“High and Low Savers? Circumstances, Patience, and Cognition”

JOB MARKET PAPER

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Abstract: Based on theory and new data, this paper develops a measure that focuses in on individual differences in consumption (or savings) decisions. This measure, the average propensity to consume out of "full" wealth, escapes much of the heterogeneity in traditional savings rates due to past shocks or other circumstances to instead reflect primarily differences in personal attributes. Full wealth is a comprehensive measure including net worth and capitalized future income (deterministic for older households), that is equivalent to the stock value of permanent income looking forward.

The paper compares the average consumption propensity observed in the HRS to the theoretical predictions of a neoclassical model with uncertainty in mortality and asset returns. Within this model using full wealth, the average propensity to consume depends only on four factors: mortality, expected asset returns, bequests, and preferences. After controlling for subjective mortality, expected asset returns, and bequests using survey data, the model with homogeneous preferences cannot account for the majority of the differences across households. More importantly, this measure confirms the finding that the rich have lower average propensities to consume (and therefore higher propensities to save) even using full wealth. Within the neoclassical model, such a wealth-savings correlation can only be explained by heterogeneous time preferences. Weak proxies for patience available in the data do correlate with the unexplained differences across households.

Looking outside the neoclassical model, other inherent differences across households such as cognitive and planning ability also correlate with the unexplained heterogeneity. Basic cognitive skills, planning horizon, and expectations formation are significant even when education is not. Therefore inherent differences across households, through heterogeneous preferences and ability, are shown to matter in explaining differences in consumption propensities.

I. Introduction

Do the rich save more? Positive correlations between income or wealth and the propensity to save are commonly found empirically (Dynan, Skinner, and Zeldes 2000; Avery and Kennickell 1991; Bosworth, Burtless, and Sabelhaus 1991; Mayer 1972). Theory often counters with explanations such as that consumption smoothing implies a positive correlation between current income and saving rates due to transitory shocks (people compensate for temporarily high income with more saving and vice versa). However, as concluded by a major survey of savings literature, if measurement error and within household income variation over time are not the main factors in the empirical observations of correlation between income and saving "…then the observed positive correlation is due to genuine permanent differences in saving behavior." (Browning and Lusardi, 1996) Dynan et al find that the strong correlation remains when proxies for permanent income are used instead of current income, seemingly ruling out transitory shocks as the primary explanation. Yet little progress has been made on demonstrating or defining such "permanent differences" across households that would account for the income-saving correlation.

Few economists would disagree that people differ in personal attributes. Even including preferences as economists define them, and stating that those differences affect economic decisions such as how much to save, is not too controversial. Yet many models of consumption (and therefore saving), or those explaining the distribution of accumulated wealth, begin with identical agents and generate heterogeneity through shocks.[2] These models contain preference parameters that theoretically allow people to differ, but since distributions of such parameters cannot be effectively identified empirically, most empirical exercises treat people as homogeneous in preferences (with a few exceptions noted below).[3]

Some personal attributes such as patience (which is centrally important to the saving decision) are almost never measured directly. Therefore it's difficult to prove the importance of the role such attributes play in explaining differences in consumption decisions across people. Furthermore, these attributes or "permanent differences" need not all be preferences as traditionally defined, which generally imply an element of choice. Behavioral theorists point to issues of self-control as well as the complexity of the optimization problem facing agents in standard models as explanations for the potential failure of these models to capture actual behavior (among others: Caplin and Leahy 2000; Laibson 1996; Mullainathan and Thaler 2000). Along these lines, differences across households in cognitive and planning

[2] Cagetti and DiNardo (2006)
[3] In some cases education is used to separate people into broad categories that we expect to be correlated with preference differences, but education also often serves as a proxy for permanent income, age profile of labor earnings, or other important factors at the same time.

ability could also contribute to differences in saving propensities and the income-saving correlation.

Based on theory and new data, this paper develops a measure that focuses in on individual differences in the propensity to consume (or save)[4]. It escapes much of the heterogeneity in savings due to past shocks or other circumstances to instead reflect primarily differences in personal attributes. This measure confirms the finding that the rich have lower average propensities to consume (and therefore higher propensities to save) even when a comprehensive measure of wealth (including human wealth, i.e. future resources) is used. The paper shows that within the neoclassical model and in this context of full wealth, such a wealth-savings correlation can only be explained by heterogeneous time preferences. Looking outside the neoclassical model, other personal attributes or "permanent differences" across households, such as cognitive and planning ability, also explain some of the heterogeneity in the average propensity to consume out of full wealth.

The Average Propensity to Consume Out of Full wealth:

Showing that people consume differently out of similar current income does not necessarily demonstrate genuine differences across households (meaning differences in preferences within the neoclassical model). Several other things would need to be known: where in the life-cycle they are, how much wealth they have, their expected income growth, and how much risk they face. Since Modigliani[5], the prevailing theory of consumption suggests that people consume out of permanent income, involving future as well as current resources. Even knowing the propensity to consume out of wealth (meaning net worth), or

[4] As with much of the literature, since savings are not directly observed but consumption is, this paper uses a model of consumption and differences across households in consumption propensities to address questions about savings.

[5] Modigliani and Brumberg (1954); Ando and Modigliani (1963).

"cash on hand" (current income plus net worth) there are still two unknowns, future resources and their risk.

But if risk could be put aside and wealth defined comprehensively as the expected value of all current and future resources, as intended by Modigliani's concept of permanent income, then the average propensity to consume out of Modigliani's full wealth would have very limited sources of difference across people other than preference. In other words, with a fixed expected present value of resources available for the remainder of one's life, neoclassical consumption theory says people with the same remaining years of life should spend about the same fraction of their resources in a given period. This is true regardless of whether they are rich or poor, or whether they have faced good shocks or bad shocks in the past.

With new data available in the Health and Retirement Study (HRS) both "full wealth" and total consumption can be measured together credibly for the first time in such a comprehensive survey. Furthermore, focusing on retired and near-retired households (the HRS covers ages 50+) implies that future income, primarily in the form of pension annuities, Social Security, and other transfers, is much more stable and predictable than for working-age households. This income can be treated as risk-less and capitalized into a present value with much less concern about income uncertainty. Focusing on consumption in retirement is not just convenient for uncertainty assumptions. Because of the share of net worth held by older households, understanding retirement consumption is critical for understanding wealth creation and capital accumulation, as well as evaluating adequacy of household savings rates and the life-cycle model itself.

Much of the consumption and saving literature focuses on Euler equations, using the marginal propensity to consume, or the response to a change in income or wealth. Euler equation analysis can address a range of questions with modest data requirements compared to what's required to test a theory in levels. But when the goal is to understand differences across households and data is available, such analysis is plagued by higher measurement error than analysis of levels (because the data is first-differenced) and insufficient time series to robustly infer characteristics of individual households from growth rates in consumption. First-differencing throws away much of the richness available in cross-sectional data. As usual, repeated cross-section is ideal so that households can be followed over time to properly identify age and cohort effects, and to exploit both average and marginal effects, but thus far only two years of HRS consumption data are available. Nonetheless, the extensive set of relevant covariates available in the HRS make cross-sectional analysis a fruitful starting place.

This paper estimates the average propensity to consume (C/M) for households in the HRS from constructed measures of Modigliani's full wealth (M) and total consumption (C). It compares the observed C/M with theoretical predictions of that propensity generated by a neoclassical model of optimal consumption and asset allocation with two sources of uncertainty, mortality and asset returns. Finding that the observed heterogeneity in C/M is magnitudes greater than that predicted by the model under homogeneous preferences, and also that much of this heterogeneity co-varies with the level of wealth, the paper evaluates the ability of several factors to explain the observed variation. The combination of this model and the richness of HRS data allows reduced form evaluation of factors within the model (such as subjective mortality and expected asset returns) and factors easily added to the model (such as bequests and demographics, i.e. household size), as well as suggestive evidence on the importance of liquidity constraints. Finally, the HRS also enables testing directly for the significance of cognitive and planning measures as well as indirect evidence on patience.

II. Literature

This section briefly addresses three types of relevant literature: those that discuss heterogeneity, either in time preference or in type of consumption behavior ("rule-of-thumb" versus consumption smoothing); those that also use the concept of full wealth emphasized here; and just a few points from the vast consumption literature.

As stated above, few consumption or savings papers focus on heterogeneity in preferences, specifically time preference, being the parameter most important to savings.[6] Exceptions to this include Lawrance (1991), Samwick (1998), and Cagetti (2003), which all find evidence of substantial heterogeneity in time preference. Krusell and Smith (1998) show that heterogeneity in discount rates can explain the distribution of wealth much better than their benchmark representative agent stochastic growth model. Although they also find that heterogeneity does not matter for aggregate movements. Dynan et al argue that heterogeneity in time preferences are not necessary to explain the income-savings correlation they observe, preferring uncertainty in income and health expenses, bequests, and behavioral explanations, yet they do not provide concrete evidence against patience heterogeneity.

Many macro level consumption studies, going back to Hall and Miskin (1982) and Campbell and Mankiw (1990), incorporate heterogeneity in the sense that some portion of the population is hypothesized to follow "rule-of-thumb" spending while others follow the permanent income hypothesis. Yet these groups have not been effectively separated and modeled at the micro level, although progress is being made. Hurst (2003) links households that have low "wealth residuals" (or unexplained accumulated wealth) at retirement with

[6] Although Cagetti (2003) shows that risk aversion can also affect wealth accumulation.

prior myopic or rule-of-thumb consumption behavior and poor planning.[7] The cognitive and planning section below discusses other prominent papers that highlight the importance of planning.

A second relevant area is other recent papers involving the concept of full wealth. First, this paper relies on those that pioneered empirical use of the pension and wealth data in the HRS. Among others, Gustman and Steinmeier (1999, 2002, 2006) have worked extensively with the pension and Social Security data in the HRS to analyze total retiree wealth, income replacement rates in retirement, adequacy of retirement savings, and structural models of saving and retirement, with an emphasis on retirement behavior.

Separately, a recent strand of asset pricing and market returns literature has focused on full wealth (specifically adding human wealth) in evaluating the CAPM and estimating the market portfolio (Campbell 1996; Jagannathan and Wang 1996; Palacios-Huerta 2003; Vissing-Jorgensen and Attanasio 2003). However, although the model used here shares some foundations with these papers, this paper does not focus on asset markets or portfolio allocation. Additionally, the "human wealth" component of full wealth in this paper is not primarily (risky) labor earnings, as is normal, but instead primarily annuities and transfers, assumed risk-free and therefore assigned a risk-free rate of return, rendering these papers of little relevance.

Finally, the life-cycle consumption and buffer stock saving literature is far too extensive to discuss aside from a few points. First, estimates indicate precautionary saving is the primary savings motive early in life but life-cycle retirement savings begins to dominate

[7] In addition to the macro literature mentioned above, Hurst determines his cutoff for low wealth residuals from two papers on savings adequacy. Engen, Gale, and Uccello (1999) and Scholz, Seshadri, Khitatrakun (2003) answer questions about savings adequacy with careful analysis of accumulated wealth (net worth) in the HRS but neither look at the consumption decision itself. Only the latter is household-specific as this paper is. Although both conclude that households save at least adequately in general, both find that some group, possibly about 20% of the population do undersave.

somewhere between ages 40 and 50 (Carroll & Samwick 1997; Gourinchas & Parker 2002; Cagetti 2003). This finding supports treating this sample, households over 50, as primarily life-cycle savers. Models using stochastic labor earnings to generate heterogeneity in the optimal consumption rule or portfolio rule by income profile and level of net worth (for example Cocco, Gomes, Maenhout 2005) are irrelevant here. That type of heterogeneity should not be present in the average propensity to consume out of full wealth both because of the comprehensive definition of full wealth and that future income is assumed to be deterministic.

Second, relative to other papers addressing the lifecycle consumption decisions of older households (Hubbard, Skinner, Zeldes 1994, Palumbo 1999, Hurd 1989) this paper focuses on differences across households and contains the key combination of consumption and full wealth data. The commonly cited "Consumption Over the Lifecycle"(Gourinchas & Parker 2002), self-described as "the first structural estimation of consumption functions with precautionary savings" acknowledges the importance of exactly the type of new data used in this paper. They explain why they don't treat retirement or retirement wealth as follows: "Further, high quality information on household asset holdings, together with consumption and income, is not available. Given that investment income, social security, and pensions represent the main sources of income during retirement, it is currently difficult to establish consumption patterns as a function of full wealth." This paper attempts to fill that gap now that such information is available.

III. Model

This paper specifically uses a neoclassical model, based on Merton (1969, 1971), of optimal consumption and portfolio choice. In this model (using certain forms of the utility function) the optimal consumption to full wealth ratio can be expressed in terms of behavior parameters and the mean and variance of asset returns. Therefore, the consumption to wealth ratio, or average propensity to consume, can be predicted for households using estimates for these behavior parameters and asset return statistics.

$$\max_{(c,\alpha)} E_{t_0}[\int_{t_0}^{T} e^{-(\rho t+\int_{t_0}^{t}\lambda_\tau d\tau)} U(C_t)\, dt] \tag{1}$$

$$Letting\ U(C_t) = \frac{C^{1-\gamma}}{1-\gamma}$$

subject to the budget constraint

$$dM = [rM + \alpha(\mu - r)M - C]dt + [\alpha\sigma]dz \tag{2}$$

Where ρ is time preference parameter, λ is a mortality hazard[8], the utility function is assumed to be CRRA, as shown, where γ is the coefficient of relative risk aversion. M is full wealth[9], r is the risk-free rate of return, α is the share of full wealth invested in risky assets, μ is the expected return on risky assets, and σ^2 is the expected variance of risky returns.

$$E_t[M] = E_t\left[\sum_{i=t}^{T} \frac{y_i}{(1+r)^{(i-t)}}\right] + NetWorth_{t-1}$$

This model can be solved for the steady state expression(s) of C/M (holding r, μ, and σ constant), yielding a familiar result from Merton:

Infinite Horizon (no mortality):

$$\frac{C}{M} = \frac{\rho}{\gamma} + (1 - \frac{1}{\gamma})[r + \frac{(\mu - r)^2}{2\gamma\sigma^2}] \tag{3}$$

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[8]Households live at most until the terminal date, T (death is certain at T), and face an increasing mortality risk up until T. The mortality rate can be incorporated into the discount rate, although here it is represented explicitly by λ. The definition of λ is the probability of reaching period t conditional on having reached period t-1. Therefore, the unconditional probability of reaching period t is $e^{-\int_{t_0}^{t}\lambda_\tau}$.

[9] This model uses a non-intuitive letter for full wealth, M for Modigliani, specifically for the purpose of reminding the reader that this is not net worth but all wealth, present and future.

For periods of time long before the terminal date T (a 20-year-old for example), the infinite horizon value of C/M may be a decent approximation. However, the sample for this paper has an average age of about 64. With more realistic finite time, the average propensity to consume out of full wealth should increase as death approaches.

Finite horizon with time-varying mortality hazard[10]:

$$\frac{C}{M} = 1 / \int_t^T e^{(1/\gamma)*[(\rho+(\gamma-1)*[r+\frac{(\mu-r)^2}{2\gamma\sigma^2}])*(t'-T)-\int_t^{t'}\lambda(\tau)d\tau]} dt' \tag{4}$$

The model contains a fixed terminal date T (set equal to age 100) to enable computation, but the mortality hazards get so high at late ages that the exact terminal date within a reasonable range makes little difference in the calculation of C/M.

Here the average propensity to consume out of full wealth is a function of only preference parameters (ρ,γ), mortality hazard, and first and second moments of expected returns.[11] Furthermore, if homogeneous preference parameters are assumed then the average propensity should only vary across households by mortality risk and variation in expected returns on assets.[12] Note also that consumption is proportional to full wealth, meaning there

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[10] If the mortality hazard λ were not time-varying, then there would be a closed form solution in finite time:

$$\frac{C}{M} = (\lambda + \rho + (\gamma - 1)[r + (\mu - r)^2 / 2\gamma\sigma^2]) / \gamma(1 - e^{(\lambda+\rho+(\gamma-1)[r+(\mu-r)^2/2\gamma\sigma^2](t-T)}) \tag{5}$$

This expression easily shows how C/M is constant in infinite time. If T→∞ (without the mortality) then the denominator goes to $\gamma(1-e^{-\infty}) = \gamma$. Since the numerator also is constant (in the special case of constant r, μ, and σ, and without mortality) then C/M is constant as T→∞.

[11] These expressions of C/M include the optimized value of the portfolio share, α*=(μ-r)/μσ^2. It is well known that households do not generally optimize portfolio allocation according to this model. Yet the analysis conducted here is in no way dependent on the assumption that they do. There's no a priori reason to think that just because this model doesn't capture how households actually allocate portfolios that it also doesn't capture how they choose consumption given their actual portfolios. The solution strategy does not depend on the optimized value of α. So the optimal consumption rule can easily be evaluated with the portfolio share expressed explicitly, such that the actual share observed in the HRS can be used. The logical rationale can either be that the actual share is optimal and just isn't modeled correctly (it omits some barrier or cost to risky investment), or that households don't have enough information about risky assets to optimize portfolios, but have more information about their own consumption choices, allowing optimal consumption decisions conditioned on their actual portfolio. Using observed portfolio shares throughout this analysis does not change the conclusions or help the model match the observed consumption.

[12] Desired bequests will be added later.

is no direct relationship between the average propensity (C/M) and the level of wealth (M). Therefore a correlation between the average propensity and level of full wealth can only come indirectly through correlations in the other factors: mortality, expected returns, or preferences.

Intuitively, the consumption smoothing explanation for observations of correlations between savings or consumption rates and level of income (through transitory shocks) or net worth (through higher or lower income replacement rates in retirement)[13] cannot explain a correlation between consumption rates and full wealth since full wealth already accounts for all expected future income.

IV. Data

This study primarily uses data from the 2000 and 2002 HRS along with consumption from the 2001 and 2003 Consumption and Activities Mailout Survey (CAMS), an HRS supplement. Since the HRS is representative of the population that was age 50 and older in 1998, the youngest members of the cohort are 53 in 2001 when consumption is measured. This paper takes households from the original HRS cohort, ages 60-70 in 2001 and the "war baby" (WB) cohort, ages 53-59 in 2001.[14] Since these cohorts include some households with a spouse outside the designated age range, some older and younger household heads appear, but the vast majority are within ages 52-74.

CAMS:

[13] Households expecting retirement income to replace a high fraction of working income will have lower accumulated net worth and spend a larger portion of that net worth, or save less of their income, before retirement relative to those with low replacement rates.

[14] Of the approximately 12,400 alive households in the 2002 HRS, 7,671 were from the HRS or WB cohorts. Then those refusing access to Social Security records and those not participating in the CAMS supplement were eliminated. In the end, 1,842 households, representing about 2,600 respondents, had all of the necessary data for this exercise.

The 2001 CAMS mailout survey was sent to a random sample of 5,000 households from the 2000 HRS and it had a 77% simple response rate.[15] The CAMS questionnaire asked respondents for household spending on 26 categories of consumption which cover well over 90% of total spending according to a comparison with the much more detailed and thorough Consumer Expenditure Survey (CEX).[16] Expenditures, are not equivalent to consumption, especially for older populations, many of whom consume housing with little expenditure because they own their homes outright. In this study, total consumption differs from CAMS total annual spending by imputing consumption flows for housing and vehicles. Imputed rental equivalence replaces housing expenditures for homeowners and an imputed smoothed vehicle consumption replaces vehicle purchases for car owners, see Appendix A for details. Purchases of other durables, such as washing machines, are not included.

Constructing Full wealth:

Full wealth, $M_t = E_t\left[\sum_{i=t}^{T} \frac{y_i}{(1+r)^{(i-t)}}\right] + NetWorth_{t-1}$ is estimated in the HRS by summing net worth (including housing) with the present value of income streams from four sources: earnings, social security, pensions, and other government benefits. The calculations are described in greater detail in the appendix.

First, for non-retired households, earnings income is estimated deterministically based on current wages incremented each year for tenure and experience based on an equation similar to that in Gustman & Steinmeier (2002). Earnings accrue until the self-

[15] The sample responding to the CAMS is not significantly different from the HRS sample as a whole on most basic characteristics such as age, marital status, race, and income, although any small differences in race and age are compensated for by a special set of weights created for the CAMS.

[16] There are some known problems of systematic respondent error, especially in the 2001 CAMS, that create high outliers and tend to inflate means for certain categories of spending as well as for overall spending. Some editing of the data has been done in cooperation with RAND analysts, however, because of these known errors, 1% of the tails of the consumption or the average consumption out of full wealth were trimmed for all analyses in this paper.

reported expected retirement age. Second, Social Security benefits are estimated based on actual earnings histories and projected earnings using the Social Security benefits formula. Benefits are adjusted according to Social Security rules if the household retired or is expected to retire at an age other than full retirement age.

Third, the cash flow and present value of defined benefit pensions are estimated using the HRS Pension Calculator with substantial adjustments to improve accuracy. The cash flow value is only used in the calculation of tax brackets but the present value provided by the Calculator is included in full wealth. For defined contribution plans, the self-reported current value from the 2002 survey is added to the estimate provided by the Calculator of any additional contributions in the future. Imputations were based on self-reports where data for the Calculator was missing.

Fourth, any government benefits currently received during the survey that are expected to be ongoing, such as veterans benefits or Social Security disability benefits are assumed to continue at their current real value. Finally, SSI is a government program that effectively provides an income floor for elderly households. Households with final resource totals that are below the present value of receiving this threshold amount from SSI every year for the rest of their life are brought up to this level.[17]

All values are after-tax (tax brackets and taxable portion of Social Security benefits are estimated *for each year* based on annual income, such that tax rates typically fall at

[17] Currently, an estimate of the value of health insurance is not included in this measure of lifetime resources. Since the focus of the analysis is on current consumption and for most people the significant consumption of health care (provided by insurance) won't happen until the future, including insurance in the denominator would distort the level of C/M unless C was also adjusted in some way, such as adding a smoothed expectation of health consumption. In terms of the variation of C/M across households, Medicare and Medicaid are available to almost all households, therefore having little impact on cross-household comparisons. There will potentially be a bias, however, for differences in private health coverage (or for differences in expected use of Medicaid). Simple indicators of health insurance coverage do not seem to be directly significantly related to the average propensity to consume, but more formal treatment of medical cost uncertainty and insurance will be taken up in later work.

retirement). The present value calculation includes a regular discount rate and a year-specific, age-specific, and race-specific mortality hazard rate based on life tables.

Not the Wealth You Know:

Full wealth is not simply scaled up net worth. It is has a different age profile and is considerably less disperse (implying less inequality) than net worth. Figures 1 shows the age profile (cross-sectionally) of net worth, "cash-on-hand" (net worth plus current income), and full wealth. Full wealth is the only measure that exhibits the downward slope in the 60s and 70s that would be expected of a retired population entering the spend-down portion of their economic lives.[18] Also, the Lorenz curves of Figure 2 show that full wealth is considerably more equally distributed across the population than is net worth. Full wealth has nearly half the dispersion of net worth (a coefficient of variation of 0.96 versus 1.67 for net worth). Full wealth is more equally distributed primarily because retirement income, particularly social security, is more progressive than earnings and dramatically less skewed than net worth.

Invariance:

Furthermore, the ratio of consumption out of full wealth does display some of the invariance to shocks and circumstances posed by the theory. Theory suggests that C/M should be more invariant to circumstances and shocks than C/networth or C/income. Comparing the observed ratio of C/M to these other two ratios in the data shows this is true (not shown)[19]. C/M is not significantly related to income shocks over the previous 6 years or education (continuous), whereas C/networth is significantly related to income shocks in the

[18] This downward slope is somewhat mechanically due to the fact that the present value of future income declines as the end of life approaches. However, it does show the reality of the evolution of resources faced by households and the slope is only partly mechanical, households actively accumulating substantial financial assets could still have an upward slope.

[19] See Pounder "The Average Propensity to Consume out of Full Wealth: Testing a New Measure" for details and results on invariance in C/M as well as properties of the change in C/M over time.

previous 2 years and education (continuous). Also, although C/M is significantly related to health status and having a pension annuity, the size and significance of the coefficients are less than equivalent coefficients relating those independent variables to C/networth (for example 1/20th the size in the case of the fair or poor health dummy variable). Not surprisingly C/income, the consumption rate out of income, is strongly related to all of these shocks and circumstances.

V. Predicted and Observed C/M

Means and Age Profile

Comparing the benchmark model above to the actual C/M requires assigning values to equation (4). To begin, all households receive identical parameters to estimate predicted C/M so that it varies only by age-dependent mortality. Values for the preference parameters, risk-free rate of return, and risky return volatility are similar to those used in many life-cycle simulation models: $\rho=0.02$, $\gamma=2$, $r=0.02$, $\sigma=0.2$.[20]

This leaves only mortality and expected returns. The conditional mortality hazard, λ, is modeled as a Gompertz function using gender-specific and race-specific life tables: $\lambda_t = \beta_1 e^{-\beta_2 age_{,t}}$ where β_1 and β_2 are estimated separately by gender and race. For the expected rate of return on risky assets, the Survey of Consumers routinely asks respondents who hold stocks what they expect the broad market return will be over the following 3 years (or 10 years in another question). The average expected return for all respondents in the Survey of Consumers in the appropriate age range (50 to 70) is 8.2% using the pooled responses from April 2002 and January 2003, bracketing the field dates of the 2002 HRS. Similarly, using inflation expectation questions from the same surveys, getting expected inflation of about 2.5%, yields an average expected real rate of return of about 5.7%.

[20] Results are also robustness tested for r=.01, .03, and .04.

Using the above parameter values the average predicted value for C/M is .042. In other words, with a risk-free rate of 2%, an expected risky real rate of return of 5.7%, and these parameter values, the average aged household should spend 4.2% of remaining lifetime resources each period. Figure 3 shows that the age profile of the predicted value looks very similar to the observed mean age profile, just shifted down. The observed C/M has a much higher overall mean of 0.076 and a median of 0.056.

The gap between the predicted and observed age profile will not be greatly affected by changing the risk-free rate r, or the risky rate of return, within reasonable ranges.[21] However, the observed consumption rate can easily be matched by simply assuming appropriate time and risk preference parameters, ρ and γ. Higher time preference, or impatience, clearly generates less spending in equation (4), whereas the effect of higher risk aversion depends on the exact parameter values, but implies lower spending over much of the plausible ranges. Without other means of identifying the appropriate level for one preference parameter, there are too many degrees of freedom to estimate both parameters uniquely. However, fitting a non-linear function to the observed C/M by minimized least squares yields parameter estimates of ρ=6.6 and γ=1.4.[22] Figure 4 shows that the mean observed age profile of C/M is quite well matched using these parameter values. Below it will be shown, however, that assigning an appropriate value of ρ and γ does *not* help to match the mean income or wealth profile of C/M.

Variation and Income Profile:

[21] Increasing or decreasing the risk-free rate of return shifts both lines up or down roughly parallel. This is because a higher r implies a higher predicted consumption rate, yet it also increases the observed consumption rate by decreasing observed full wealth through a higher discount rate in the present value calculation. The expected risky rate of return would have to be implausibly high, a *real* rate over 10%, to narrow the gap substantially between predicted and observed.

[22] The preference parameter values needed to match the median observed C/M, being considerably lower than the mean, would obviously be a lower ρ and/or higher γ.

Observed C/M has considerable variation, a standard deviation of .06 and coefficient of variation of .78 (Table 1 shows descriptive statistics for C/M and its components). Age, or mortality, only accounts for a very small part of the variation, judged by regressing observed C/M on the predicted value, using expression (4), where mortality is the only source of variation (see Table 2). Random measurement error always adds variability to actual measures relative to their true values, but the variation in actual C/M is far from random. The average propensity to consume co-varies strongly with income and wealth.

The Rich Do Save More:

Consistent with the findings of (Dynan et al), there is a strong negative correlation between observed average propensity to consume (C/M) and prosperity, whether prosperity is measured by total wealth, net worth, or income. The relationship is dramatically obvious in the simple moving average of C/M by income (Figure 5). Full wealth, M, is the most desirable measure of prosperity because it is comprehensive, akin to permanent income. But the true statistical between C/M and M is difficult to determine since measurement error in observed M would obviously create a negative bias in the correlation between observed C/M and observed M. The bias created by measurement error is in the same direction as the observed correlation, so further analysis is necessary to establish that the relationship truly exists.

Table 3 shows the bivariate OLS coefficients for logged C/M after accounting for age[23] with each of the following as the independent variable: logged M, quartiles of M, logged income, and logged consumption (C). Quartiles may have less measurement error than continuous M and still show a similar magnitude relationship. Income, which also shows a strong relationship, should be highly correlated with wealth, but independent of the

[23] To account for age, the C/M used is actually the residual of logged C/M on logged predicted C/M, where the predicted value varies only by age.

random reporting error in the net worth and pension components of full wealth. Most convincing, though, is the significantly negative relationship between C and C/M. When correlating C and C/M, the bias from the measurement error in C would be positive, yet the true relationship overwhelms the measurement error bias. High spenders have even higher wealth, such that their propensity to consume is low relative to other households.

VI. Sources of Variation within the Model

The neoclassical model laid out by Merton and used here leaves very few sources of heterogeneity in the propensity to consume when full wealth is used. This section will show that heterogeneity in preferences, particularly time preference, is the only *within-model* source of variation that could plausibly explain a large portion of the observed variation in C/M and fit with the observed negative correlation of full wealth and C/M.

Expected Returns

As stated above, the model only allows variation from expected returns, mortality, and preferences. All households are still assumed to face the same risk-free rate, r, and the volatility of risky assets, σ^2, but now the expected risky return is allowed to vary.[24] Variation in expected returns across households is estimated by responses in the HRS to questions about expected stock market returns over the next 5 years. The HRS does not ask respondents directly for estimates of market returns. However, in 2002 the survey does ask what they think the probability is that returns will average more than 10% in the following 5 years (and also the probability that returns will be greater than 0%). The April 2002 and January 2003 Survey of Consumers, in addition to directly soliciting estimated returns, also

[24] Note that a gap between the borrowing rate and risk-free saving rate would work in the opposite direction from the observed relationship between C/M and full wealth. It would lower the propensity to consume among would-be borrowers, i.e. low-wealth households, and reduce the present discounted value of future income for those households with higher shares of full wealth tied up in future income flows, which are also the lower-wealth households. Similarly, a lower risk-free investment rate for poor households, who may have less financial market access, even to safe vehicles for saving, would work in the wrong direction.

ask a similar question: what's the probability that market returns will be greater than 5%. Using the predictive power of that question as well as regression coefficients for education and region, each respondent was assigned an estimated rate of return around the mean of 5.7%, see Appendix C for details. Table 4 shows that predicting C/M incorporating expected return variation barely improves the fit of the predicted C/M to the observed C/M relative to the model that allows only age variation. The simple correlation coefficient rises only from 0.15 to 0.16.

Subjective Mortality:

Second, mortality hazard variation by age, gender, and race is included in the predicted value of C/M, but many people are likely to have better information about their own mortality than just national averages. For example, they know their health and family history. The HRS asks many questions about health and also asks for subjective expectations about their own likelihood of living to various ages, such as 75 or 85. Table 5 shows that C/M, even after accounting for age, does indeed vary significantly by health status and "subjective life expectancy". The latter is the ratio of the self-reported probability of living to age 75 to the actuarial probability of living to age 75 (which accounts only for age, race, and gender). These significant effects remain when additional demographic and socio-economic variables are added (see appendix D for list). However, once again, this factor only accounts for a small part of the heterogeneity in observed C/M, raising the R^2 from .027 to .06.

Preferences:

This leaves only preferences within the model as a source of explanation for the heterogeneous propensities to consume and particularly, the relationship between consumption propensity and level of wealth. Heterogeneity in risk aversion plays a small role. Theoretically it has both a precautionary effect[25] and a wealth effect that act against each other in expression (4), creating an ambiguous effect on C/M. Table 6 shows that measured risk aversion does co-vary negatively with the average propensity to consume.[26] It is insignificant in bivariate regression but approximately doubles in size and gains significance when life expectancy and health, as well as the other demographic covariates, are added. However, the effect remains small and it does not contribute significantly to the fit of the regression.

The time preference parameter, on the other hand, has an unambiguously positive and much more direct effect on the propensity to consume according to expression (3). In fact, heterogeneity in time preference, or patience, would cause exactly the observed relationship between the propensity to consume and full wealth. More patient households will accumulate higher full wealth and spend it at a lower rate.[27] Unfortunately, there are no usable measures of the time preference parameter to directly estimate the effect of patience heterogeneity. Theory and empirical evidence have already eliminated other factors within the model, so the remainder of the paper takes two approaches to building the argument that patience heterogeneity is the primary source of variation in the average propensity to consume out of full wealth: 1) eliminate as many alternative explanations as possible and 2) correlate remaining variation in C/M with other survey measures that are suggestive of patience. Section VII addresses common additions to the standard model, section VIII

[25] Precaution refers to the uncertainty in the model of asset returns and lifespan.
26 The HRS contains survey measures of risk aversion for subsets of the sample in various waves. About 80% of the sample considered in this study has at least one observed response to the risk aversion questions, which are based on gambles over lifetime family income and can place individuals into categories, each with a bounded range of values for their risk aversion parameter (Barsky et al 1997). In Table 6, the OLS coefficient on risk aversion for the subset of respondents with a response in any wave of the HRS uses the midpoint of each risk aversion range and includes the other covariates from Table 5 in the regression. Other specific values within the categorically defined range bounds do not dramatically alter the results.
[27] This is true even in retirement and even if their level of consumption is upward sloping over time ($\rho<r$).

incorporates the cognitive and planning ability hypothesis, and finally, section IX relates remaining residuals to measures indirectly related to patience.

VII. Extensions to the Model

The above discussion has all been limited to the assumptions of the specified model. Given that the role of patience cannot be shown directly, this section uses additional variables available in the HRS to consider some of the most likely alternatives to patience as an explanation for the heterogeneity in C/M. Such alternatives are evaluated in their ability to explain variation in C/M as well as the correlation between C/M and wealth.

Bequests:

Adding bequests to the objective function expressed in (1), such that the problem is now:

$$\max_{(c,\alpha)} E_{t_0}[\int_{t_0}^{T} e^{-(\rho t+\int_{t_0}^{t}\lambda_\tau d\tau)} U(C_t) + B\, dt]$$

where B is assumed to take the form $e^{-\rho T}\dfrac{\varepsilon^{\gamma}}{1-\gamma}$, again following Merton (1969). The parameter ε measures how strongly the household values bequests relative to their own utility, in other words, it is an indicator of the bequest motive. If we set

$$D = \frac{\rho + (\gamma-1)[r + \frac{(\mu-r)^2}{2\gamma\alpha^2}]}{\gamma}$$ so that the finite horizon expression of C/M (5) can be

$$\frac{C}{M} = 1 / \int_t^T e^{D(t'-T)-\int^{t'}\lambda(\tau)d\tau}\, dt'$$

expressed as (using the non-time varying mortality for simplicity):

$$\frac{C}{M} = \frac{D}{1-e^{D(t-T)}}$$

then the modification to that solution when bequests are added is simply:

$\frac{C}{M} = \frac{D}{1+(D\varepsilon - 1)e^{D(t-T)}}$. This simplifies to (5) in the no-bequest case where ε=0 (Merton 1969). The expression Dε is positive, so including bequests decreases C/M and dampens the effect of age on C/M.

This paper does not attempt to structurally estimate variation in the bequest motive directly. However, the HRS does include questions about the probabilistic expectation of leaving bequests of various sizes.[28] Table 7 shows OLS results of various specifications using the answers to the bequest questions. It is clear that household expectations about bequests matter to the propensity to consume in the expected direction. Households that expect to leave a bequest, and the subjective probabilities of leaving various sized bequests, are associated with a lower propensity to consume.

To get a sense of what the coefficients mean, consider a household that has in mind a dollar figure for their bequest (abstracting here from the distinction between desired and expected bequests just for the purpose of obtaining a rough estimate). Imagine that they would "set aside" some of their full wealth in planning their propensity to consume, an amount b=E(M_T), such that $\frac{C}{M-b} = \frac{D}{1-e^{D(t-T)}}$. Using the dummy variable for leaving a bequest over \$100,000, and coefficients from column (1) of Table 7, at the mean for households that expect to leave a large bequest, M=\$1,180,000 and adjusted C/M=0.055. So a coefficient of 0.30 on the mean C/M of 0.055 implies a decrease in C/M of 0.0165 for these households. What amount of b generates this change at the mean M? The answer, of course, is 30% of M, or approximately \$350,000 at the mean. This is a little high, about 65% of net

[28] Note that the exact wording of the HRS questions confounds the desire to leave bequests with the sheer likelihood of leaving a bequest given uncertain lifespans. A household with no particular desire to leave a bequest could still express a positive likelihood of leaving a bequest if they accumulate and spend down wealth to target a consumption path that would still leave them resources in case of living longer than average life expectancy. The "expected bequest" concept is relevant here, though, since it indicates how much of their wealth the household expects to consume during their expected lifetime.

worth for the average household that expects to leave a large bequest. For comparison, Hurd and Smith (2002) estimate that HRS households around age 70 will end up leaving approximately 39% of their net worth in bequests. However, that figure is not restricted to households that expect to leave a large bequest.

Clearly, the HRS questions cannot completely account for the effect of varying bequest motives on the model's optimal predictions of C/M. However, although bequests obviously explain some of the variation in observed C/M, it would require several magnitudes more variation than what is captured by the HRS questions in order for bequests to be the primary reason that C/M varies.

Liquidity Constraints:

Life-cycle models are often concerned with liquidity constraints, although usually only early in the life-cycle. Liquidity constraints are generally only found binding at early ages (e.g.Laitner 2005), making it unlikely that households of the age range examined here would be affected. However, unlike many other studies, this paper includes the present value of future income as a part of wealth. These resources, such as future social security, cannot be borrowed against. In addition, the share of the illiquid future income as a fraction of full wealth is much higher for low-wealth/low-income households, raising the possibility of significant borrowing constraints that are not equal across households. However, when using full wealth, the effect of liquidity constraints on the average propensity to consume is unambiguous. It pushes C/M down (Carroll and Kimball 2001). Here, low-wealth households are spending more, not less, of their resources than theory predicts. This does not fit with a liquidity constraint explanation. To be more precise, Figure 6 shows the moving average of C/M as the fraction of liquid wealth (meaning non-housing net worth) rises. It shows the opposite of what would be expected if liquidity constraints were binding the spending of households with only a small fraction of their full wealth available to them to spend.[29]

VIII. Cognition, Planning, and Expectations

Moving further from the neoclassical model and standard extensions, there are potentially a large number of alternative hypotheses for what could cause heterogeneity in C/M, although they must be by definition out of the mainstream. Following the theme of differing personal attributes across households this section addresses differences in cognitive, planning, and expectations formation ability. Basic cognition and basic mathematical skills are certainly a prerequisite for behaving as an optimizing consumer. Other prerequisites are thinking ahead and being able to evaluate the probability of future events. In particular, heterogeneity in such abilities could plausibly cause variation in C/M and correlations between wealth and C/M, where some people are able to calculate optimal rules and those who are not save less each period and accumulate less wealth. This section tests whether having or lacking those skills is associated with the variation in C/M, particularly whether lacking them is associated with spending their resources much faster than theory predicts. Although this is certainly not the only alternative explanation, it is plausible, interesting, and has measures available in the HRS for testing.[30]

Literature:

Several papers by Lusardi have documented the importance of financial literacy and planning for retirement on wealth and retirement outcomes, but have not tied these directly to consumption. Caplin and Leahy (2003) also tie the propensity to plan (interpreted as a self-control mechanism) to better wealth outcomes. Hurst (2003) ties low wealth residuals with

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[29] This figure is not driven by a handful of wealthy households or some other artifact of the data, it is fairly robust to various definitions of liquid wealth and for the bottom half of the wealth distribution taken alone.
[30] Other alternatives worth pursuing include non-homothetic preferences and including wealth itself in the utility function (Carroll).

prior myopic consumption decisions and shows that these households are poorer planners. Aside from questions at the center of Lusardi's work, the HRS contains numerous questions that might shed light on possible myopic behavior for 'low savers', such as planning horizon, mathematical ability, expectations formation, and other cognitive measures.

Lillard and Willis (2001) look at responses in the HRS to all of the subjective expectations questions that require respondents to give answers in the form of a percent probability about a future event (there are five to ten such questions in each wave of the survey). They find that, regardless of the question, some respondents tend to give "focal" answers, such as 0 or 50 or 100, rather than more precise answers. These may be reasonable responses to some questions, but thoughtful responses to questions such as the probability of rain tomorrow, the probability of living to age 75, or the probability of working to age 65, are likely to be a more precise answer. The authors conclude that this "focal" tendency may be linked to uncertainty about answering the question.[31] Furthermore, they link the tendency to give precise, non-"focal" answers to investment in riskier financial assets and better returns. This measure of precision in responses is also linked to other economic outcomes in preliminary work-in-progress by this author and others.

Measures:

The HRS contains several basic cognition variables, but some are only asked of respondents over 65. The most appropriate questions asked of all respondents are word recall, a counting backwards exercise, and a multi-stage subtraction test. The Willis-Lillard measure of expectations formation, calculated as the fraction of precise answers, adds a measure of sophisticated expectations to these basic skills.

[31] Such uncertainty possibly indicates difficulty with thinking about future events probabilistically or difficulty with forming expectations.

Finally, the HRS asks respondents for their financial planning time horizon, with choices from a few months up to more than 10 years. This variable may be considered an indication of time preference, and the results are consistent with that interpretation. However, the term time preference in this paper refers to the parameter in a rational forward-looking model. In the extreme, some households, for example those that only plan for a few months, are probably better described as not conforming to the model (e.g. behaving myopically) rather than as having very high discount rates.

Results:

Table 8 reports the regression coefficients for these measures of cognition, expectations formation, and planning horizon on C/M. The results show that poor cognitive skills, imprecise answers, and short planning horizons all increase the average propensity to consume. All of the effects are statistically significant and some of the coefficients are sizeable, between a third to half those of the dummy variables on expected bequests. It is particularly notable that in the full regression (Table D1) all of these variables are statistically significant while only one of the education dummies is (barely) significant, suggesting that these ability measures are measuring something over and above education or that is better measured by ability than by education.

IX. Indirect Evidence for Patience

Table 9 shows that the residual variation in C/M, after controlling for all of the variables in Table 8, is significantly correlated with a few variables that could be intuitively associated with time preference, such as smoking, spending of a windfall, and personality traits. Smoking, in addition to indicating risk tolerance, is likely associated with a higher discount rate since the smoker is placing more value on immediate gratification than the possible long-term health consequences. Table 10 shows smokers have a significantly positive residual variation in C/M.

The second and third rows of Table 9 refer to questions asked as part of the CAMS consumption survey, which ask respondents what they'd do with a hypothetical 20% increase in income, spend it all, save it all, or spend some and save some. The table shows indicator variables for each of the first two responses, omitting the "spend some/save some" group. Although only one of the two is significant, column (1) shows that the "spend all" respondents have higher residual consumption propensity and the "save all" respondents have lower.

The other variables in Table 9 are for a small sub-sample from a 1999 mailout supplement. This supplement included questions that ask the respondent to agree or disagree on a 5-point scale with statements about their personality. Stronger agreement with statements like "I am not a worrier", "I am seldom apprehensive about the future", "I crave excitement", and "I am not driven to get ahead" are all associated with a higher residual C/M, most of them significantly. The statement "I strive for excellence" has a negative and strongly significant association with residual C/M. These statements are purely subjective and suggestive at best, with no clear relation to time preference as used in economic models. However, intuition suggests that respondents who worry about and prepare for the future, by being apprehensive, by being driven, and by striving for excellence, are exhibiting more patience and higher value for the future.

The fact that these traits generate significant results in such a small sample size, and a sizeable improvement in the R^2 of the regression (from 0.014 to 0.127), suggests that a component of the remaining heterogeneity in C/M is certainly correlated with personal attributes, whether or not those attributes can be concretely related to patience. Connecting such traits to the parameters used in economic models would need to be explored in future work.

IX. Conclusion

Relying on theory and new data to identify a measure that has very limited scope for variation across households within the standard model, this paper focuses on attribute differences rather than shocks to explain heterogeneity in consumption decisions. This measure provides strong evidence that the rich have higher average savings propensities.

Within the confines of a life-cycle consumption model, the theory suggests time preference is of primary importance in matching the observed average propensity to consume. Heterogeneity in time preference could easily explain the observed negative correlation between the consumption propensity and the level of full wealth. The role of heterogeneous time preference cannot be directly tested, but among the standard factors in the model, only expected bequests is shown empirically to play a substantial role in explaining both the consumption variation and the savings-wealth correlation.

Planning horizon and cognitive limitations also explain some of the variation in the average propensity to consume, suggesting an important role for attributes other than preferences. But substantial variation in the average propensity to consume remains after proxying for subjective mortality, heterogeneous expected returns, heterogeneous risk aversion, expected bequests, and potentially myopic behavior due to poor optimizing skills. That residual variation is correlated with variables weakly affiliated with patience. Therefore inherent differences across households, through heterogeneous preferences and ability, are shown to matter in explaining differences in consumption propensities. Alternative behavioral models are not ruled out but many are consistent with the spirit of this finding, specific tests are left for future work.

Figure 1: Age Profile of Wealth

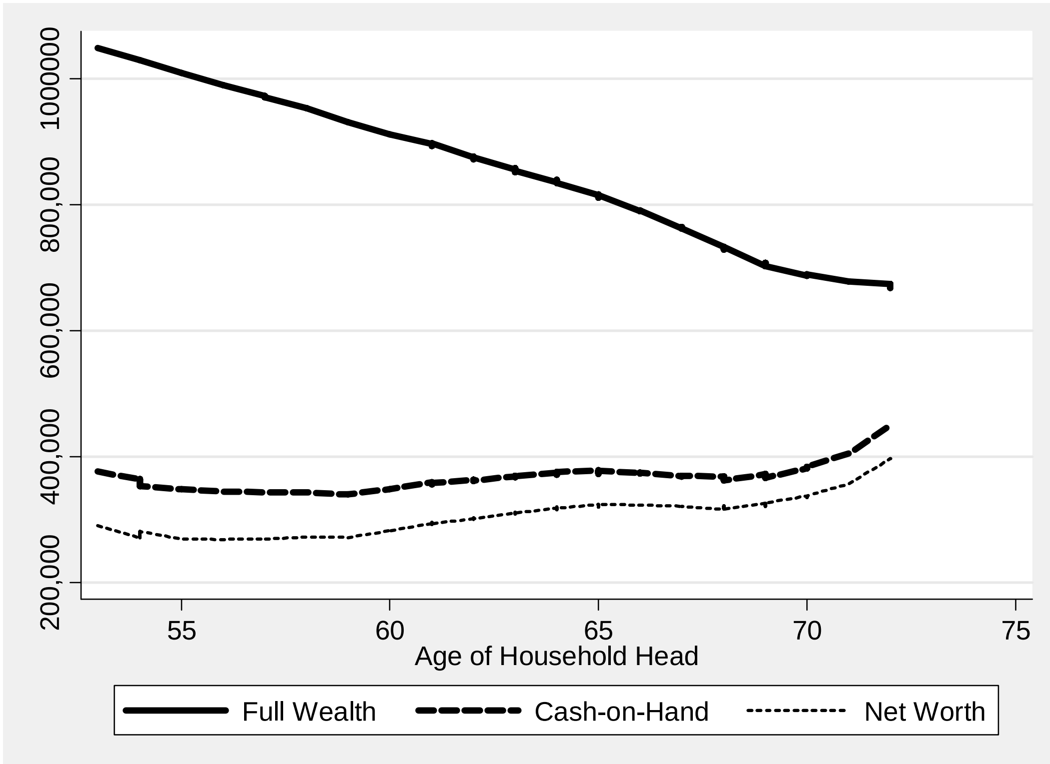

Figure 2: Lorenz Curves of Net Worth and Full Wealth

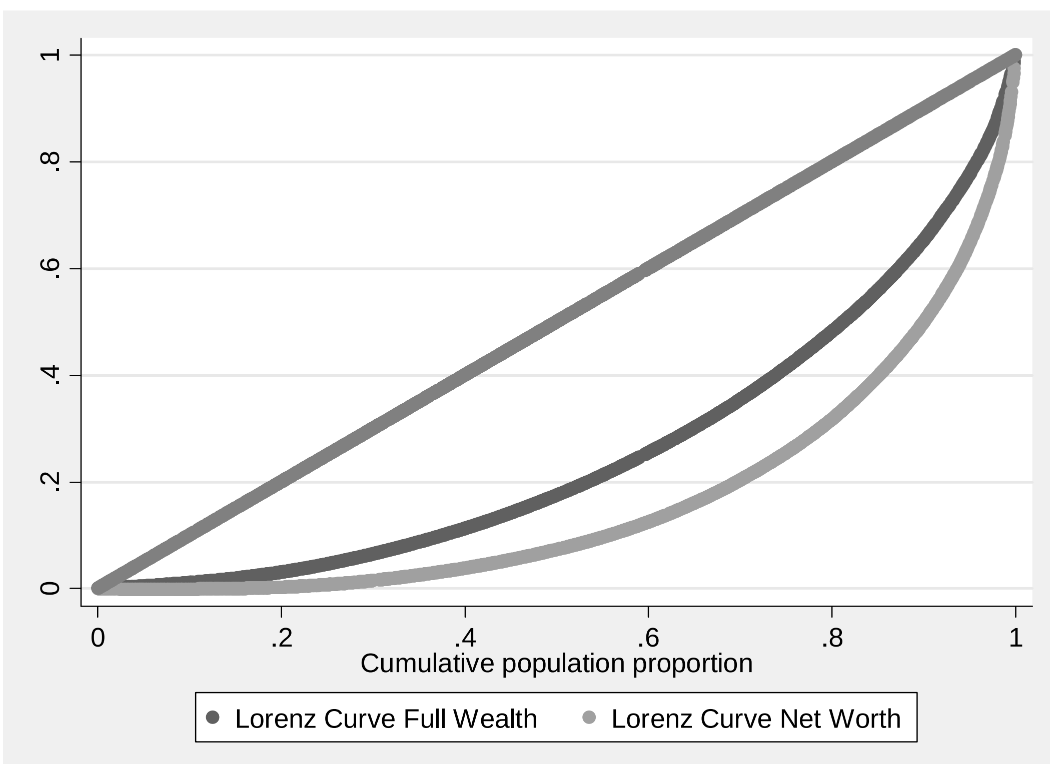

Figure 3: Predicted and Actual C/M: Moving Average Age Profile

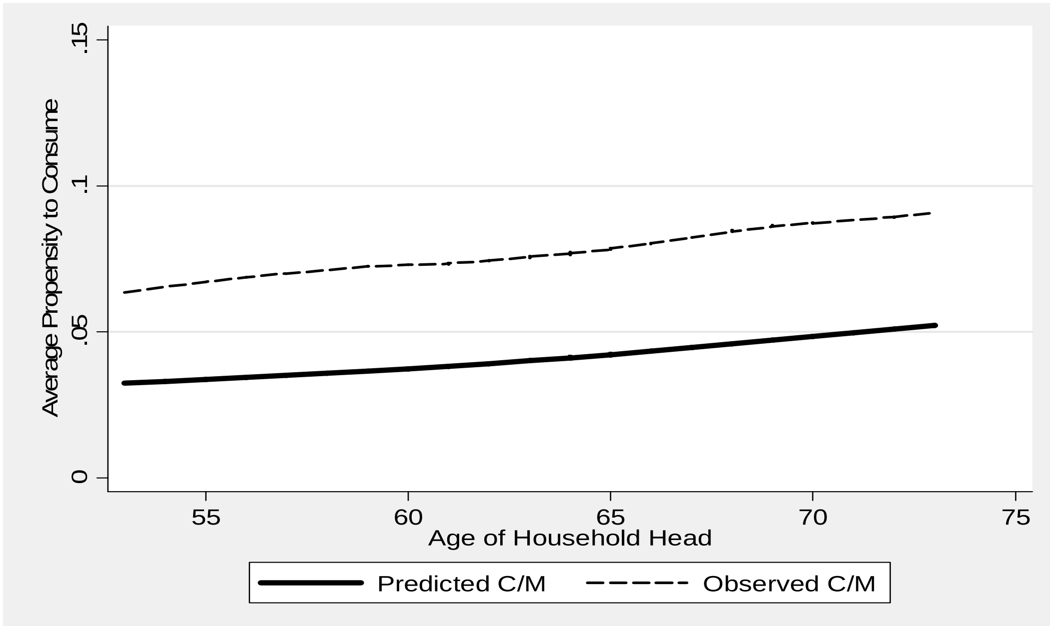

Figure 4: Predicted and Actual C/M:

Moving Average Age Profile Using Fitted Estimates for ρ and γ

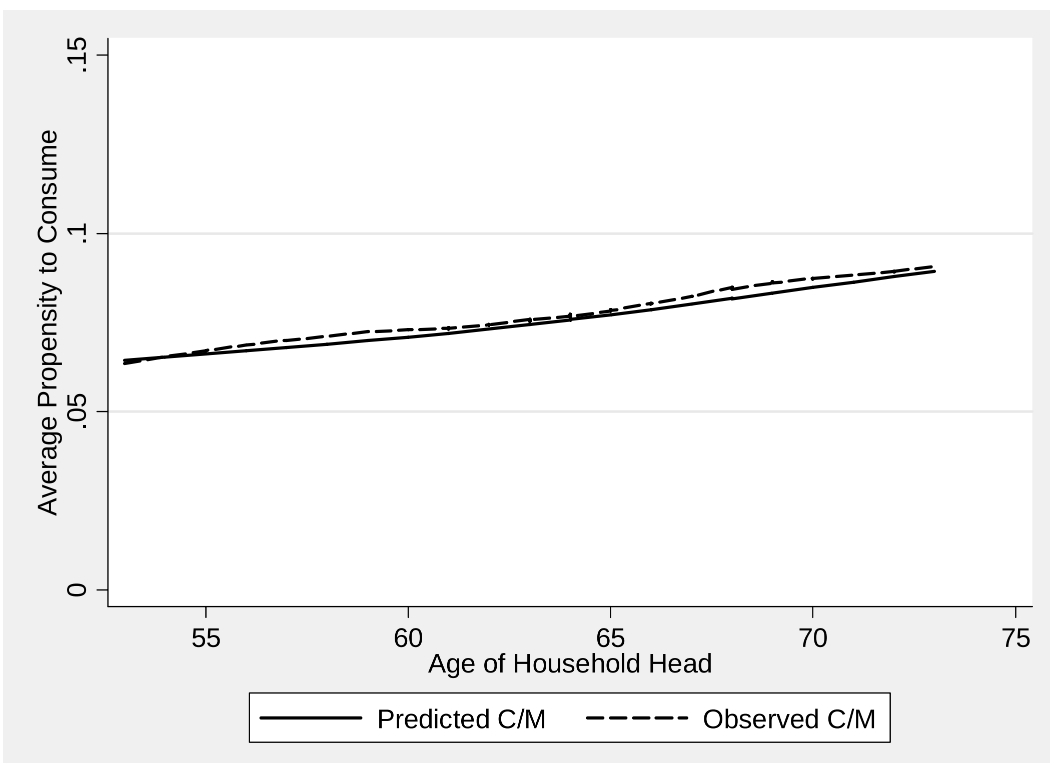

Table 1. Characteristics of Consumption and Full Wealth

	Mean	Median	Std Deviation	Coefficient of Variation
Consumption	\$40,260	\$34,960	\$30,750	0.76
Human Wealth, M	\$738,100	\$551,600	\$730,500	0.99
C/M	0.086	0.066	0.066	0.77
Net Worth (2002)	\$324,300	\$141,200	\$543,500	1.68
Income (2000)	\$65,650	\$42,990	\$89,690	1.37
Income (2002)	\$62,100	\$40,220	\$76,760	1.24

Table 2:

Dependent Variable: ln(C/M)	
Log Predicted C/M from (4) with variation by mortality only	0.013** (0.002)
Constant	-2.56 (0.006)
N=1842	R^2=0.022
Simple correlation coefficient:	0.15

Table 3:

Dependent Variable: Residual of ln(C/M) after mortality adj	(1)	(2)	(3)	(4)
Log Full Wealth	-0.526 ** (0.010)			
Quartile of Full Wealth				
2nd Quartile		-0.550** (0.029)		
3rd Quartile		-0.925** (0.029)		
Top Quartile		-1.312** (0.021)		
Log Income			-0.248** (0.012)	
Log Consumption				-0.163** (0.025)
Constant	2.40 (0.133)	-3.85 (0.021)	-1.94 (0.131)	-2.85 (0.263)
N=1842	R^2=0.597	R^2=0.547	R^2=0.180	R^2=0.022

Figure 5: Predicted and Actual C/M:

Moving Average Income Profile Using Fitted Estimates for ρ and γ

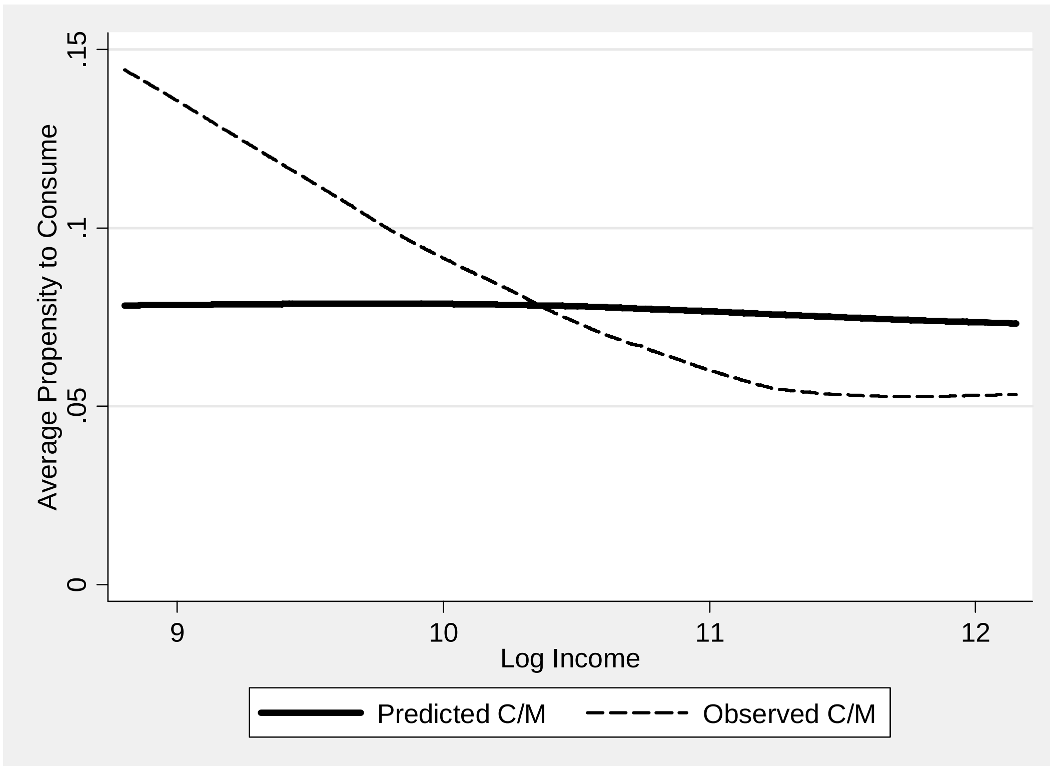

Table 4

Dependent Variable: ln(C/M)	(1)	(2)
Log Predicted C/M from equation (4) with variation by mortality only	0.013** (0.002)	
Log Predicted C/M from equation (4) with variation by mortality and expected risky returns		0.017** (0.002)
Constant	-2.56 (0.006)	-2.54 (0.007)
N=1842	R^2=0.023	R^2=0.027
Simple correlation coefficient:	0.15	0.16

Table 5

Dependent Variable: Residual of ln(C/M) after mortality adj	(1)	(2)	(3) with additional demographics (see appendix)
Subjective Life Expectancy Ratio	-0.191 ** (0.037)	-0.194 ** (0.037)	-0.097 ** (0.036)
Self-Reported Health:			
Excellent or Very Good	-0.141** (0.036)	-0.138** (0.036)	-0.080** (0.034)
Fair or Poor	0.147** (0.045)	0.151** (0.045)	0.082* (0.042)
Age of Head		-0.060** (0.028)	-0.109** (0.026)
Age of Head Squared		0.0005** (0.0002)	0.0009** (0.0002)
Constant	-4.35 (0.042)	-2.48 (0.870)	-1.24 (0.821)
N=1693	R^2=0.061	R^2=0.062	R^2=0.209

Table 6:

Dependent Variable: Residual of ln(C/M) after mortality adj	(1)	(2) Sample with Risk Aversion Measure N=1242	(2)	(3) with additional demographics (see appendix)
Risk Aversion Survey Measure	-0.010 (0.009)		-0.017* (0.009)	-0.020** (0.009)
Subjective Life Expectancy Ratio		-0.221 ** (0.044)	-0.222** (0.044)	-0.122 ** (0.042)
Self-Reported Health:				
Excellent or Very Good		-0.133** (0.043)	-0.136** (0.043)	-0.087** (0.041)
Fair or Poor		0.141** (0.052)	0.137** (0.052)	0.087* (0.050)
Age of Head		-0.006 (0.045)	-0.003 (0.045)	-0.003 (0.042)
Age of Head Squared		0.00001 (0.00040)	0.00002 (0.00040)	0.0003 (0.0003)
Constant	-4.43 (0.075)	-4.61 (1.41)	-4.42 (1.41)	-3.53 (1.34)
N=1242	R^2=0.000	R^2=0.064	R^2=0.066	R^2=0.184

Figure 6. Observed Propensity to Consume by Fraction of Liquid Assets (Moving Average)

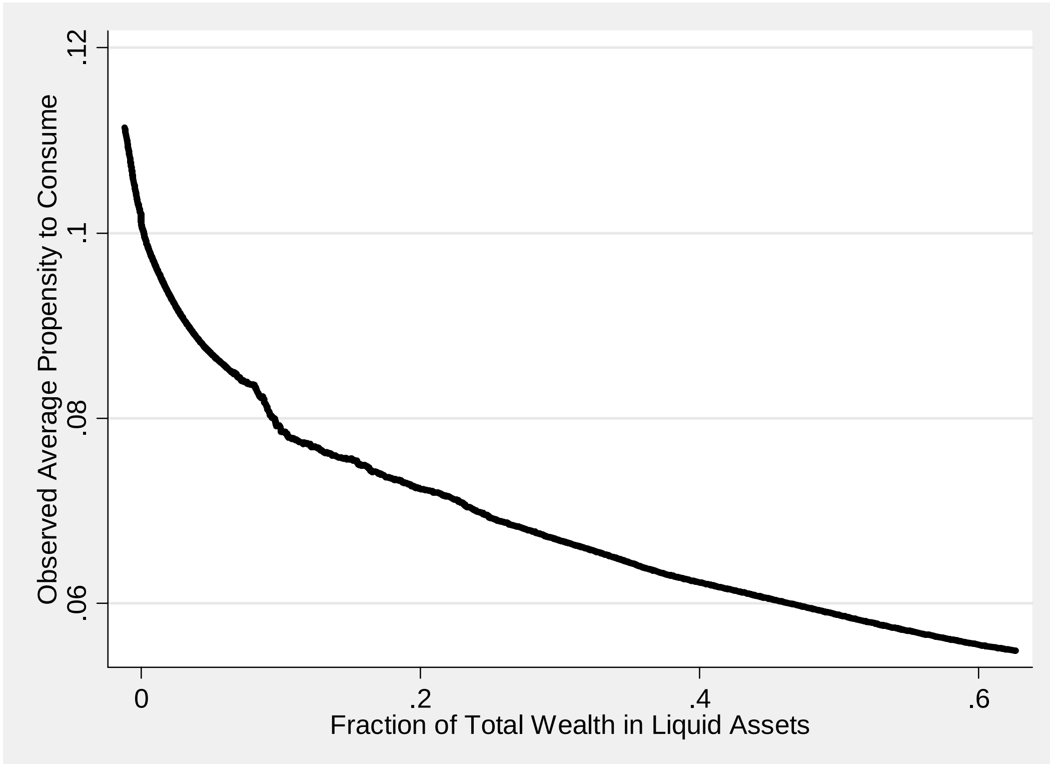

Table 7

Dependent Variable: Residual of ln(C/M) after mortality adj	(1)	(2)	(3) with additional demographics (see appendix)
Dummy: Positive Likelihood of Any Bequest	-0.326** (0.052)	-0.164** (0.057)	-0.123** (0.056)
Dummy: >50% Likelihood of Bequest>$100k	-0.300** (0.031)	-0.079** (0.038)	-0.042 (0.036)
Probability of Bequest >$10k (Continuous)		-0.002** (0.0005)	-0.0007 (0.0005)
Probability of Bequest >$100k (Continuous)		-0.004** (0.0005)	-0.003** (0.0005)
Subjective Life Expectancy Ratio	-0.105** (0.036)	-0.074** (0.036)	-0.046 (0.036)
Self-Reported Health:			
Excellent or Very Good	-0.076** (0.035)	-0.052 (0.035)	-0.052 (0.033)
Fair or Poor	0.064 (0.043)	0.044 (0.043)	0.029 (0.042)
Age of Head	-0.068** (0.026)	-0.058** (0.026)	-0.096** (0.025)
Age of Head Squared	0.0005** (0.0002)	0.0005** (0.0002)	0.0008** (0.0002)
Constant	-1.91 (0.833)	-2.17 (0.817)	-1.33 (0.803)
N=1645	R^2=0.148	R^2=0.192	R^2=0.256

Table 8

Dependent Variable: Residual of ln(C/M) after mortality adj	(1) Includes all demographics, bequests, health, and life expectancy (see appendix)
Long Financial Planning Horizon	-0.070** (0.028)
Fraction of Precise Answers	-0.088* (0.053)
High Word Recall	-0.062** (0.030)
Counting Backwards	-0.124** (0.048)
Hardest Subtraction Problem	-0.049* (0.030)
Constant	-0.91 (0.80)
N=1645	R^2=0.273

Table 9

Dependent Variable: Residual of ln(C/M) after mortality adjustment plus OLS on all demographics, bequests, life expectancy, health, cognition, and planning covariates	(1)	(2) Personality Mailout Sub-Sample N=235	(3) Personality Mailout Sub-Sample N=235
Smoker	0.046* (0.028)	-0.015 (0.070)	-0.017 (0.066)
Reports would Spend all of hypothetical income increase	0.089* (0.052)	0.127 (0.122)	0.119 (0.116)
Reports would Save all of hypothetical income increase	-0.039 (0.032)	-0.149** (0.074)	-0.104 (0.071)
Personality Questions			
Not a worrier			0.021 (0.021)
Seldom apprehensive about future			0.044** (0.022)
Not driven to get ahead			0.033* (0.020)
Crave excitement			0.047** (0.023)
Strive for excellence			-0.122** (0.024)
Constant	-0.94 (0.02)	-0.91 (0.06)	-0.76 (0.12)
	N=1645	N=235	N=235
	R^2=0.003	R^2=0.014	R^2=0.127

Appendix A: Imputation of Housing and Vehicle Consumption

For homeowners, spending on mortgage, property tax, and homeowners insurance is replaced by an imputed rental equivalence value for their home. Rental equivalence values were estimated using the relationship between housing characteristics and reported rental equivalence for owned homes in the 2001 CEX. To impute the flow of consumption from housing, housing characteristics including property value, census district, urban/rural, number of rooms, and type of housing (such as single family, apartment, or trailer) were regressed on reported rental equivalence in the 2001 CEX for the sample of homeowners with household head aged 53 or over (see Table A2). The coefficients were then applied to each household's housing characteristics as reported in the 2002 HRS. This regression has an adjusted r-square of .40, very similar to that for the hedonic regression in Johnson, Shipp, and Garner (1997) that regresses actual rent paid by renters on factors such as location, rooms, and housing type.

A value for vehicle consumption is imputed based on the relationship between household characteristics and net outlays on new and used cars and trucks in the 2001 CEX, as described in the appendix to this paper. As in Cutler and Katz (1991), the household characteristics used to impute vehicle consumption include income, family size, education of head, total household expenditures (less vehicle expenditures), and total expenditures squared, as well as number of cars owned (see Table A1). This imputation is applied to households that either report owning a vehicle in the 2000 HRS or report paying vehicle insurance in the CAMS.

Table A1. Regression to Impute Vehicle Consumption Using Consumer Expenditure Survey
Dependent Variable: Vehicle Consumption

	Coefficient	Std. Error
Total non-vehicle expenditures	0.052**	0.0086
Total non-vehicle expenditures squared	-1.76xE-9	5.18xE-9
Pretax income	0.005	0.0039
Age of reference person	-43**	14
Family size	386**	126
Male	-11	267
Education		
Less than high school	249	416
High school	956**	342
Some college	332	400
College (omitted group)		
Intercept	2287	1106
R-Squared	0.215	

*Significant at the 90% level **Significant at the 95% level

Table A2. Regression to Impute Housing Consumption Using Consumer Expenditure Survey
Dependent Variable: Rental Equivalence

	Coefficient		Std. Error
Property value	0.0037	**	0.0001
Property value squared	-1.7xE-9	**	9.4xE-11
Census divisions (New England omitted)			
Mid-Atlantic	-408	**	60
South Atlantic	-247	**	29
East North Central	-505	**	47
West North Central	-122	**	29
East South Central	-459	**	35
West South Central	-267	**	32
Mountain	-467	**	59
Pacific	-22		31
Urban	16		31
Urban*Mid-Atlantic	300	**	57
Urban*West North Central	261	**	47
Urban*Mountain	259	**	58
Number of rooms in house	28	**	3
Housing type			
Duplex	-144	**	46
Apartment	114	**	39
Mobile home	-31		30
Other housing	53		81
Single family home (omitted)			
Intercept	542	**	46
R-Squared	0.397		

*Significant at the 90% level **Significant at the 95% level

Appendix B: Constructing Full wealth

Full wealth, $M_t = E_t\left[\sum_{i=t}^{T}\frac{y_i}{(1+r)^{(i-t)}}\right] + NetWorth_{t-1}$ is estimated in the HRS by summing financial and housing assets with human wealth, or the present value of future income streams. Net worth comes from the RAND user-contribution variables which include some imputations for assets. Net worth is defined as the value of primary residence, vehicles, owned businesses, other real estate, IRAs, stocks/mutual funds, investment trusts, bonds, Treasury securities, CDs, "other assets", and money market, savings, and checking accounts *less* the value of all mortgages, home loans, and other debt (such as unpaid medical bills, loans, or credit card debt). Due to the multiple categories and the extensive use of brackets plus limited imputations to reduce non-response, these data are generally considered high quality.

1. Earnings

As stated above, human wealth, or future income, has four components. First, for non-retired households, earnings income is estimated deterministically based on current wages incremented each year for tenure and experience.[32] Wages from 2002 until assumed retirement were forecast deterministically using the method of Gustman and Steinmeier (2002) that increments wages from the existing wage base for each additional year of experience and tenure using experience and tenure coefficients from a wage regression.[33]. Earnings are accrued until the estimated retirement age, which itself is based on survey responses to questions about planned retirement.[34]

2. Social Security

Future Social Security benefits are estimated by calculating the AIME and PIA using each respondent's record of covered Social Security earnings since 1951 (as well as forecasted earnings up to age retirement). If retirement age is <=62 the household is assumed to take reduced benefits at age 62. For retirement ages from 63 to 68, households are assumed to begin receiving Social Security (with actuarial adjustment) at retirement age. For retirement ages 68 and over, Social Security benefits (actuarially adjusted) are assumed to begin at age 68. The calculation then generates the present value of after-tax household

[32] Work assignment and labor earnings were calculated separately for each respondent. Respondents with a zero or missing 2002 wage and designated "not in the labor force" (as opposed to retired), were not assigned a wage and were assumed not to work. Respondents with a zero or missing 2002 wage who self-report that they are fully retired (even if they have not reached their pre-determined retirement age) are assumed to not work or receive any labor earnings for the remainder of their lives. All others with a zero or missing 2002 wage (due to unemployment or any reason other than self-report of full retirement) were assumed to be working full time and assigned their wage from 2000

[33] The wage regression, using the same covariates as Gustman and Steinmeier, returned almost identical coefficients for tenure and experience as their paper, which is not surprising since they also use a subset of the HRS sample.

[34] Retirement ages are set based on self-reports of expected retirement age or year (taking the most recent previous wave's report when multiple reports are available). Only about half of workers report a specific age or year of expected retirement. However, a majority of the rest does report at least one of the following: a "normal retirement age" for their job/occupation, an age at which they expect to change jobs (presumably leave a primary job for a slower-paced job), or an age at which they expect to reduce work hours. These responses were used as benchmarks to estimate an expected retirement age for each household. For example, someone reporting that the normal retirement age for their job is 62 and they expect to reduce hours at age 60 would be assigned a retirement age of 62. About 10% of workers responded to none of these questions and were arbitrarily assigned a retirement age of 65. Expected retirement ages are bounded at 50 and 70.

expected Social Security benefits up to age 100. The present value calculation includes discounts for actual mortality probabilities from age 65 to 100 based on life tables.[35]

3. Pensions

Third, the cash flow and present value of defined benefit pensions are estimated using the HRS Pension Calculator and using actual earnings histories rather than projecting earnings from one base year. The cash flow value is only used in the calculation of tax brackets but the present value provided by the Calculator is included in M. The present value of defined contribution plans provided by the Calculator is also added to M. Imputations based on self-reports where used when either a defined benefit or defined contribution pension was missing or zero and the respondent self-reported a value.

4. Permanent Benefits

Households already receiving other government income in 2002 that in not poverty-based, such as veteran benefits or Social Security disability, are assumed to continue receiving those benefits until death. The present value of after-tax benefits from these sources is included in wealth. The present value calculation includes discounts for actual mortality probabilities from age 65 to 100 based on life tables.

5. Poverty Benefits

SSI is a federal welfare program for the elderly and disabled that essentially sets a floor on elderly income in the vicinity of $6,000-10,000 per year (varies by state and marital status). Any household whose final present value of wealth by the described calculations ends up below the approximate present value (mortality discounted) of receiving this income floor for the rest of their lives, is assumed to receive this income floor as a government benefit.[36]

6. Taxes

Annual tax rates are estimated based on projected income from: earnings; the annual cash flow of pension annuities (from the pension calculator); a rough fraction of interest, dividend, or rent producing financial assets for high-financial-wealth households (to represent taxable interest or rental income); veterans and SSDI benefits; and the portion of Social Security benefits that are taxable (determined explicitly on a year to year basis). These tax rates, specific to each household each year, are applied to annual earnings and Social Security before the present value calculation. The tax rate applied to the present value of pension annuities (generated by the pension calculator) is the average of the household's tax rates from ages 65-85.

[35] For married couples, household benefits are the maximum of each spouse receiving Social Security based on their own work history or 1.5 times the Social Security for the higher earning spouse. The present value calculation for married couples also incorporates the different mortality risks for different age spouses. The expected value for each year is the sum of three values, the couple's SS benefit multiplied by the probability of both being alive, the head's benefit multiplied by the probability that only the head is alive, and the survivor's benefit multiplied by the probability of only the spouse being alive.

[36] The discounted present value of this income floor is approximately $100,000 for a 65 year-old couple.

Appendix C: Imputed Expected Returns

Within the Survey of Consumers data, a simple OLS to predict the expected returns in the Survey of Consumers using socio-demographic information and the probability question reveals that expected returns are difficult to predict. No set of basic factors available in the Survey of Consumers explains more than 18% of the variation in expected returns for this age group. Nonetheless, this paper uses coefficients from this OLS for the most predictive variables: the probability of returns over 5%, education, and region of residence. Income and percent of assets held in stocks did not have significant effects on expected returns.

The question about the probability of returns over 5% contributed on average 2.7% (percentage points) to the expected return in the Survey of Consumers for respondents age 50 to 70 (in other words 2.7% is the average value of the probability question response times its regression coefficient). The effect of the probability question in the HRS is calibrated to also affect the expected return by 2.7% on average. In addition, college education decreases expected returns by more than 1 percentage point and advanced degrees decrease expected returns by 2 percentage points. Finally, expected returns are significantly higher for residents in the South and Midwest than those in the Northeast and West.

Appendix D: OLS with all variables

Table D1:

Dependent Variable: Residual of ln(C/M) after mortality adj	(1)
Subjective Life Expectancy Ratio	-0.055 (0.035)
Self-Reported Health:	
Excellent or Very Good	-0.033 (0.033)
Fair or Poor	0.029 (0.042)
Age of Head	-0.102** (0.025)
Age of Head Squared	0.0008** (0.0002)
Retired	-0.040 (0.034)
Black or Hispanic	0.080* (0.042)
Female Respondent	0.070* (0.035)
Widowed	0.131 (0.094)
Female x Widow	0.197* (0.108)
Entrepreneur	-0.296** (0.070)
Education: No HS Diploma	0.023 (0.044)
Education: Some College	-0.033 (0.037)
Education: College and Graduate	-0.072* (0.038)
Number of Non-Couple Household Members	0.063** (0.013)
Probability of Receiving an Inheritance	-0.0002 (0.0004)
Positive Likelihood of Any Bequest	-0.094* (0.056)
>50% Likelihood of Bequest>$100k	-0.024 (0.036)
Probability of Bequest >$10k (Continuous)	0.0006 (0.0005)
Probability of Bequest >$100k (Continuous)	0.003** (0.001)
Long Financial Planning Horizon	-0.070** (0.028)
Fraction of Precise Answers	-0.088* (0.053)
High Word Recall	-0.062** (0.030)
Counting Backwards	0.124** (0.048)
Hardest Subtraction Problem	-0.049* (0.030)
Constant	-0.91 (0.80)
N=1645	R^2=0.273

Bibliography

Ameriks, John, Andrew Caplin, John Leahy, and Tom Tyler, "Measuring Self-Control," NBER Working Papers 10514, 2004.

Ando, A. and F. Modigliani, “The ‘Life-Cycle’ Hypothesis of Saving: Aggregate Implications and Tests”, *American Economic Review*, 53, pp.55-84.

Avery, Robert B. and Arthur B. Kennickell, “Household Saving in the US” *Review of Income and Wealth*, Dec 1991, 37(4).

Barsky, B., F.T. Juster, M. Kimball, and M. Shapiro, M., “Preference Parameters and Behavioral Heterogeneity: An Experimental Approach in the Health and Retirement Study,” *Quarterly Journal of Economics* 112 (2), May 1997, 537-579.

Bosworth, Barry, Gary Burtless, and John Sabelhaus, “The Decline in Saving: Evidence from Household Surveys”, *Brookings Papers on Economic Activity*, 1991, 1 pp.183-241.

Browning, Martin, and Annamaria Lusardi, “Household Savings: Micro Theories and Micro Facts,” *Journal of Economic Literature*, Dec. 1996 Vol. 34, pp. 1797-1855.

Cagetti, Marco, “Wealth Accumulation Over the Lifecycle and Precautionary Savings,” *Journal of Business and Economic Statistics*, Vol. 21, 2003.

Campbell, John Y., “Understanding risk and return,” *Journal of Political Economy* 104, 1996, 298–345.

Campbell, John Y. and N. Gregory Mankiw, “Permanent Income, Current Income, and Consumption,” *Journal of Business and Economic Statistics*, 1990, pp. 265-279.

Caplin, Andrew and John Leahy, "The Social Discount Rate," NBER Working Papers 7983, 2000.

Caplin, Andrew and John Leahy, “Wealth Accumulation and the Propensity to Plan,” *The Quarterly Journal of Economics*, 118 (3), August 2003.

Carroll, C. D. and M. Kimball, “Liquidity Constraints and Precautionary Saving”, NBER Working Paper W8496, Oct. 2001.

Carroll, Christopher D. and Andrew A. Samwick, “The Nature of Precautionary Wealth”, *Journal of Monetary Economics*, vol. 40, 1997 pp41-71.

Cocco, J., F. Gomes and P. Maenhout, “Consumption and Portfolio Choice Over the Life-Cycle,” *The Review of Financial Studies* 18:491-533, Summer 2005.

Cutler, David and Lawrence Katz (1991) “Macroeconomic Performance and the Disadvantaged” *Brookings Papers on Economic Activity* Vol. 1991 No.2.

Dynan, Karen E. & Jonathan Skinner & Stephen P. Zeldes, 2000. "Do the Rich Save More?," NBER Working Papers 7906.

Engen, Eric M., William G. Gale, and Cori E. Uccello, “The Adequacy of Household Saving” *Brookings Papers on Economic Activity*, no. 2, 1999, pp65-165.

Gourinchas, Pierre-Olivier and Jonathan A. Parker, “Consumption Over the Life Cycle”, *Econometrica* vol. 70(1), 2002, pp47-89.

Gustman, A.L. and Steinmeier, T.L., “Effects of Pensions on Savings: Analysis with Data from the Health and Retirement Study” *Carnegie Rochester Conference Series on Public Policy* 50(99), 1999, pp 271-324.

Gustman, A.L. and Steinmeier, T.L., “Retirement and the Stock Market Bubble”, NBER Working Paper 9404, 2002.

Gustman, Alan and Thomas Steinmeier, “The Social Security Early Entitlement Age in a Structural Model of Retirement and Wealth” NBER Working Paper 9183, September 2002.

Gustman, A.L. and Steinmeier, T.L., “Social Security and Retirement Dynamics”, Michigan Retirement Research Center, University of Michigan, 2006.

Hall, Robert and Frederic Mishkin, “The Sensitivity of Consumption to Transitory Income: Estimates from Pane Data on Households,” *Econometrica* 50(2): 461-481, 1982.

Hubbard, R. Glenn, J. Skinner, S. P. Zeldes, “Expanding the Life-Cycle Model: Precautionary Saving and Public Policy”, *The American Economic Review*, vol. 84(2), Papers and Proceedings, May 1994, pp174-179.

Hubbard, R. Glenn, J. Skinner, S. P. Zeldes, “The Importance of Precautionary Motives in Explaining Individual and Aggregate Saving”, NBER Working Paper 4516, 1994.

Hurd, M. D., “Mortality Risk and Bequests”, *Econometrica* Vol 57(4) July 1989, pp.779-813.

Hurd, M.D. and Smith, J.P., “Expected Bequests and their Distribution,” NBER Working Paper W9142, 2002.

Hurst, E., “Grasshoppers, Ants, and Pre-Retirement Wealth: A Test of the Permanent Income Hypothesis”, NBER Working Paper W10098, Nov. 2003.

Jagannathan, Ravi and Zhenyu Wang, “The conditional CAPM and the cross-section of expected returns,” *Journal of Finance* 51, 1996, 3–53.

Johnson, David, Stephanie Shipp, and Thesia Garner (1997) “Developing Poverty Thresholds Using Expenditure Data” in *Proceedings of the Government and Social Statistics Section*, American Statistical Association, August 1997.

Krusell, Per and Anthony A. Smith, “Income and Wealth Heterogeneity in the Macroeconomy,” *Journal of Political Economy*, Vol 106(5), Oct. 1998, pp. 867-896.

Laibson, David, “Golden Eggs and Hyperbolic Discounting,” *Quarterly Journal of Economics* 112(2): 443-477, 1996.

Laitner, J. “Estimating Life-Cycle Parameters from Consumption Behavior at Retirement”, NBER Working Paper W11163, March 2005.

Lawrence, Emily. 1991. “Poverty and the rate of time preference: Evidence from panel data.” *Journal of Political Economy*, 119, pp. 54-77.

Lillard, Lee and Robert Willis, “Cognition and Wealth: The Importance of Probabilistic Thinking” Michigan Retirement Research Center Working Paper 2001-007, June 2001.

Lusardi, Annamaria, “On the Importance of the Precautionary Saving Motive”, *The American Economic Review*, vol. 88(2), Papers and Proceedings, May 1998, pp449-453.

Lusardi, Annamaria, “Planning and Saving for Retirement”, Dartmouth College Working Paper, December 2003.

Mayer, Thomas, <u>Permanent Income, Wealth, and Consumption: A Critique of the Permanent Income Theory, the Life-Cycle Hypothesis, and Related Theories</u>, Berkeley: Univ. California Press, 1972.

Merton, Robert C. “Lifetime Portfolio Selection Under Uncertainty: The Continuous-Time Case,” *Review of Economics and Statistics*, 51 (August): 247-57.

Merton, Robert C. “Optimum Consumption and Portfolio Rules in a Continous-Time Model,” *Journal of Economic Theory*, 3 (December): 373-413.

Merton, Robert C. <u>Continuous-Time Finance</u>. Basil Blackwell Inc., Cambridge Massachusetts, 1990.

Modigliani, F. and Brumberg, R., “Utility Analysis and the Consumption Function: An Interpretation of Cross-Section Data”, in Kurihara, K. (ed), <u>Post-Keynesian Economics</u>, New Brunswick: Rutgers University Press, 1954.

Mullainathan, Sendhil and Richard H. Thaler, "Behavioral Economics," NBER Working Papers 7948, 2000.

Palacios-Huerta, Ignacio, “The robustness of the conditional CAPM with human capital,” *Journal of Financial Econometrics* 1, 2003, 272–289.

Palumbo, M. G., “Uncertain Medical Expenses and Precautionary Saving Near the End of the Life Cycle”, *The Review of Economic Studies* Vol 66(2) April 1999, pp.395-421.

Samwick, Andrew A., "Discount rate heterogeneity and social security reform," *Journal of Development Economics*, vol. 57(1), pages 117-146, October 1998.

Scholz, John K., Ananth Seshadri, and Surachai Khitatrakun, “Are Americans Saving Optimally for Retirement?” NBER Working Paper 10260, Feb 2004.

Van Praag, B. and Booij, A. “Risk Aversion and the Subjective Discount Rate: A Joint Approach”, CESinfo Working Paper No. 923, April 2003.

Vissing-Jørgensen, Annette and Orazio P. Attanasio, “Stock-market participation, intertemporal substitution, and risk-aversion,” *American Economic Review Papers and Proceedings* 93, 2003, 383–391.