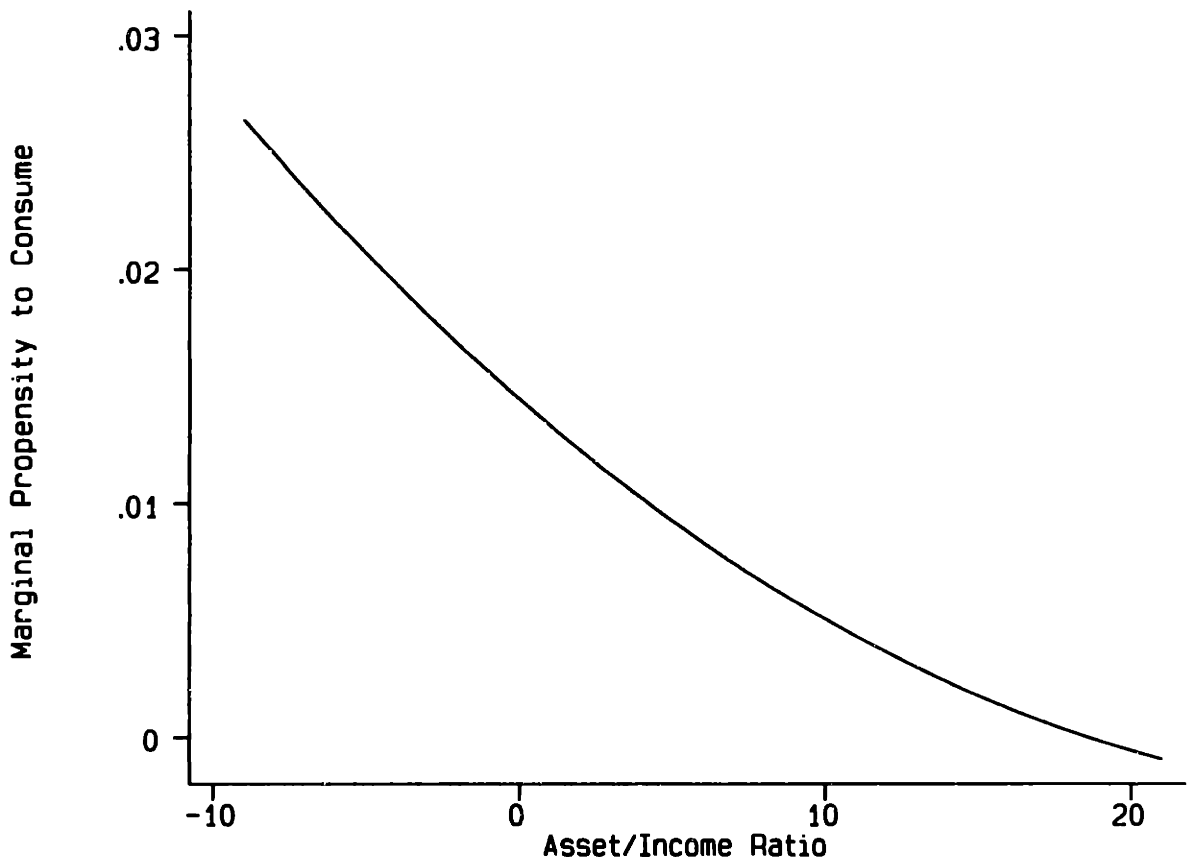
Wealth variable is real net wealth in 1984. MPC is caculated at the sample mean age using coeffi cients from Table 3. Data from 1983-1987 included.

Figure 4



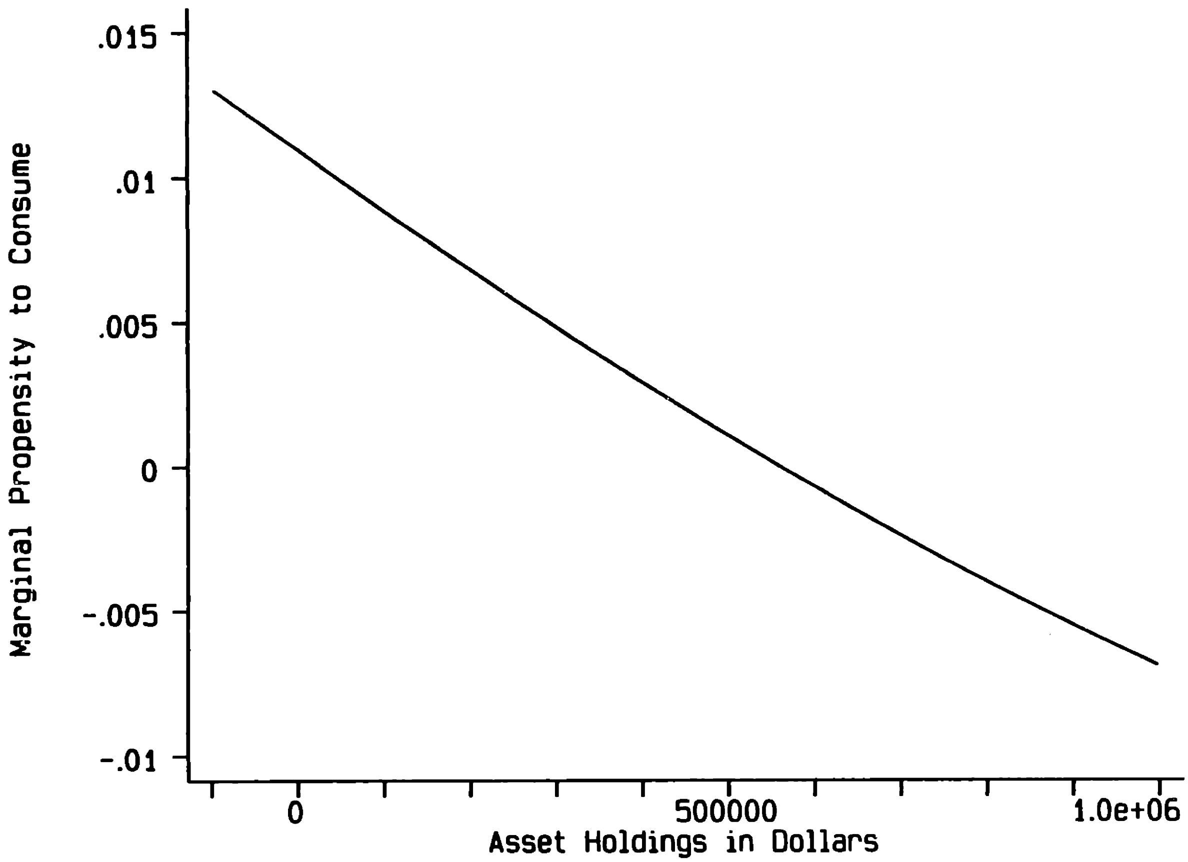
Wealth variable is real net wealth in 1984. MPC is caculated at the sample mean age using coeffi cients from Table 4. Data from 1976-1987 included.

Figure 5



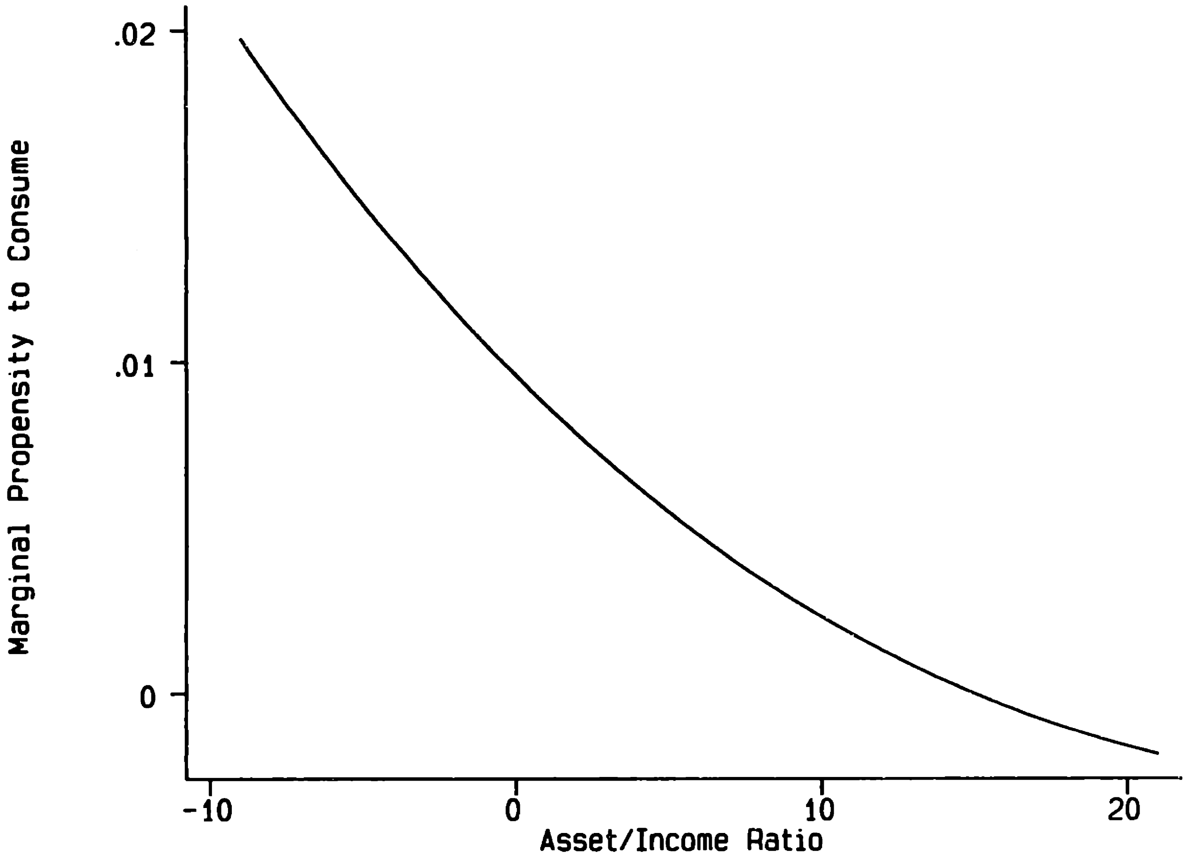
Asset / income ratio is real net wealth in 1984 divided by average income for the household over the sample period. MPC is caculated at the sample mean age using coefficients from Table 9. Data from 1983-1987 included.

Figure 6



Wealth variable is constructed from data on asset income. MPC is calculated at the sample mean age using coefficients from Table 10. Data from 1976-1987 included.

Figure 7



Asset / income ratio is wealth (constructed from asset income) divided by average income for that household over the sample period. MPC is caculated at the sample mean age using coefficients from Table 12. Individual means subtracted from all variables. Data from 1976-1987 included.

Chapter 3

Substitution Between Gifts and Bequests by the Elderly

3.1 Introduction

Wealth derived from intergenerational transfers constitutes a significant share of the aggregate capital in the United States. While the exact magnitude of that share is hotly contested, most researchers estimate that at least 20 percent and perhaps as much as 80 percent of wealth originated as bequests (Kotlikoff and Summers, 1981; Kotlikoff, 1988; Modigliani, 1988). The motivation for bequests is thus an important factor in predicting the effectiveness of policies designed to increase domestic saving and the capital stock. Moreover, in an era of tight budgets and public antipathy towards income taxes, taxes on bequests represent a potentially attractive source of revenue for the government. Calculation of the incentive effects of any such taxes, however, would also require an understanding of the motivation behind bequests. Finally, because theories predicting the neutrality of government debt are based on a particular type of bequest motive, the nature of bequest motives is a crucial factor in determining the effects of a government budget deficit.

Explanations for intergenerational transfers fall into two broad categories. First, there are many reasons individuals might want to leave bequests. Most simply, they may care about their heirs' welfare. Along the same lines, the act of giving gifts itself, rather than the resultant increase in the recipient's utility, may give the donor pleasure.[1]

Bequeathable wealth also might be built up in part to manipulate the behavior of potential heirs, who may be anxious to curry favor with wealthy relatives or friends (Bernheim, Schlieffer and Summers, 1985). Along similar lines, bequests may be a payment under an implicit contract for annuities provided by one's children (Kotlikoff and Spivak, 1981).

On the other hand, since no one knows exactly when they are going to die, bequests may simply be accidental. A person must save some assets up to the point of death to guard against the possibility of a long life, or they risk being left with nothing in their old age (Abel, 1981). I define bequests as unintentional if the bequest motive does not influence consumption and saving behavior, i.e. if there is no operative bequest motive.[2]

Note that this does not necessarily mean that individuals do not get utility from the knowledge that their heirs will benefit from their estate, or that decedents would not prefer to see their estate go to their heirs rather than the government, a fact that seems clear from casual observation. Bequests can be unintentional (by my definition) even if they enter the utility function as long as the individual in question is at a corner solution demanding zero bequests.

In this paper I attempt to establish whether or not bequests are intentional by investigating whether inheritance tax rates have an impact on the giving of inter vivos gifts. If bequests were purely accidental, inheritance taxes clearly should have no effect on inter vivos gifts. If, on the other hand, at least some part of bequests were intended, higher inheritance tax rates could lead individuals to substitute gifts for bequests. In order to identify the effect of taxes independent of wealth I utilize cross-state differences in bequest taxes. State taxes are ideal for the purposes of this study, not only because they provide variation in tax rates for individuals with similar

[1]While these motives are in a sense similar, they have very different implications for debt neutrality (Andreoni, 1989).

[2]See Abel (1987) for a discussion of operative bequest motives.

assets, but also because in many cases they are levied on estates much smaller than those subject to Federal estate taxes, and thus affect a much higher percentage of decedents. I find evidence that there is significant substitution between bequests and gifts, indicating that at least some part of bequests are in fact intentional.

In the remainder of the paper, I will review previous research and "stylized facts" on bequest motives, detail a simple model demonstrating the effect of inheritance taxes on gifts in the case of intentional bequests, describe the data used in the study, present the empirical results, and conclude.

3.2 Previous Research

An argument once often cited in favor of a bequest motive is the savings behavior of the elderly. Cross-sectional studies find that wealth continues to rise with age after retirement, a pattern difficult to reconcile with the absence of bequest motives (Mirer, 1979; Kurz, 1984). There are, however, many reasons to question the applicability of these cross-sectional results to the behavior of individuals, not least the negative relation between wealth and mortality rates. Panel studies, in contrast, have found that wealth indeed falls on average after retirement, although it rises for a significant fraction of households (Diamond and Hausman, 1982; Hurd, 1987).

Stronger evidence in favor of a bequest motive is provided by the relative lack of annuitization by the elderly. An annuity is simply a financial instrument that pays some amount in installments until the death of the purchaser, at which time all liability is canceled. The return on an annuity will in general be higher than that on a bond because the stream of payments ceases upon death and because there is no principal to be repayed. Thus an elderly person with no bequest motive, wanting only to maximize consumption until death, would convert all assets to annuities (Yaari, 1965). In fact only a small percentage of the elderly actually purchase annuities on the private market, though almost all hold significant amounts in the form of social security and pensions. The apparent reluctance on the part of the elderly to annuitize their resources is consistent with a bequest motive since annuities by definition cannot be bequeathed.

There are, however, several alternative explanations for the limited use of annuities by the elderly. An annuity can be considered an insurance policy against an unusually long life, because the payment stream is continued until death. As with most types of insurance, there is likely to be some degree of adverse selection. Those who expect to live an unusually long time have a greater incentive to buy annuities, and this lowers the return for all purchasers (assuming that individuals have information on their lifespan unobservable by insurance companies). Moreover, providers of annuities require some profit margin. For these reasons, the return on annuities is not "actuarially fair": the cost of an annuity is greater than the expected value of the stream of payments for an average individual. Friedman and Warshawsky (1990) find the effect on cost to be significant. Without a bequest motive, however, an individual will completely annuitize as long as the return on annuities is greater than that on alternative investments (e.g. bonds), a condition that appears to hold.[3]

Annuities may also be less liquid than some other assets. If individuals hold private information on their probability of death, it may be difficult to sell annuity policies except at a deep discount (indeed this problem may be more serious than that caused by the information asymmetry involved in buying annuities, as individuals are more likely to have private information about impending death than about a long future life). If the possibility of uncertain events, such as catastrophic medical expenses, plays a large role in the savings behavior of the elderly, the relative illiquidity of annuities could be an important factor in their lack of popularity.

Bernheim (1991) exploits an intriguing fact in an attempt to investigate bequest motives: the proper mix of (actuarially fair) annuities and life insurance is a perfect substitute for bequeathable wealth. Many elderly hold a large fraction of their total wealth in the form of annuities from social security. Because the level of social security established by a fixed formula and not subject to choice, these individuals could be

[3]This is true even for individuals who have provate information that leads them to expect a short lifetime. While annuities will be the most unfair for this group, they will still dominate bonds that pay a lower interest rate if there is no extra benefit from holding bequeathable wealth.

"overannuitized"; they might desire to leave some of their social security wealth as a bequest. While they cannot do this directly,[4] they can accomplish the same thing in practice by using some of their social security payments to pay life insurance premiums, with their heirs designated as the beneficiaries. Thus if bequests were intended, one might expect those with a greater level of annuities from social security to also have more life insurance.

Bernheim finds that this relation holds in a sample of elderly from the 1970's. The level of life insurance held is significantly and positively related to the level of social security payments. A possible criticism of this result is that social security payments are not exogenous; they depend on an individual's earnings history. The regressions employed control for the level of "lifetime earnings" as calculated from earnings histories. In theory this means that the differences in benefits are identified only off of differences in the pattern, not level, of earnings. An example is the division of earnings between spouses. This, however, is a factor that might well influence the level of life insurance held independently of any bequest motive. Furthermore, over time there has been a large trend upwards in the level of social security benefits which has not been accompanied by a comparable rise in life insurance holdings (Auerbach, Kotlikoff, and Weil, 1992).

An alternative strategy is to try to isolate factors that could separate individuals based on the level of their bequest motives. Hurd (1987) assumes that if bequest motives existed, individuals with children would have a stronger motive than others. Because of this, one would expect those with children to dissave their assets after retirement at a lower rate than others in an effort to maintain greater bequeathable wealth. In fact, both couples and singles with children appear to dissave more rapidly than those without children. This appears to cast doubt on the existence of bequest motives.

It seems possible, however, that childless individuals form attachments as strong as the bond between parents and children, and have an equal desire to pass on their

[4]The direct sale of the annuity stream represented by social security payments is prohibited by law.

wealth. Moreover, Hurd's analysis implicitly assumes that all dissaving represents personal consumption. In fact, parents with living children may give them significant gifts. This alone could account for the their relatively high dissaving rates.

Crown and Leavitt (1992) is one of the only studies to examine the effects of state death taxes on behavior. It found differentials in state tax rates lead to migration by the elderly from high to low tax states. If true, this finding would suggest that at least an amount of bequests equal to the cost of moving was intended (only in this case would moving be worthwhile). The cost of "legal" as opposed to actual migration may be very low, however, amounting in some cases simply to officially establishing residence in a vacation home. Moreover, the results are subject to criticism as much of the migration found was from high tax northeastern states (Massachusetts, New York) to low tax southern states (Arizona, Florida). This may be a natural migration pattern regardless of state tax rates, making the results difficult to interpret.

3.3 Theory

To fix ideas about substitution between gifts and bequests I begin by examining a one-period utility function of the form

$$U = U\left(c, g, \lambda b(1-t)\right)$$

where c is consumption, g is a gift, λ is a dummy variable equal to one if bequests provide utility and zero otherwise, b is the bequest, and t is the proportional tax rate on the bequest. (For simplicity I assume an individual lives only one period and that there is only one recipient for the gift and bequest). Trivially, if bequests do not enter the utility function the tax should have no effect on behavior.[5] In the presence of a bequest motive, an rise in the bequest tax will increase the level of gifts given as long

[5]If the individual is at a corner solution demanding zero bequests (i.e. the bequest motive is inoperative), a lower tax rate could in principle result in substitution toward bequests. In the context of the empirical work that follows, however, unless the bequest motive is operative at a level of taxes that applies to some individual on the sample, there will be no measured effect of taxes on gifts.

as gifts and bequests are gross substitutes.[6]

If the bequest does enter the utility function, it seems likely that the gift would be a close substitute for the bequest as they both perform the same role- transferring resources to another individual. This brings up another question, however: if gifts and bequests are essentially the same act with different timing, and bequests face higher taxes than gifts (as is true in actuality), why would any planned transfers take the form of bequests?

One factor is that the inter vivos transfer of a substantial portion of a parent's wealth (for example) may significantly alter family relationships, possibly leading to a loss of authority or attention. (A theme familiar from Shakespeare's King Lear). Because of this, individuals may wish to delay desired transfers until their death.

In addition, the elderly face uncertain costs, including the possibility of catastrophic medical expenses or long-term nursing home care. Potential donors may therefore wish to wait until the uncertainty is resolved before transferring resources.

At any rate, while it cannot be established with certainty that bequest taxes should increase the level of gift-giving, it is certainly true that taxes should have no effect on either the level of gifts given or on the probability of giving a gift above a certain level in the absence of a bequest motive. These are the null hypothesis that I test in this paper.

3.4 Data

The data in this study comes from the 1986 Survey of Consumer Finances (SCF). That survey was a follow up to a 1983 survey which interviewed a random sample of 3,824 households. In 1986, 2,822 of those households were reinterviewed, answering question covering wealth, income, and gifts given and received, among other information.[7] In

[6]Note that because bequests are denominated in dollars, the effect of the tax on the level of the pretax bequest is ambiguous; it will actually be positive if the price elasticity of demand for bequests is less than one. As long as gifts and bequests are sufficiently close substitutes, however, this is unlikely to be the case.

[7]A separate high-income sample of 359 was also interviewed, but for reasons of privacy the state of residence of these households is not identified, making it impossible to identify the death tax rates

particular, each household reported any gifts to another household which exceeded $3000 over the previous three years. The survey thus misses any smaller gifts. It seems likely, however, that gifts given to avoid inheritance taxes tend to be large. In any case, if smaller gifts are affected by taxes, the censoring of the data should bias against finding any effect of death taxes. I limit my analysis to the households whose heads are over 65, on the theory that inheritance taxes are most likely to affect the gift-giving behavior of the elderly.

The primary independent variable I will use is the marginal state death tax for each household. Calculation of this rate is somewhat problematic. State death taxes take one of three forms. In 25 states and the District of Columbia the tax on an estate is equal to the maximum amount that can be deducted from the Federal estate tax. The Federal estate tax allows a credit for state death taxes paid, subject to an upper limit which depends on the size of the estate. This credit was instituted to allow states to gain some revenue from death taxes free of the concern that wealthy elderly might move to another, lower tax state. In these states, the (state) marginal tax rate is effectively zero for all individuals- the state tax amounts only to a transfer from the Federal to state treasury.[8]

Another 7 states rely on an estate tax above and beyond the Federal credit. This tax is a function of the total estate left by the decedent, and applies to the estate before its distribution to heirs.

Lastly, 18 states impose an inheritance tax. This tax is levied on the recipient of a bequest. Because of this, in a state with an inheritance tax, the tax will depend not only on the size of the estate, but also on how it is divided among heirs. For example, because the taxes are in most cases graduated, and include exemptions, an estate divided among many heirs will face lower taxes than an estate given to only

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that they faced.

[8]Because a tax equal to the maximum Federal credit provides revenue to a state at no direct cost to its residents, the Federal credit provides a floor for the state tax. All states that levy estate or inheritance taxes of their own also provide for an "alternative minimum tax" to absorb the Federal credit (interestingly, this was not always the case; as late as 1966 Nevada still had no death taxes at all, thereby foregoing the revenue from the Federal credit, either out of principle or lack of information).

one person.

As a further complication, the tax rate often depends on the decedent's relationship to the heir. Surviving spouses and children tend to face lower tax rates than unrelated individuals, with other close relatives sometimes paying intermediate rates. Calculation of a precise tax rate thus requires knowledge of the household's precise bequest plans, which is not available.

I assume that households with living children will divide the estate equally among them. Menchik (1980) finds evidence in a sample of Connecticut probate records that this type of equal division is the norm. In the absence of records on other relatives, I assume that childless households bequeath to relatives in the next closest category, as defined by the individual state (this category typically includes brothers and sisters, for example).

A significant issue under either type of tax is the number of adults in the household. Households headed by couples can limit total tax liability by spreading out the total bequest to the ultimate heirs over two estates. I attempt to control for this problem by including a dummy variable for single headed household in the regressions that follow.

Another potential problem is that six states levy a tax on gifts as well as bequests. These gift taxes, however, tend to have generous exemptions. Typically the law allows $10,000 in gifts per recipient per year tax free. This means that, for example, a single parent with two children could donate $60,000 to her children tax free over the three year period studied if it were evenly divided between children and among years. In practice, assuming donors pursued this type of tax-minimizing strategy, no one in the sample would have incurred any gift taxes.[9] I therefore do not include any measure of gift taxes in the analysis.

There is also a question of timing. I measure the marginal tax rate that would apply to an estate if the owner died the next day. In fact the date of death is uncertain

[9]Several donors in fact gave exactly the maximum that they could without incurring taxes (assuming all gifts were given to their children), suggesting that at least some households are very conscious of the tax laws.

(for most people, at least). Older individuals, having higher mortality rates, are more likely to face those taxes at any given moment. Moreover, there are independent reasons to think that older individuals might be more likely to give gifts (for example, they have resolved more of their lifetime uncertain expenses). In fact several studies (Scholz, 1991; Altonji, Hayashi, and Kotlikoff, 1992) have found that older individuals give more gifts. For these reasons I also include age as an independent variable in my regressions.

As in any empirical work that utilizes cross-state differences, there is some danger that bequest tax rates or state of residence could be endogenously determined. If gifts and bequests are actually close substitutes as I have assumed, however, the endogeneity could bias the results in favor of the null hypothesis of taxes having no effect. Assume, for example, that there are two types of people, generous and stingy, where generous people want to transfer money to others (both inter vivos and via bequests) and stingy people do not. Then states with a majority of generous people are likely to vote in laws for low inheritance taxes, but also have a higher level of gifts. Moreover, the generous elderly will have a motivation to move to states with low taxes, again producing a negative correlation between taxes and gifts.

This is, of course, only one of many possible stories. A model in which some people prefer to give via gifts and others prefer to give via bequests would lead to the opposite conclusion (although this does not seem as intuitive to me). Ultimately, to take the results obtained in this paper at face value requires the assumption that endogeneity does not significantly affect the assignment of laws to individuals.

State inheritance and estate tax rates were obtained from the Commerce Clearing House State Tax Guide. Table 1 shows the calculated tax rates for families with assets of $50,000, $200,000, and $500,000 for all the states that would levy non-zero taxes on estates of that size. Each family is assumed to have one child who will receive the entire estate. The marginal tax rates on the smallest estate range to a high of 6% in Pennsylvania, while those on the largest estate are highest in Massachusetts or Kentucky at 10%. Note that while there is a fair amount of variation in the tax rates shown, a large part of the sample variation is between the states shown and those with marginal tax rates of zero.

The Federal government also levies an estate tax. Because of a large credit, the Federal estate tax applies only to estates of more than $600,000, but begins at a marginal tax rate of 37%, far above the rates charged by any state. To avoid Federal taxes confounding the analysis, I include a dummy variable for wealth greater than $600,000. This should control for the effects of the Federal tax, which applies equally to everyone.

In addition to the tax rate, I include as independent variables two separate measures of resources. Net wealth in 1983 is simply current assets minus liabilities at the beginning of the sample period. The net present value of pensions and social security is the total annuity value of the all pensions plus social security (i.e. the stream of payments discounted by both the interest rate and the probability of death).

Table 2 shows means of the variables used. The sample mean of gifts is $3743, but among the 13% of households that reported gifts of over $3000 (i.e. those with non-zero gifts as measured by the survey), the mean gift was over $28,000. The marginal bequest tax averaged 1.18% for the entire sample, and 2.30% for those who gave gifts. Wealth is significantly greater for those who gave gifts. More than 90% of the households on the sample have children, and more than a third of household heads are single.

3.5 Results

I begin by attempting to determine whether individuals in states with non-zero bequest taxes were more likely to give gifts of over $3000. This is a relatively conservative approach, as it ignores differences in the severity of the taxes between states. In addition, many households in the states with taxes would not face a bequest tax because their wealth is too low. Column 1 of Table 3 shows the results of a probit regression with a dummy veriable equal to one if the household reported gifts over $3000 as the dependent variable.[10] The coefficient on the dummy variable taxdum is positive, as expected, but is not statistically significant. Column 2 shows the results of a tobit regression with the level of gifts as the dependent variable. The point estimate of the coefficient on taxdum is large, implying more than $9000 more in gifts were given in states that had death taxes. Once again, however, the coefficient is not significant.

In order to obtain a more precise estimate of the effect of bequest taxes in the probability of giving a gift, in Table 4 I substitute the calculated marginal tax rate on bequests (tax) for the dummy variable, again using a probit formulation.[11] Table 4, column 1, shows the results for the basic equation. The coefficient on the marginal bequest tax is positive and significant at the 5% level, implying that higher taxes increase the likelihood of a large gift, as would be expected if some part of bequests were intentional. The coefficient estimate implies that a one-percent increase in the marginal bequest tax rate leads to a 7% increase in the likelihood of giving gifts of more than $3000.

As would be expected (as long as gifts were a normal good), bequeathable wealth and the present value of pension wealth, which together summarize the bulk of the resources available to those in the sample, are positively related to the probability of a large gift being given. The coefficient on pension wealth is significant at the 5% level, while that on bequeathable wealth is significant at the 10% level. Interestingly, a marginal dollar of annuity wealth appears to have a larger effect on the probability of a gift than does a marginal dollar of bequeathable wealth.[12] This provides some additional evidence that bequests may be intentional. As described above, Bernheim (1991) theorizes that individuals who desire to leave some of their annuity wealth to their heirs may buy life insurance. Another strategy, however, would be to simply give

[10] The variables in Table 3 are as follows: taxdum is a dummy variable equal to one if the state of residence has a non-zero bequest tax; wealth is net bequeathable wealth; pvpen is the present value of annuity flows, discounted by interest and mortality rates; Wealth > $600,000 is a dummy variable for net wealth greater than $600,000; kid is a dummy variable equal to one if the household has a living child; single is a dummy variable equal to one if the household head is single; and age is the age of the household head.

[11] I assume $Pr(y_i > 3000) = X_i'\beta + u_i$, where Pr denotes probability, y_i is the gift given by household i, X_i is a vector of independent variables, and u_i is a disturbance term distributed normal(0, s). The log likelihood function in this case is $\sum_{y_{[i}} > 3000 \log F(X_i'\beta) + \sum_{y_i<3000} \log(1 - F(X_i'\beta))$.

[12] A test of the equality of the coefficients on wealth and pvpen has a p-value of 7%.

some portion of the annuity received each year to one's heirs. (Unlike life insurance, this does not provide a perfect hedge against lifetime uncertainty, but still results in transferring some of the annuity wealth). This motivation could lead annuity wealth to have a greater affect on gifts than bequeathable wealth.[13]

Having a child or being single positively affects the probability of a gift, as expected, but the coefficients are not significant. Consistent with previous studies, the probability rises with age, but the effect is not statistically significant.

Column 2 allows the influence of an inheritance tax to differ for those with and without children. If households with children have a significantly stronger bequest motive than those without (as assumed in Hurd, 1987, 1989), then the coefficient on the interaction term (tax x kid) should be positive. The coefficient is indeed positive, but not significantly different from zero. A likelihood ratio test indicates that the coefficients on the two tax variables are jointly significant at the 5% level.[14] The other coefficients are similar to those in column 1.

In column 3 the influence of the tax rate is allowed to vary with each of the dummy variables. The interactions with age and being single are both predicted to have a positive effect on gifts: age, because it increases mortality rates and thus the likelihood of a bequest tax being levied in any given period; and being single because it means any bequests outside the household must be left all at once (rather than split between two estates as is possible with a couple) and will thus face higher taxes. Although not statistically significant, the coefficients are positive as expected, with the exception of the interaction with age, which is extremely imprecisely measured. A likelihood ratio test of the hypothesis that all four tax rate coefficients are jointly zero has a p-value of 14%. A test of the hypothesis that the three interactive terms are identically zero has a p-value of 86%.

Table 5 applies a logistic regression to the same set of variables.[15] While the

[13]A possible alternative explanation is that bequests are unintended and that annuities are therefore more valuable to the holders than an equal level of bequeathable wealth, due to the insurance function of the annuity.

[14]The test statistic, distributed as χ^2 with two degrees of freedom, is 6.50 .

[15]The form of the regression is identical to the probit case except that in the equation $Pr(y_i > 3000) = X_i'\beta + u_i$ the error term u_i is assumed to have the logistic distribution rather than the

coefficient estimates differ, the qualitative results are very similar. Most importantly, the bequest tax rate (in a regression without interactions) still has a positive and significant effect on the probability of gifts over $3000.

Table 6 examines influences on the total dollar amount of gifts, using a tobit formulation to account for the fact that the data on gifts is left-censored at $3000.[16] Column 1 shows that the estimated effect of the inheritance tax rate on the level of gifts is positive and significant at the 10% level, once again supporting the idea that bequests are intentional. The measured effect is large: a one percent increase in the marginal tax rate is associated with over $3500 in additional gifts over a three year period.

Pension wealth once again has a larger effect on gift-giving than does bequeathable wealth. The coefficients on kid, single, and age enter positively as expected.

In columns 2 and 3, the experiment of allowing the effect of the tax rate to vary with independent variables is repeated. In neither case are the coefficients on the tax variables jointly significant. The coefficients on the interactions with the tax rate have the expected positive signs, except for the interaction with age.

3.6 Conclusion

The lack of direct data on bequests makes it very difficult to investigate bequest motives. Like several other studies, this paper attempts to surmount the data problem by studying variables with an indirect relation to bequests. It shows that there is a strong positive correlation between bequest tax rates and the likelihood of giving a large amount of gifts. There is also a positive, but statistically weaker, correlation between the amount of gifts given and tax rates. These facts are consistent with the existence of operative bequest motives in at least some portion of the population.

normal.

[16]The regressions assume $y_i = X_i'\beta + e_i$, where y_i is total gifts, X_i is a vector of explanatory variables, and e_i is a disturbance term distributed normal (0, s). The log likelihood function to be maximized is $\sum_{y_i>3000} \log f((y_i - X_i'\beta)/s) + \sum_{y_i<3000} \log F((3000 - X_i'\beta)/s)$, where f and F are the normal and cumulative normal distributions, respectively.

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Table 1

State	Tax type	Tax rate in percent on estate of		
		$50,000	$200,000	$500,000
Connecticut	Estate	0	4	6
Delaware	Inheritance	2	6	6
Indiana	Inheritance	2	3	5
Iowa	Inheritance	1	8	8
Kansas	Inheritance	0	4	4
Kentucky	Inheritance	5	7	10
Louisiana	Inheritance	3	3	3
Maryland	Inheritance	1	1	1
Massachusetts	Estate	0	10	10
Michigan	Inheritance	2	4	7
Nebraska	Inheritance	1	1	1
New York	Estate	0	4	6
Ohio	Estate	3	5	7
Oklahoma	Estate	0	1.5	6.5
Pennsylvania	Estate	6	6	6
South Dakota	Inheritance	6	7.5	7.5

Tax rate is the marginal tax rate on an additional dollar given to a single child out of an estate of the total size shown.

Table 2

Variable	Mean	
	Sample	If gifts > $3000
Total gifts	3743	28,368
Gifts > $3000	.132	1
Tax rate	1.18	2.30
Wealth	154,296	421,852
Npvpen	126,856	162,798
Wealth > $600,000	.047	.20
Kid	.905	.938
Single	.385	.296
Age	74.1	73.4
N	485	64

Total gifts is the dollar amount of gifts given to individuals outside the household in the past three years. Gifts > $3000 is a dummy variable equal to one if gifts totalled more than $3000. Tax rate is the marginal state bequest tax rate facing a household (see Data section for notes on derivation). Npvpen is the net present value of all pensions, disability payments, and social security. Wealth > $600,000 is a dummy variable equal to one if household wealth is greater than $600,000. Kid is a dummy variable equal to one if the household head has children. Single is a dummy variable equal to one if the household head is single. Age is the age of the household head. All dollar variables are measured in 1986 dollars.

Table 3

	Probit 1	Tobit 2
Taxdum	.178 (1.15)	9265 (0.79)
Wealth (x 10^{-6} in col. 1)	.610 (2.19)	.501 (2.57)
Npvpen (x 10^{-6} in col.1)	2.40 (2.34)	.159 (2.06)
Wealth > $600,000	.556 (1.28)	39,470 (1.31)
Kid	.165 (0.57)	11,961 (0.54)
Single	.170 (0.88)	15,684 (1.06)
Age	-.000903 (0.07)	719 (0.72)
Log likelihood	-167.03	-796.62
N	485	485

Dependent variable in column 1 is an indicator equal to one if gifts over $3000 were given and zero otherwise. Dependent variable in column 2 is total dollar value of gifts given. Absolute value of t-statistics are in parentheses.

Table 4
Probit

	1	2	3
Tax	.0719	.0393	.0237
	(2.51)	(0.69)	(0.07)
Tax x kid		.0453	.0793
		(0.69)	(0.88)
Tax x single			.0493
			(0.60)
Tax x age x 10^{-3}			-.368
			(0.08)
Wealth x 10^{-6}	.471	.457	.451
	(1.65)	(1.58)	(1.56)
Npvpen x 10^{-6}	2.49	2.52	2.52
	(2.41)	(2.44)	(2.43)
Wealth > $600,000	.562	.561	.583
	(1.28)	(1.27)	(1.32)
Kid	.272	.164	.139
	(0.89)	(0.49)	(0.41)
Single	.211	.226	.174
	(1.07)	(1.14)	(0.80)
Age	-.00155	-.00134	-.000741
	(0.91)	(0.01)	(0.05)
Log likelihood	-167.03	-166.78	-166.60
N	485	485	485

Dependent variable is an indicator equal to one if gifts over $3000 were given and zero otherwise. Absolute value of t-statistics are in parentheses.

Table 5
Logit

	1	2	3
Tax	.125	.0678	.145
	(2.49)	(0.70)	(0.23)
Tax x kid		.0821	.126
		(0.72)	(0.80)
Tax x single			.0793
			(0.55)
Tax x age			-.00184
			(0.23)
Wealth x 10^{-6}	.988	.960	.940
	(1.40)	(1.36)	(1.35)
Npvpen x 10^{-6}	3.95	3.99	4.00
	(2.06)	(2.08)	(2.09)
Wealth > $600,000	.839	.844	.877
	(0.99)	(0.99)	(1.05)
Kid	.507	.277	.250
	(0.85)	(0.43)	(0.38)
Single	.352	.385	.291
	(0.94)	(1.01)	(0.70)
Age	-.00585	-.00531	-.00239
	(0.22)	(0.20)	(0..08)
Log likelihood	-167.91	-167.64	-167.49
N	485	485	485

Dependent variable is an indicator equal to one if gifts over $3000 were given and zero otherwise. Absolute value of t-statistics are in parentheses.

Table 6
Tobit

	1	2	3
Tax	3,580	2,463	14,277
	(1.65)	(0.57)	(0.60)
Tax x kid		1,489	3,592
		(0.30)	(0.52)
Tax x single			4,208
			(0.68)
Tax x age			-196
			(0.65)
Wealth	.0442	.0439	.0438
	(2.23)	(4.70)	(2.20)
Npvpen	.165	.167	.168
	(2.13)	(2.21)	(2.15)
Wealth > $600,000	37,923	37,577	40,258
	(1.26)	(2.22)	(1.32)
Kid	17,162	13,599	12,709
	(0.75)	(0.53)	(0.49)
Single	18.150	18,636	13,486
	(1.20)	(1.23)	(0.80)
Age	593	595	1012
	(0.59)	(0.59)	(0.86)
Log likelihood	-795.56	-795.51	-795.14
N	485	485	485

Dependent variable is total dollar value of gifts given. Absolute value of t-statistics are in parentheses.