Preliminary

Are Americans Saving "Optimally" for Retirement?

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There is considerable skepticism in public policy discussions and the financial press that Americans are preparing adequately for retirement. A quotation from the Wall Street Journal captures a popular view:

> A long time ago, New England was known for its thrifty Yankees. But that was before the baby boomers came along. These days, many New Englanders in their 30s and '40s, and indeed their counterparts all over America, have a different style: they are spending heavily and have sunk knee-deep in debt. ... A recent study sponsored by Merrill Lynch & Co. showed that the average middle-aged American had about $2,600 in net financial assets. Another survey by the financial-services giant showed that boomers earning $100,000 will need $653,000 in today's dollars by age 65 to retire in comfort – but were saving only 31 percent of the amount needed. In other words, saving rate will have to triple. Experts say the failure to build a nest egg will come to haunt the baby boomers, forcing them to drastically lower standards of living in their later years or to work for longer, perhaps into their '70s.[1]

Three approaches have been taken in the academic literature to investigate saving adequacy. The first compares wealth data to financial planning rules of thumb, such as "retirement income should replace 60 to 80 percent of pre-retirement income."[2] This approach provides useful descriptive information. But as Engen, Gale, and Uccello (1999) emphasize, households differ in their expectations and the uncertainties they face. These differences will result in a *distribution* of optimal wealth-earnings ratios rather than a single value, even for groups of households with identical ages, education, pension status, marital status, and current wages. Without a model that incorporates important aspects of the economic environment, studies that

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[1] "Binge Buyers: Many Baby Boomer Save Little, May Run Into Trouble Later On: They Don't Build Nest Eggs Nearly Rapidly Enough for an Easy Retirement," Bernard Wysocki Jr., 6/5/95, A1 Wall Street Journal. Also, see Edward Wolff (2002) in a monograph entitled *Retirement Insecurity: The Income Shortfalls Awaiting the Soon-to-Retire*, who concludes "retirement wealth accumulation needs to be improved for the vast majority of households."

[2] See, for example, Moore and Mitchell (1998), Gustman and Steinmeier (1999a), and Kotlikoff, Spivak, and Summers (1982).

compare household wealth to rules of thumb shed little light on the degree to which households are optimally preparing for retirement.

The second approach examines consumption changes around retirement.[3] Banks, Blundell and Tanner (1998) and Bernheim, Skinner and Weinberg (2001) identify what has been termed "the retirement-savings puzzle," where consumption falls upon retirement by more than would be anticipated by a life-cycle model where forward-looking households are equating the discounted marginal utility of consumption across time. Bernheim *et al.* interpret the post-retirement consumption declines (and wealth patterns) as indicating that retirees are surprised when they discover they have a lower-than-optimal level of retirement resources and are therefore forced to reduce consumption. Hurd and Rohwedder (2003) question this interpretation, showing that realized consumption changes following retirement closely match anticipated changes for households in the Health and Retirement Study (HRS). More generally, making inferences about saving adequacy and optimal behavior based on consumption changes around retirement is difficult. Retirement may occur for unanticipated reasons (such as adverse health shocks), which may lead to sudden drops in consumption, and it is difficult to quantify work-related expenses and identify leisure and consumption complementarities.

Engen, Gale, and Uccello (1999) use a third approach. They solve the life-cycle problem from death to first working age using a dynamic, stochastic life-cycle model, and obtain a distribution of optimal wealth-earnings ratios by Monte Carlo simulation of consumption choices

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[3]Hamermesh (1984) used limited consumption data from the Retirement History Survey in 1973 and 1975 to measure the ability of households to sustain pre-retirement consumption levels. He finds households do not have sufficient wealth to maintain pre-retirement consumption and that they respond by reducing real consumption as they age. Hausman and Paquette (1987) also find evidence of inadequate wealth accumulation.

of representative households. They then compare the *distribution* of simulated optimal ratios to actual ratios computed from the Survey of Consumer Finances and the HRS. They find a wide distribution of simulated optimal ratios due to realizations of earnings uncertainty, and argue that empirical work that focuses on discrepancies of actual wealth relative to a median (or mean) target wealth-income ratio does not provide compelling evidence of under- or over-saving. Actual wealth-to-earnings distributions from the HRS and SCF closely match (or are larger than) the simulated optimal distributions.

But the Engen *et al.* result does not answer the issue posed in this paper: are Americans saving optimally for retirement? Each HRS (and SCF) household has an optimal wealth income ratio given their (and any specific) life-cycle model and the fact that actual and simulated wealth-to-earnings distributions are similar does not ensure that each household is achieving its target. It is easy to construct examples where most households have less wealth than their optimal targets, yet the distributions of actual and simulated optimal wealth-earnings ratios align.

Previous studies of saving adequacy use the life-cycle model to organize thoughts or directly formulate tests. Given the importance of the life-cycle framework, it is surprising that no study actually uses the approach to predict household wealth at given ages, conditional on past earnings and other characteristics of households affecting consumption. This paper fills that void. We construct a life-cycle model that captures the key features of a household's consumption/saving decisions and, using data on the entire history of earnings realizations that the household received, we solve every household's life-cycle problem and derive implications for optimal wealth at given ages.

Our approach has a number of distinctive features. We incorporate detailed HRS data on family structure and age of retirement (treating both as exogenous and known from the beginning of working life) in calculating optimal life-cycle consumption profiles. Households form expectations about social security based on a detailed representation of social security rules. Expectations about defined benefit pension benefits are based on empirical predictions of pension entitlements (for those eligible to receive benefits) that are a function of final-year earnings. Earnings expectations come from age-earnings profiles estimated using restricted-access social security earnings records, incorporating an individual-specific term. Finally, our analysis examines all households in the HRS.[4]

I. The Health and Retirement Study

The HRS is a national panel study with an initial sample (in 1992) of 12,652 persons and 7,702 households.[5] It oversamples blacks, Hispanics and residents of Florida. The baseline 1992 study consisted of in-home, face-to-face interviews of the 1931-1941 birth cohort, and their spouses, if married. Follow-up interviews were given by telephone in 1994, 1996, 1998, 2000, and 2002. In this draft we focus on the 1992 data, though later waves are used in developing our data.

The survey covers a wide range of topics, including batteries of questions on health and cognitive conditions and status; retirement plans and perspectives; attitudes, preferences, expectations and subjective probabilities; family structure and transfers; employment status and

[4] In contrast, Engen, Gale, and Uccello (1999) restrict their analysis to married couples with at least one full-time worker.

[5] An overview of the HRS is given in a Supplementary issue of the Journal of Human Resources, 1995 (volume 30). There, 22 authors discuss and assess the data quality of many dimensions of the initial wave of the HRS. Subsequently careful work with the HRS related to this paper includes Gustman, Mitchell, Samwick and Steinmeier

job history; job demands and requirements; disability; demographic background; housing; income and net worth; and health insurance and pension plans.

1.1. Key features of the HRS data

We make use of equivalence scales in our model of household consumption. Consequently, we use HRS information on fertility and family structure to count the number of children and adults at each age during the household's working life.

The detailed financial information available in the HRS and the restricted access social security earnings data are central for the analysis. Social security earnings records are available for 64.5 percent of married households and 73.2 percent of single households. These provide a direct measure of earnings realizations and lifetime income, and, as described below, they are used to estimate household's expectations of future earnings. The earnings histories also allow us to accurately simulate social security benefits for the respondent and spouse or, if higher, the couple.

Net worth is a comprehensive measure that includes housing assets less liabilities, business assets less liabilities, checking and saving accounts, stocks, bonds, mutual funds, retirement accounts, certificates of deposits, the cash value of whole life insurance, and other assets, less credit card debt and other liabilities. It excludes defined benefit pension wealth, social security wealth, consumer durables, and future earnings. The concept of wealth is similar (and in some cases identical) to those used by other studies of wealth and saving adequacy.

We use the "Pension Present Value Database" that Bob Peticolis and Tom Steinmeier have kindly made available on the HRS Web Site to calculate the value of defined benefit pensions

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(1998), Moore and Mitchell (1998), Gustman and Steinmeier (1999a) and Gustman and Steinmeier (1999b).

and, as described below, estimate household's expectations of future pension benefits.[6] The program makes present value calculations of HRS pensions for wave 1 respondents for nine different scenarios, corresponding to the Social Security Administration's low, intermediate and high long-term projections for interest rates, wage growth rates and inflation rates. We use the intermediate values for underlying assumptions with the Peticolis-Steinmeier DB pension wealth calculations.[7]

Following others in the literature (for example, Engen *et al.*, 1999, page 159), we do not use the Peticolis-Steinmeier calculations for valuing DC pensions. Gustman and Steinmeier (1999b) document discrepancies between reported and calculated pension values, showing the mean accumulations reported by respondents are only 69 percent of the amounts calculated by using pension documents. It might seem that there is no *a priori* reason to choose between self-reports of DC pension wealth or calculations made on the basis of detailed plan documents. In this case, however, the self-reports are more useful than the calculated values for two reasons. First, one could argue that it is people's perceptions of their DC wealth that will influence life-cycle consumption behavior. Second and more importantly, the pension calculation program assumes a constant contribution rate over time for participants of plans with voluntary contributions. If workers alter their contribution patterns (in particular, begin to increase contributions as they approach retirement and/or have children that leave the household), the calculated amounts will be overstated. Indeed, Gustman and Steinmeier (1999b) present evidence consistent with DC

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[6]See http://www.umich.edu/~hrswww/center/rescont2.html. We use self-reported defined-benefit pension information for households not included in the Peticolis and Steinmeier file.

[7]The intermediate Social Security Administration assumptions are 6.3 percent for interest rates, 5 percent for wage

pension contributions increasing with age. Because of this, we use self-reported information to calculate DC pension wealth.[8]

Table 1 provides descriptive statistics for the HRS sample. Mean (median) earnings in 1991 of HRS households are $33,358 ($24,902), though note that 34 percent are not in the paid labor force when interviewed in 1992. The mean (median) present discounted value of lifetime household earnings is $1,923,363 ($1,583,380). Retirement consumption will be financed out of pension wealth (mean is $124,861, median is $36,394); social security wealth (mean is $135,781, median is $127,334); and non-pension net worth (mean is $240,933, median is $102,000). These descriptive means and medians are comparable to other work published with the HRS.

Our empirical procedures result in social security replacement rates that are similar to those discussed in Engen *et al.* (1999). The replacement rate is defined as equaling annual social security benefits divided by the average of the final five years of earned income (prior to retirement), multiplied by 100. The median for our sample of married couples is 43.5 percent. Those with less than a high school degree have a median of 47.5 percent. Those with a high school degree or some college have a median rate of 46.4 percent. College graduates have a median rate of 35.5 percent, while those with more than a college degree have a median rate of 32.2 percent. Engen *et al.* cite figures from Grad (1990) writing in the *Social Security Bulletin* that an average replacement rate for couples was roughly 55 percent in 1982. Social security has become somewhat less generous since 1982 (Engen *et al.* suggest reducing average replacement

growth, and 4 percent for inflation.

[8] After documenting the problem, Gustman and Steinmeier (1999b) raise concerns about respondent misreporting, so they use the plan documents for DC wealth, adjusted downwards based on a regression analysis of self-reported and calculated pension wealth. This leads them to reduce the calculated DC pension amounts by roughly half for a calculated pension of $25,000 and almost two-thirds for a calculated pension of $100,000.

rates by 20 percent, or to roughly 45 percent to account for reductions in social security benefits). Our data are based on social security earnings records and a simplified simulation of social security rules,[9] so it is not surprising that our data are consistent with figures reported elsewhere.

Figure 1 highlights the critical role played by social security in enhancing retirement income, particularly for households with low levels of lifetime income. It shows the median levels of pension wealth, social security wealth, and non-pension net worth in each lifetime income decile. Social security exceeds the combined value of pension and non-pension net worth in the bottom two deciles of the lifetime income distribution and private net worth only exceeds the value of social security in the top two deciles of the lifetime income distribution. The metaphor of the "three-legged stool," where retirement income security is supported by the three legs of social security, employer-provided pensions, and private wealth accumulation, is only satisfied (at the median) for households in the top 70 percent of the lifetime income distribution due to the lack of employer-provided pension coverage of low-income workers.

1.2. Subjective assessments of retirement preparation

A substantial number of Americans are concerned about their standard of living in retirement. Table 2 shows responses by heads of households to a question that asks if they worry about "not having enough income to get by" in retirement (the specific questions are given in the notes to the table). Twenty-two percent of the not-retired heads and 30 percent of the retired heads "worry a lot" about not having enough income to get by. Roughly 45 percent (depending on working status) of the heads worry somewhat or worry a lot about not having enough income for retirement.

[9]The Appendix provides details of the social security calculations.

There is substantial variation in the concern people have about retirement income across lifetime earnings percentiles. Over sixty percent of households in the lowest 20 percentiles of the lifetime earnings distribution worry a lot or worry somewhat about not having enough income to get by in retirement. Over forty percent of those in the middle deciles (40-60 percentile) of the lifetime earnings distribution worry a lot or somewhat. But these worries are not exclusive to low- and middle-income households. Over a quarter of those in the top decile of the lifetime earnings distribution report worrying a lot or somewhat about not having enough income to get by. Nine percent of the top decile worry a lot, while 47 percent of the bottom decile worry a lot.

The subjective responses suggest that Americans worry about their financial security in retirement. But a more rigorous standard for assessing retirement preparation is needed to help interpret the subjective evidence. We turn to this in the following sections.

II. The Economic Environment

Consider a simple life-cycle model, augmented to incorporate uncertain lifetimes, uninsurable earnings and borrowing constraints. Individuals within a household can live up to a maximum age D. Between ages 0 and $S-1$ individuals are children and therefore make no consumption decisions. At age S they become adults and potentially give birth to n children at ages B_1, B_2, ..., B_n. Adults start working at age S and have exogenous labor supply (and total labor income equals earnings). Earnings depend on age (as it affects work experience) and a random shock that can be correlated across time. At age $R+1$ adults retire and face a probability of death in each remaining year of life. In retirement adults receive income from social security, defined benefit plans (if they have one) and assets. Social security receipts depend on average earnings during the pre-retirement period, while defined benefit pension receipts are a function of an adult's last earnings receipt before retirement.[10] Every period adults decide how much to consume and how much to save for the future.

2.1 Consumer's maximization problem

An individual derives utility $U(c)$ from his period-by-period consumption, c. Let c_j and a_j represent his consumption and assets at age j. With probability p_j the individual survives into the next period so an individual survives until age j with probability $\prod_{k=S}^{j-1} p_k$. At age D, $p_D = 0$. Let the discount factor on future utilities be β. Then expected lifetime utility is

$$E\left[\sum_{j=S}^{D} \beta^{j-S} \left(\prod_{k=S}^{j-1} p_k\right) U\left(c_j\right)\right]$$

where $\prod_{k=S}^{j-1} p_k = 1$ if $j-1 < R$. The expectation operator E denotes the expectation over future earnings uncertainty. Consumption and assets are chosen to maximize expected utility subject to the constraints,

$$y_j = e_j + ra_j + T,\ j \in \{S, ..., R\},$$

$$y_j = SS\left(\sum_{j=S}^{R} e_j\right) + DB\left(e_R\right) + ra_j + T,\ j \in \{R+1, ..., D\},$$

$$c_j + a_{j+1} = y_j + a_j - \tau\left(y_j\right), j \in \{S, \ldots, D\}$$

and

[10] Incorporating pensions and social security benefits (that depend on actual past earnings histories) is one feature distinguishing our model from others. The realistic social security system we model could have potentially important effects for poorer households whose social security receipts can represent a large fraction of retirement income. The added complication is that the state space of the individual expands.

$$a_{j+1} \geq 0,$$

where a_{j+1} represents his asset holdings at age $j+1$.[11] Further, τ is a tax function that depicts total tax payments as a function of taxable income y_j. SS and DB are social security and defined benefit receipts. As noted earlier, the former is a function of aggregate lifetime income while the latter is a function of earnings received at the last working age. Finally, T denotes means-tested transfers.

2.2 The Earnings Process

The earnings of an individual i at age j, e_j^i depend on age (experience), and a stochastic shock. An exact description of the estimation is postponed to the next section. For now, assume that earnings ability evolves according to the AR(1) process

$$\log(e_j^i) = \rho \log(e_{j-1}^i) + \mu_j^i + \varepsilon_j^i,$$

where ρ is the degree of persistence in earnings across ages. The idiosyncratic stochastic component ε_j is assumed to be drawn from $N(0, \sigma_\varepsilon^2)$, while μ_j^i is a mean-shifter across ages. This mean-shifter will be made up of two components – first, the effect of age and experience which will be that same for all individuals and second, an individual-specific age-invariant component given by α^i. A higher value of α^i implies that the individual will, all else equal, experience a higher permanent income than the corresponding individual with a lower value

[11] This constraint will never be violated even if it weren't imposed exogenously and is a direct implication of the non-negativity restriction on consumption. The intuition is the following: for the problem to be well-specified, the individual shouldn't be allowed to die with debts regardless of the stochastic sequence of earnings shocks he faces. Since his earnings shocks in every period can get arbitrarily close to zero, the individual should be in a position to repay his debt even in this eventuality – failing this, consumption goes to zero and marginal utility of consumption goes to infinity, which is clearly non-optimal (since the utility function satisfies the Inada condition). Consequently,

of α^i. To facilitate exposition, we denote the distribution from which an individual will draw next period's (age $j+1$) earnings e', conditional on the current earnings draw being e at age j, by $F_j\left(e'\middle|e\right)$.

2.3 Recursive Formulation of the Life-Cycle Problem

The life-cycle problem may be solved backwards from age D, given the terminal condition at that age. We start by describing the problem for retired adults.

2.3.1 The Retired Adult's Problem

A retired adult between the ages $R+1$ and D obtains income from social security, defined benefits and pre-retirement assets.[12] The dynamic programming problem at age j is

$$V(e_R, E_R, a, j) = \max_{c,a'} \left\{ U(c) + \beta p_j V(e_R, E_R, a', j+1) \right\}, \tag{1.1}$$

subject to

$$y = SS(E_R) + DB(e_R) + ra + T(e_R, E_R, a, j),$$

$$c + a' = y + a - \tau\left(y\right), \tag{1.2}$$

In equation (1.1), $V(e_R, E_R, a, j)$ denotes welfare at age j, $V(e_R, E_R, a', j+1)$ denotes next period's welfare, β is the discount factor on future utilities, and p_j the probability of survival between ages j and $j+1$. Additional notation is y, taxable income; c, consumption; e, earnings; T, means-tested transfers; and a, assets. The interest rate is denoted by r and taxes on income are denoted by τ. Total earnings up to the current period are denoted by E_R while his

the consumer will maintain a non-negative asset position in every age. The same logic applies in retirement, with the exception that rather than earnings uncertainty, the individual now faces uncertainty in life-span.

[12] To simplify notation, age j variables will be expressed without any subscripts or superscripts, and age $j-1$ variables and age $j+1$ variables will be represented with subscript "-1" and superscript "'", respectively.

last earnings draw, at the age of retirement is e_R. Note that E_R and e_R do not change once the individual is retired.

2.3.2 The problem at the age of retirement

Age R represents the last working age for the individual. At this age, the individual knows that in the next period he will cease working and begin receiving income from social security and defined benefit pensions. The corresponding dynamic programming problem is

$$V(e_R, E_{R-1}, a, R) = \max_{c,a'} \left\{ U(c) + \beta p_j V(e_R, E_R, a', R+1) \right\}, \tag{1.3}$$

subject to

$$y = e_R + ra + T(e_R, E_{R-1}, a, R),$$

$$c + a' = y + a - \tau(y),$$

and

$$E_R = E_{R-1} + e_R.$$

During his last working age, he receives an earnings draw, label it e_R. This draw will determine his defined benefits in retirement. Further, this earnings draw together with his total earnings to date E_{R-1} go about to determine his total lifetime earnings, E_R. Lifetime social security receipts will depend on E_R.

2.3.3 The Working Adult's Problem

Between ages S and R, the individual receives an exogenous earnings draw e. Given earnings and savings from previous period, the individual decides how much to consume and save. The decision problem reads

$$V(e, E_{-1}, a, j) = \max_{c,a'} \left\{ U\left(\frac{c}{g(A,K,j)} \right) + \beta \int_{e'} V(e', E, a', j+1) dF_j\left(e' \middle| e\right) \right\}, \tag{1.4}$$

subject to

$$y = e + ra + T(e, E_{-1}, a, j),$$

$$c + a' = y + a - \tau(y),$$

and

$$E = E_{-1} + e.$$

Note that during working years, earnings draws for the next period are drawn from a distribution conditional on the individual's age and current earnings draw. Lastly, $g(A, K, j)$ is a function that adjusts for changing family size, where A denotes number of adults and K denotes number of children. The solution to the decision problem yields the decision rule as a function of the individual state, denote this decision rule $a' = A(e, E_{-1}, a, j)$. We assume that each household begins life with zero assets. Given the observed earnings history of a household, we recover the optimal level of assets at every age using the decision rules.

III. Calibration and Estimation of Exogenous Processes

In this section we specify functional forms and parameter values that we use for the numerical simulations. Parameters are generally based on existing empirical work.

Preferences: The utility function for consumption of final goods is assumed to be CRRA:

$$U(c,l) = \begin{cases} \dfrac{c^{1-\gamma}}{1-\gamma}, \text{ if } \gamma \neq 1 \\ \log c, \text{ if } \gamma = 1 \end{cases}$$

We set the discount factor on descendants' utilities, $\beta = 0.97$, and set $\gamma = 2$.

Survival Probabilities: These are calculated based on the 1992 life tables of the Center for Disease Control and Prevention, U.S. Department of Health and Human Services (http://www.cdc.gov/nchs/data/lifetables/life92_2.pdf)

Equivalence Scale: This is obtained from Citro and Michael (1995) and takes the form $g(A,K,j)=(A+0.7K)^{0.7}$.

Taxes: Taxes on income are specified exogenously. The model economy's income tax function is

$$\tau(y)=a_0\left(y-\left(y^{-a_1}+a_2\right)^{-1/a_1}\right).$$

This form for the personal income tax is estimated by Gouveia and Strauss (1994) to characterize the U.S. effective household income tax in 1989. Their estimated values are $a_0=0.258$, $a_1=0.768$ and $a_2=0.031$.[13]

Transfers: The government redistributes according to an income maintenance program following Hubbard, Skinner and Zeldes (1995). The transfer that an individual receives while working is given by

$$T=\max\left\{0,\underline{c}-\left[e+(1+r)a\right]\right\},$$

while the transfer that he or she will receive upon retiring is

$$T=\max\left\{0,\underline{c}-\left[SS(E_R)+DB(e_R)+(1+r)a\right].\right\}$$

Essentially, this transfer function guarantees a pre-tax income of $\underline{c}$ which we set to \$7000.

Earnings Process Let the age-earnings profile be specified as

$$\log e_j=\alpha^i+\beta_0+\beta_1 AGE_j+\beta_2 AGE_j^2+u_j,$$

$$u_j=\rho u_{j-1}+\varepsilon_j,$$

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[13] $a_1=-1$ corresponds to a lump sum tax with $\tau(y)=-a_0a_2$, while when $a_1\to 0$, the tax system converges to a proportional tax system with $\tau(y)=a_0y$. For $a_1>0$ we have a progressive tax system.

where e_j is the observed earnings of the household *i* at age *j* in 1992-dollar units, α^i is the household specific constant, AGE_j is age of the head of the household, u_j is an AR(1) error term of the earnings equation, and ε_j is a zero-mean i.i.d. error term. The distribution of ε_j is assumed to be normal. The parameters to be estimated are α^i, β_0, β_1, β_2, ρ, and σ_ε^2. Equivalently, the above earnings process can be written as

$$\log(e_j) = \rho \log(e_{j-1}) + (x'_j - \rho x'_{j-1})\beta + \varepsilon_j \qquad (1.5)$$

where $(x'_j - \rho x'_{j-1})\beta = \alpha^i(1-\rho) + \beta_0(1-\rho) + \beta_1(AGE_j - \rho AGE_{j-1}) + \beta_2(AGE_j^2 - \rho AGE_{j-1}^2)$.

Based on (1.5), the predicted value of e_j when ε_j is normally distributed is

$$e_j = e_{j-1}^{\rho} \exp\{(x'_j - \rho x'_{j-1})\beta + \sigma_\varepsilon^2/2\} \exp\{\varepsilon_j\}$$

The sampled households are divided into 6 groups according to marital status, education, and number of earners in the households. Therefore, there are 6 sets of these (individual-group specific) parameters.[14]

With these estimates, we can predict household earnings. For any age *j*, denote *l* as the latest period that we observe actual earnings prior to age *j*. Under the assumption that ε_j has a normal distribution, *predicted* earnings are given by

$$\hat{e}_j = \exp(\alpha^i + \beta_0 + \beta_1 AGE_j + \beta_2 AGE_j^2 + \rho^{(j-l)} u_l + \sigma_\varepsilon^2/2)$$

where the period *s* disturbance is calculated as

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[14] The 6 groups are (1) single without a college degree; (2) single with a college degree or more; (3) married, head without a college degree, one earner; (4) married, head without a college degree, two earners; (5) married, head with a college degree, one earner; and (6) married, head with a college degree, two earners. A respondent is an earner if his or her lifetime earnings are positive and at least 20% of the lifetime earnings of his or her spouse.

$$u_l = \log(e_l) - \alpha^i - \beta_0 - \beta_1 AGE_l - \beta_2 AGE_l^2$$

The household *expected* earnings profile is $\{\bar{e}_j\}_{j=S}^{R}$, where S is the first year that the head of the household started working full time, R is the head's last year of work, and the expected earnings at age j are defined as observed earnings if the data are available. Otherwise they equal $\hat{e}_j$. The resulting estimates are given in Table 3.

A detailed description of the social security function and the estimation of the defined benefit function are relegated to the appendix.

3.1 Model solution

We solve the dynamic programming problem by linear interpolation on the value function. Recall that the state space is comprised of four variables: current earnings, e; earnings to date E_{-1}, assets a; and age i. We begin by discretizing the state space. The grid for earnings is constructed using the discretization procedure discussed in Tauchen (1986). The grid for assets is chosen to be denser at lower levels of assets and progressively coarser so as to account for non-linearities in the decision rules for assets induced by the borrowing constraint. We start at age D and compute the value function $V(e_R, E_R, a, D)$ associated with all possible states in the discretized set. (The problem at this stage is trivial, since the individual will simply consume all income). We move backwards to the previous period and solve for the value function and the decision rule for assets. For points that do not lie on the grid, we linearly interpolate. (More specifically, if optimal assets do not lie on the grid, we linearly interpolate between the points on the grid that lie on either side). In this fashion we go all the way to the starting age S and consequently recover the decision rules $a' = A(e, E_{-1}, a, j)$ for all j.

IV. Model Predictions and the Data

As we discuss above, for each household in our sample, we go backwards from the age of death and compute optimal decision rules for consumption (and hence asset accumulation) from the oldest possible age (D) to the beginning of their working life (S). These decision rules differ for each household, since each faces stochastic draws from different distributions (recall that α_i is household-specific). Other characteristics also differ across households: for example, birth years of children affect the "adult equivalents" in a household at any given age; and the pension status of individuals in a household vary, which will affect the defined benefit function. Consequently, it is not sufficient to solve the life-cycle problem for just a few household types.

Once optimal decision rules are solved for each household, the model is simulated for each household using data on the observed realizations of earnings. These simulations generate an optimal level of wealth for each household, given the underlying model. Specifically, we start at age S, the first working age, where the household is assumed to start off with zero assets. Earnings-to-date are also zero at S. Given observed earnings at age S, $\hat{e}_S$, wealth (saving) is given by $a_{S+1} = A(\hat{e}_S, 0, 0, S)$. In the next period, the household receives an observed earnings draw $\hat{e}_{S+1}$, so aggregate earnings are given by $\hat{E}_S = \hat{e}_S$. Consequently, wealth is given by $a_{S+1} = A(\hat{e}_{S+1}, \hat{E}_S, a_S, S+1)$. We move forward in this fashion until we reach the age at which wealth data are available for that particular household.

In this section we compare the optimal wealth levels for each household to the wealth recorded in the HRS. We start be providing information on optimal wealth accumulation implied by the simulation model, and compare that to targets reported in Engen, Gale and

Uccello (1999). We then present detailed information on the degree to which HRS households are meeting their specific targets. The third subsection examines correlations between household characteristics and the degree to which households are and are not meeting their targets. The final subsection examines the degree to which subjective attitudes about retirement are consistent with deviations between actual and optimal (in the context of our model) behavior.

4.1 Optimal wealth accumulation in the HRS

Table 4 summarizes the distribution of optimal net worth holdings. Like the results of Hubbard, Skinner, and Zeldes (1995), low-skilled households will optimally accumulate negligible amounts of wealth outside of social security. The optimal wealth target for households in the 10th percentile of the distribution of optimal wealth targets is \$180 (including housing wealth). Means-tested transfer programs including AFDC (during the period being studied), food stamps, SSI and other forms of assistance have income and asset tests. Households receiving these assets or who may draw benefits with a negative earnings shock will optimally not accumulate assets, since doing so will make households ineligible for transfers.[15]

Optimal wealth targets are \$79,128 for the median household and grow to \$451,060 for the household at the 90th percentile of the optimal net worth distribution. These targets include the current value of defined contribution pensions (including 401(k)s) as well as housing net worth (as long as households are willing to reduce housing in retirement to maintain consumption standards). In other studies, wealth targets are commonly given in the form of wealth-earnings ratios. In the second column of Table 4 we show targets as a ratio of 1991 earnings. Optimal

[15] Empirical work on the effects of asset tests and asset accumulation comes to mixed conclusions. Gruber and Yelowitz (1999) find significant negative effects of Medicaid on asset accumulation, but Hurst and Ziliak (2001) find only very small effects of AFDC and food stamp asset limits.

wealth-earnings ratios are 2.6 at the median, and reach 16.4 at the 90th percentile of the distribution.

Table 5 compares optimal targets from our model with optimal targets from Engen, Gale, and Uccello (1999) for married households age 60 to 62 with college degrees and covered by pensions. There are only 325 households in the HRS between 60 and 62, so we did not restrict our comparison sample to those with college degrees and pensions. Our model also differs in important ways from theirs, in that we incorporate a transfer system with asset tests. Most importantly, optimal wealth is determined through the interaction between optimal decision rules from the life-cycle model and HRS households' earnings realizations. Despite these differences, as the first two rows of Table 5 show, the optimal target wealth-income ratios are strikingly similar for households in the bottom half of the optimal wealth-earnings distribution. The Engen *et al.* approach appears to significantly understates optimal wealth-income ratios at the top of the distribution. The bottom panel of Table 5 shows that our optimal wealth-income targets have similar qualitative patterns as the Engen *et al.* targets across lifetime income quintiles.

The primary feature of our work that distinguishes it from previous work is that we can compare optimal levels of wealth with actual wealth for each household in the HRS.

4.2 Are households preparing optimally for retirement?

Figure 2 gives a scatterplot of optimal net worth against actual net worth for HRS households, for households with optimal and actual wealth between \$0 and \$1,000,000. The figure is striking, in that households appear to cluster heavily just below the 45 degree line. The scatterplot gives suggestive visual evidence that most households appear to be saving adequately for retirement.

Figure 3 graphs the distribution of the difference between actual and optimal wealth targets. If our model perfectly characterized household behavior, this difference would be \$0 for all households. We see all households from the 25th percentile of the distribution and above are meeting or exceeding their wealth target. Households in the 10th percentile of the "actual minus optimal" wealth distribution have wealth shortfalls, but the magnitudes appears small. Figure 3 provides evidence against the idea that most HRS households are preparing poorly for retirement.[16]

The optimal standard implied by the model may *overstate* optimal wealth accumulation. As noted by Banks *et al.* (1998) and many others, life-cycle models imply that the discounted marginal utility of consumption, and not necessarily consumption itself, should be smoothed across time periods. Consumption could easily fall in retirement without affecting the marginal utility of consumption as households complete home mortgage payments and expenses related to work fall. Another consideration is raised by Börsch-Supan and Stahl (1991), who suggest there may be a physical constraint on consumption for the elderly, which also may lead to a declining consumption trajectory with age. Hurd and Rohwedder (2003) emphasize the potential importance of consumption-leisure complementarities in retirement.

There is little evidence in Figure 3 that HRS households are failing to accumulate sufficient resources to maintain the discounted marginal utility of consumption in retirement. But in thinking about optimal behavior, utility losses can also arise from consuming too little. Nevertheless, the magnitudes of "over-saving" are relatively modest. Moreover, it is plausible that high lifetime-income deciles have operative bequest motives.

[16] The patterns and levels in Figure 3 are similar when the sample is split between those with and without college

Table 6 shows the fraction of HRS households with wealth deficits, broken out by lifetime earnings deciles. Overall 15.9 percent of the HRS sample has deficits (their wealth is less than the optimal target). The likelihood of having a deficit falls with lifetime income. While by this measure, somewhat more than one in six HRS households is saving too little, the median magnitude (conditional on having a deficit) is small, averaging $13,500. While some households are approaching retirement with significant wealth deficits, Table 6 provides additional evidence that HRS households overwhelmingly are prepared well for retirement. It is also striking how a well-specified life-cycle model can account for variation in household wealth accumulation. A simple goodness of fit measure – $R^2 = 1 - \left(\frac{\sum_{i=1}^{N} (o_i - a_i)^2}{\sum_{i=1}^{N} (a_i - \bar{a})^2} \right)$, where a_i is the actual wealth of household i and o_i is the household's optimal target – shows the model overall explains 73 percent of the cross-household variation in wealth.

There is some question about the degree to which the elderly are willing to reduce housing equity to sustain consumption in retirement. Venti and Wise (2001), for example, write "... these results suggest that in considering whether families have saved enough to maintain their pre-retirement standard of living after retirement, housing equity should not be counted on to support general non-housing consumption."[17] Figure 4 shows the effects of excluding half of housing from the resources available to meet the wealth target. Figure 5 shows the effect of excluding all housing equity. Excluding half of housing equity, half of all households meet or exceed their

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degrees, and into single and married households.

[17] Also see Venti and Wise (1990) for a similar conclusion. Sheiner and Weil (1992) suggest households may be

wealth targets. Households in the 25th to 50th percentiles of the distribution have deficits, but they never exceed $50,000 (and they are considerable lower for households in the bottom of the lifetime earnings distribution). If no housing equity is used for retirement consumption, households have large retirement wealth deficits. With the major increases in property-backed credit over the last 15 years, we think it is an extreme position to assert that a significant fraction of households will refuse to tap any housing equity to support consumption in retirement.

4.3 Characteristics correlated with over- and under-saving

Table 7 shows probit estimates of the probability that an HRS household has failed to meet their optimal wealth target. Relative to households in the first lifetime earnings decile, the probability of under-saving is 4 to 6 percentage points lower for households in the 4th through 10th lifetime earnings deciles. The probability of under-saving falls by 0.7 percentage points for every year of age. Blacks are 2.8 percentage points more likely than Whites to be saving less than their optimal targets. Despite the presence of a handful of significant partial correlations, the magnitude of the relationships appears fairly small, other than the effects of lifetime income (and possibly age).

Table 8 shows median regression coefficients of factors correlated with our measure of "saving adequacy" – the difference between actual and optimal wealth. Lifetime earnings are positively, monotonically correlated with adequacy. Adequacy increases with age and is higher for self-employed households. Adequacy is negatively correlated with men, and Blacks and Hispanics relative to Whites.

4.4 Subjective expectations of retirement living standards and saving adequacy

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willing to decrease housing equity to support consumption.

In this section we briefly examine the relationship between subjective assessments of retirement preparation and measures of saving adequacy (actual net worth minus the optimal net worth target). Table 9 shows the coefficients of ordered probit regressions examining the factors correlated to the response to the questions highlighted in Table 2. Specifically, we examine factors correlated with the degree to which families worry about not having enough income to get by. In addition to demographic characteristics, we also include a measure of saving adequacy. [18] If the subjective questions and the life-cycle simulation model have analytic value, we expect saving adequacy to be negatively correlated with worries about retirement living standards.[19]

The ordered probit results for whether or not people worry about retirement look exactly the way we anticipated (see the specific wording of the question in the notes to Table 2). People with low levels of education and with low lifetime earnings worry more about their financial status in retirement than those with the opposite characteristics.[20] After conditioning on these characteristics, the saving adequacy measure is significant and in the expected direction. The larger the difference between wealth and the optimal wealth level, the less households worry about retirement.

While earlier results suggest Americans worry too much about living standards in retirement, worries are significantly correlated with retirement preparation. In this sense

[18] Results are similar if we include a dummy variable indicating the household was failing to meet its target rather than using the saving adequacy measure.

[19] We pool the samples of retirees and non-retirees.

[20] Non-whites appear to worry less about retirement finances than whites.

American's worries about financial security in retirement seem well grounded in that they corresponds fairly closely to the characteristics associated with likely drops in living standards.

VI. Conclusions

This work is preliminary, so our conclusions are unusually tentative. With that caveat, we make the following suggestions. First, we offer a rigorous, novel (for the literature) approach to assessing the degree to which a representative sample of households nearing retirement have prepared financially for that event. We find strikingly little evidence that HRS households have under-saved. And because consumption requirements likely fall when households reach retirement (if for no other reason than work expenses fall and some households will finish paying off their mortgages), our standard also likely overstates required wealth. We also note that our primary data come from 1992, well before the exceptionally strong stock market performance of the 1990s. Because 84 percent of households meet or exceed their wealth targets (and most of those who are below miss by a relatively small amount), we are skeptical that the consumption changes around retirement documented by Bernheim, Skinner, and Weinberg (2001) is due to inadequate retirement wealth accumulation.

We also find it striking how much of the variation in observed wealth accumulation can be explained by our life-cycle model. We explain over 70 percent of the variation in wealth for married households, and over 80 percent for single households who never married. And the results presented reflect no tweaking or prior fitting of the model. If we had found major deviations from the model and behavior, it would be difficult to determine whether Americans were preparing poorly for retirement, or we had constructed a lousy behavioral benchmark. The fact that our predictions and data closely align suggests two things to us. First, as mentioned above, Americans are saving enough to maintain living standards in retirement. And second, the life-cycle model provides a very good representation of behavior related to retirement wealth accumulation. Of course, we still admit the possibility that Americans are preparing poorly for retirement and our underlying behavioral model is lousy, and the errors coincidentally offset.

Befitting the preliminary status of the paper, we need to provide extensive sensitivity analysis to underlying model parameters. Our "to do" list includes essentially every input parameter. But past work suggests the discount rate (Carroll, 1999; and Laibson, 1999 both argue the appropriate discount rate should be zero); the process governing earnings expectations, and risk aversion will significantly affect optimal targets. It is unlikely that our parameter choices reflect all readers' consensus choices. We intend to provide sufficient sensitivity analyses to fully understand the degree to which reasonable modeling choices affect our conclusions.

Lastly, we were purposefully provocative in choosing the paper title. As mentioned earlier, saving too much has efficiency costs in the sense that, absent preferences about intergenerational transfers or charitable contributions, lifetime utility could be increased by reallocating consumption. Of course, the degree to which observed behavior deviates from the optimal targets may simply be an empirical measure of the intensity of transfer motives (and for those under-saving, this may be a measure of the magnitude of the reduction in work expenses or consumption-leisure complementarities that await selected households in retirement). But even if households met their targets precisely, if they spent 50 percent of the household budget on financial planning advice, their behavior would not be optimal. So the question posed in the title remains unanswered. We do think the paper provides new, strong support for the life-cycle model as a good characterization of the process governing retirement wealth accumulation. And more importantly, it adds considerably to our confidence that Americans are preparing well for retirement.

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Appendix

Social Security function:

From the expected earnings profiles, we can calculate the *lifetime* summation of household earnings at the first period of retirement as $E_R \equiv \sum_{j=S}^{R} e_j$, where e_j denotes the household earnings at age j in a common base-year unit, and S and R denote the first and the last working ages, respectively.[21] Denote $\overline{\phi}^h$ and $\overline{\phi}^w$ as the fractions of E_R that are contributed by the husband and wife of the household, respectively.[22] Based on E_R, $\overline{\phi}^h$ and $\overline{\phi}^w$, we can approximate the household annual social security benefits as follows.[23]

(a) Calculate *Individual* PIA

Individual *i*'s annual indexed monthly earnings (AIME) can be approximated as

$$AIME^i \approx \overline{\phi}^i \, E_R \big/ L^i \qquad (1.6)$$

with

[21] Notice that the summation is just a straightforward summation of earnings in a common base-year currency unit, <u>not</u> a discounted present value of earnings. The former is the concept employed by the social security administration (SSA), while the latter—which involves discounting earnings in a base-year currency unit with real interest rates—is not.

[22] The terminologies "husband" and "wife" are not literal. In particular, we call a single male respondent "husband" and a single female respondent "wife." Without this simplification, we need separate treatments for married and single households. Under this generalization, $\overline{\phi}_i^h = 1$ and $\overline{\phi}_i^w = 0$ for single-male households, and $\overline{\phi}_i^h = 0$ and $\overline{\phi}_i^w = 1$ for single-female households.

[23] The social security benefits derived from the calculation below is not precise because the calculated AIME may be smaller than the actual AIME and, conditional on AIME being correctly calculated, the calculated household benefits may be larger than the actual ones. For the former, the reasons are (i) we do not exclude 5 years of lowest earnings from calculation, (ii) we use base-year (i.e. real) values of earnings after age 60 instead of nominal values, (iii) we do not take into account earnings in retirement if respondents work beyond their household retirement dates. For the latter, the reason is that we assume both husband and wife of a married household are eligible for collecting benefits at the household retirement date. If one of them is not eligible at the retirement date, the approximation will overstate the benefits. Nevertheless, our calculations are considerably more accurate than those in many other life-cycle simulation models, including Engen, Gale, and Uccello (1999), whose work is most similar to ours.

$$L^i = 12 \times \max\{R^i - 22, 40\}$$

where $i = h$ (husband) or w (wife), and L^i is the number of months of i's covered period.[24] Without loss of generality, we set $L^w = 40$ for single-male households and $L^h = 40$ for single-female households.

Individual PIA can be calculated as

$$\begin{aligned} PIA^i &= 0.90 \times \min\{AIME^i, b_0\} + 0.32 \times \min\{\max\{AIME^i - b_0, 0\}, b_1 - b_0\} \\ &+ 0.15 \times \max\{AIME^i - b_1, 0\} \end{aligned} \quad (1.7)$$

where b_0 and b_1 are the bend points. For the 1992 formula, b_0 = \$387 and b_1 = \$2,333.

(b) Calculate *Household* Annual Social Security Benefits

First, the *individual* monthly social security benefits are calculated as

$$ssb^i = \max\{d^i_{own} PIA^i, d^i_{spouse} PIA^{-i}, ssx^i\} \quad (1.8)$$

where $-i = h$ if $i = w$ and $-i = w$ if $i = h$, d^j_{own} is the fraction of i's PIA that i would get if i collected benefits based on i's PIA, d^j_{spouse} is the fraction of PIA of i's spouse that i would get if i collected benefits based on PIA of i's spouse, and ssx^i is the monthly benefits that i would get if i collected benefits based on PIA of i's ex-spouse.[25] Without loss of generality, for single-male households, $d^h_{spouse} = d^w_{own} = d^w_{spouse} = ssx^w = 0$, and $d^w_{spouse} = d^h_{own} = d^h_{spouse} = ssx^h = 0$ for single-female households. In addition, we set $ssx^h = ssx^w = 0$ for married households because we do

[24] Without the lower bound of 40 years in the max operator (max{R_i – 22, 40}), AIME would be too high for households whose members retire before age 62. In addition, notice that we use the *household* retirement date (R_i) rather than the *individual* retirement date. This is mainly for convenience.

[25] To recover the ex-spouse's PIA, we first compute the benefit amount that a single respondent would get based on her own earning history. Then, compare the amount to the reported amount of social security benefits in the first wave that the respondent reported collecting the benefits. If the reported benefit amount is higher, we assume that

not have any information to determine ssx^i. Similarly, $ssx^i = 0$ for any single households without information to determine their ex-spouses' PIA.

Finally, household *i*'s *annual* social security benefits can be approximated as

$$ss_i = 12 \times (ssb_i^h + ssb_i^w) \tag{1.9}$$

Defined Benefit pension:

The annual defined benefit (DB) pension benefit is estimated as

$$\begin{aligned} db = {} & DB^h \{\beta_0^h + \beta_1^h UNION^h + \beta_2^h YRSV^h + (\gamma_0^h + \gamma_1^h UNION^h + \gamma_2^h YRSV^h\}\phi_R^h e_R\} + \\ & DB^w \{\beta_0^w + \beta_1^w UNION^w + \beta_2^w YRSV^w + (\gamma_0^w + \gamma_1^w UNION^w + \gamma_2^w YRSV^w\}\phi_R^w e_R\} \\ & + \beta_0^b DB^h DB^w + \xi \end{aligned} \tag{1.10}$$

where the superscripts *h* and *w* indicate "husband" and "wife," respectively. DB^i is a binary variable equal to 1 if *i* has a DB pension. $UNION^i$ is a binary variable equal to 1 if *i* belongs to a union at the DB job. $YRSSV^i$ is the number of years that *i* stays in the DB job up to *i*'s retirement date. e_R is the household earnings in the last period of work, and ϕ_R^h and ϕ_R^w indicate the fractions of e_R that belong to the husband and wife, respectively, with $\phi_R^h + \phi_R^w = 1$ by construction. ξ is an error term that is assumed to distribute as $N(0, \sigma_\xi^2)$.[26] Finally, the parameters to be estimated are $\beta_0^b, \beta_0^h, \beta_1^h, \beta_2^h, \beta_0^w, \beta_1^w, \beta_2^w, \gamma_0^h, \gamma_1^h, \gamma_2^h, \gamma_0^w, \gamma_1^w, \gamma_2^w$ and σ_ξ^2.

db is calculated by assuming that the household receives annual DB pension benefit that is constant in real term from the first period of retirement until none of the recipients survive. In particular, let *dbwealth* be the observed present discounted value of *db*.

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the single collected benefits based on her ex-spouse's records and the reported amount is used to recover her ex-spouse's PIA.

[26] The specification is estimated with ordinary least squares using the White formula for the standard error.

$$dbwealth = \sum_{j=R+1}^{D} \pi_j \frac{db}{\delta_j} \quad \Rightarrow \quad db = dbwealth \Big/ \sum_{j=R+1}^{D} \frac{\pi_j}{\delta_j}$$

where δ_j is the discount rate that converts pension benefits at age *j* into an equivalent value of 1992 dollars (i.e. having δ_j 1992-dollars at age *j* is as good as having one 1992-dollars in 1992), and π_j is the probability that the household will survive at age *j* conditional on surviving in the year that *dbwealth* was reported, *R* is the last period of work, and *D* is a terminal age where household will not live beyond this age. The estimation results are given in the Table below.

Appendix Table 1: Coefficient Estimates for Annual DB Pension Benefits

	Coefficient Estimates	Standard Errors
Husband's Estimate of Constant	2,511.28	(516.74)
Husband's Estimate of Union Status	-565.70	(445.54)
Husband's Estimate of Years In Service	53.97	(26.65)
Husband's Estimate of His Last-Period Earnings	-0.0693	(0.0149)
Husband's Estimate of His Last-Period Earnings Interacting with Union Status	0.0132	(0.0197)
Husband's Estimate of His Last-Period Earnings Interacting with Years In Service	0.0046	(0.0010)
Wife's Estimate of Constant	-1,616.75	(617.55)
Wife's Estimate of Union Status	1,288.25	(308.17)
Wife's Estimate of Years In Service	163.58	(23.05)
Wife's Estimate of Her Last-Period Earnings	0.0981	(0.0383)
Wife's Estimate of Her Last-Period Earnings Interacting with Union Status	-0.0172	(0.0231)
Wife's Estimate of Her Last-Period Earnings Interacting with Years In Service	-0.0013	(0.0013)
Estimate of Constant if Both Husband And Wife Has A Pension	-92.10	(436.31)
R^2	0.548	
N	2,269	

Table 1: Means, Medians, and Standard Deviations from the Health and Retirement Study (dollar amounts are in 1992 dollars)			
Variable	Mean	Median	Standard Deviation
1991 Earnings	33,358	24,902	161,070
PDV of Lifetime Earnings	1,923,263	1,583,380	11,000,000
Pension Wealth	124,861	36,394	210,493
Social Security Wealth	135,781	127,334	381,803
Non-Pension Net Worth	240,933	102,000	522,966
Mean Age	56.7		5.1
Mean Ed (years)	12.5		3.5
Fraction Male	.73		.44
Fraction Black	.11		.31
Fraction Hispanic	.07		.25
Fraction Couple	.68		.46
Did Not Complete H.S.	.25		.43
High School Graduate	.54		.50
College Graduate	.12		.32
Post College Education	.09		.29
Fraction Self Employed	.14		.35
Fraction Retired	.34		.47

Source: Author's calculations from the 1992 HRS. Sample sizes in each cell range from 7,580 to 7,222 depending on missing values and the table is weighted using the HRS household weights.

Table 2: Percentage of People Expressing Worry About Not Having Enough Income to "Get By" in Retirement (or "Bothered" for those already retired)

	Not Retired (Head)	Retired (Head)
Worry a Lot	22.2	29.9
Worry Somewhat	22.6	15.7
Worry a Little	19.4	15.6
Do Not Worry	15.5	24.8
Will Never Retire Completely	13.0	8.0
Inappropriate, Not Applicable, or Do Not Know	7.3	6.0

Notes: The specific question (K12e) for people completely retired reads "Now for things that some people say are bad about retirement. Please tell me if during your retirement they have bothered you a lot, somewhat, a little or not at all: Not having enough income to get by." The specific question (K22e) for people not fully retired reads "Now for things that worry some people about retirement. Please tell me if they worry you a lot, somewhat, a little, or not at all: Not having enough income to get by." The responses are weighted with the household's wave 1 analysis weight.

Table 3: Coefficient Estimates for the AR(1) Earnings Profiles

Group	Coefficient Estimates					R^2	*N*
	Group Constant	*Age*	Age^2	$\hat{\rho}$	$\hat{\sigma}$		
Single, Non-College	3.91 (0.022)	0.28 (0.003)	-0.003 (0.00005)	0.65	0.59	0.075	36,149
Single, College	3.36 (0.044)	0.32 (0.008)	-0.004 (0.0001)	0.71	0.52	0.238	6,984
Married, Non-College, One-Earner	5.38 (0.015)	0.25 (0.002)	-0.003 (0.00003)	0.69	0.42	0.193	105,975
Married, Non-College, Two-Earner	5.72 (0.028)	0.23 (0.005)	-0.003 (0.00006)	0.71	0.41	0.379	29,371
Married, College, One-Earner	4.56 (0.017)	0.30 (0.003)	-0.003 (0.00004)	0.74	0.414	0.216	75,972
Married, College, Two-Earner	4.82 (0.031)	0.27 (0.006)	-0.003 (0.00008)	0.76	0.447	0.269	18,762

Number of households for these groups are 1453, 253, 3049, 841, 2186 and 564 respectively.

Table 4: Percentile Distribution of Optimal Net Worth (excluding DB Pensions) and Wealth-to-Earnings Ratios for HRS Households (dollar amounts in 1992 dollars)

Percentile	Optimal Net Worth (excluding DB pensions)	Optimal Wealth-Earnings Ratio (using 1991 earnings)
10th percentile	$180	0.11
25th percentile	18,529	0.93
50th percentile	79,128	2.60
75th percentile	203,400	6.31
90th percentile	451,060	16.37

Notes: Authors' calculations from the model described in sections III and IV. Retired households are not included in the optimal wealth-earnings column so the sample size is 6250 for the first column and 5186 for the second. Both columns are weighted using the HRS sample weights.

Table 5: Comparison of Optimal Wealth-Earnings Ratios From Our Model and Engen, Gale, Uccello (1999): Households Age 60-62

	5^{th} percentile	25^{th} percentile	50^{th} percentile	75^{th} percentile	95^{th} percentile
EGU[1]	0.37	1.68	2.92	4.35	7.05
Our model[2]	0.37	1.80	3.54	7.44	35.44
Earnings quintiles			Median wealth-earnings ratios by income quintile		
EGU lowest	0.1	1.0	2.9	5.0	8.6
EGU 2^{nd}	0.4	1.6	3.1	4.8	7.5
EGU 3^{rd}	0.5	1.8	3.2	4.7	6.8
EGU 4^{th}	0.7	1.8	2.9	4.2	6.2
EGU 5^{th}	1.0	1.9	2.7	3.7	5.3
Lifetime earnings					
SSK lowest	0.2	1.2	4.1	8.4	42.8
SSK 2^{nd}	0.4	2.0	3.1	7.0	126.2
SSK 3^{rd}	0.5	1.7	3.2	6.6	25.8
SSK 4^{th}	0.2	1.8	3.5	5.6	11.8
SSK 5^{th}	0.9	2.4	4.1	8.4	20.0

Notes: Figures for Engen, Gale, and Uccello (1999) come from Tables 3 and 4 of their paper.
[1]The Engen, Gale and Uccello calculations apply to college graduates with a 3 percent rate of time preference covered by pensions.
[2]Our calculations differ in many significant ways from the Engen *et al.* sample. First, the sample is all households age 60-62 in the HRS. Because the sample is small (325 households) we cannot break the sample into those with and without college degrees or pensions. Second, our model differs from EGS in the fact that we incorporate a transfer system, which will lower the optimal wealth accumulation of low-income households, and we have data on the actual earnings shocks households receive.

Table 6: Percentage of Population Failing to Meet Optimal Wealth Targets and Magnitude of Wealth Deficit as a Fraction of the Final Year of Earnings, By Lifetime Income Decile		
Lifetime Income Decile	Percentage Failing to Meet Optimal Target	Median Deficit (conditional on deficit, 1992 dollars)
Lowest	18.6	2,977
2nd	21.4	7,055
3rd	19.2	8,059
4th	16.7	9,282
Middle	16.2	14,974
6th	12.0	28,007
7th	13.9	28,724
8th	15.0	25,883
9th	13.4	32,814
Highest	12.3	54,847
Total	15.9	13,506

Notes: Authors' calculations as described in the text.

Table 7: Probit Estimates of the Probability that Households Accumulate Too Little Wealth

	dF/dx	Std. Err.	z
2nd Lifetime Income Decile	-0.006	0.018	-0.36
3rd Lifetime Income Decile	-0.009	0.018	-0.48
4th Lifetime Income Decile	-0.039	0.018	-2.05
5th Lifetime Income Decile	-0.038	0.019	-1.91
6th Lifetime Income Decile	-0.054	0.019	-2.55
7th Lifetime Income Decile	-0.060	0.019	-2.89
8th Lifetime Income Decile	-0.046	0.020	-2.09
9th Lifetime Income Decile	-0.060	0.020	-2.68
10th Lifetime Income Decile	-0.061	0.021	-2.61
Retired	-0.014	0.010	-1.38
Has Pension	0.000	0.000	-1.46
Social Security Wealth	0.000	0.000	-0.23
Age	-0.007	0.001	-6.86
Male	0.002	0.013	0.17
Black	0.028	0.013	2.33
Hispanic	-0.008	0.016	-0.5
Married	0.003	0.013	0.19
No High School Degree	-0.003	0.018	-0.16
High School Graduate	0.003	0.016	0.16
Graduate Degree	0.027	0.022	1.25
Self Employed	0.002	0.013	0.13

obs. P = 0.171551
pred. P = 0.1668293 (at x-bar)

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(*) dF/dx is for discrete change of the dummy variable

Table 8: Median Regression of "Saving Adequacy" (Actual Net Worth - Optimal Net Worth)	Coef.	Std. Err.	t
2nd Lifetime Income Decile	620.24	371.43	1.67
3rd Lifetime Income Decile	1219.72	473.67	2.58
4th Lifetime Income Decile	2924.56	1012.22	2.89
5th Lifetime Income Decile	4210.22	1400.50	3.01
6th Lifetime Income Decile	6810.47	1705.64	3.99
7th Lifetime Income Decile	10533.25	2028.06	5.19
8th Lifetime Income Decile	10788.15	2821.02	3.82
9th Lifetime Income Decile	16480.84	3403.60	4.84
10th Lifetime Income Decile	30085.23	5088.53	5.91
Retired	-400.09	239.07	-1.67
Has Pension	0.02	0.01	4
Social Security Wealth	0.00	0.01	0.07
Age	186.07	51.75	3.6
Male	-1088.47	396.72	-2.74
Black	-2684.15	582.12	-4.61
Hispanic	-1314.59	643.10	-2.04
Married	364.05	628.37	0.58
No High School Degree	-2286.13	1974.65	-1.16
High School Graduate	-826.57	2028.93	-0.41
Graduate Degree	4163.26	3995.55	1.04
Self Employed	14703.63	2788.55	5.27
Constant	-6168.74	3076.41	-2.01
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Standard errors are bootstrapped

Table 9: Ordered Probit Estimates of the Degree to Which People Worry About Not Having Enough Income to "Get By" in Retirement (Also see Table 2)

	Coef.	Std. Err.	z
Actual Net Worth - Optimal Net Worth	0.000000745	0.000000105	7.09
2nd Lifetime Income Decile	0.151	0.069	2.19
3rd Lifetime Income Decile	0.279	0.071	3.93
4th Lifetime Income Decile	0.580	0.074	7.84
5th Lifetime Income Decile	0.644	0.078	8.26
6th Lifetime Income Decile	0.775	0.084	9.22
7th Lifetime Income Decile	0.751	0.084	8.96
8th Lifetime Income Decile	0.766	0.086	8.94
9th Lifetime Income Decile	0.783	0.089	8.81
10th Lifetime Income Decile	0.872	0.095	9.16
Retired	0.018	0.037	0.5
Age	0.029	0.004	7.78
Male	0.108	0.045	2.39
Black	0.151	0.042	3.57
Hispanic	-0.168	0.059	-2.84
Married	0.033	0.045	0.73
No High School Degree	-0.223	0.062	-3.62
High School Graduate	-0.064	0.053	-1.2
Graduate Degree	0.106	0.068	1.55
Self Employed	0.041	0.051	0.81
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_cut1 |	1.728	0.213	
_cut2 |	2.413	0.214	
_cut3 |	3.075	0.215	
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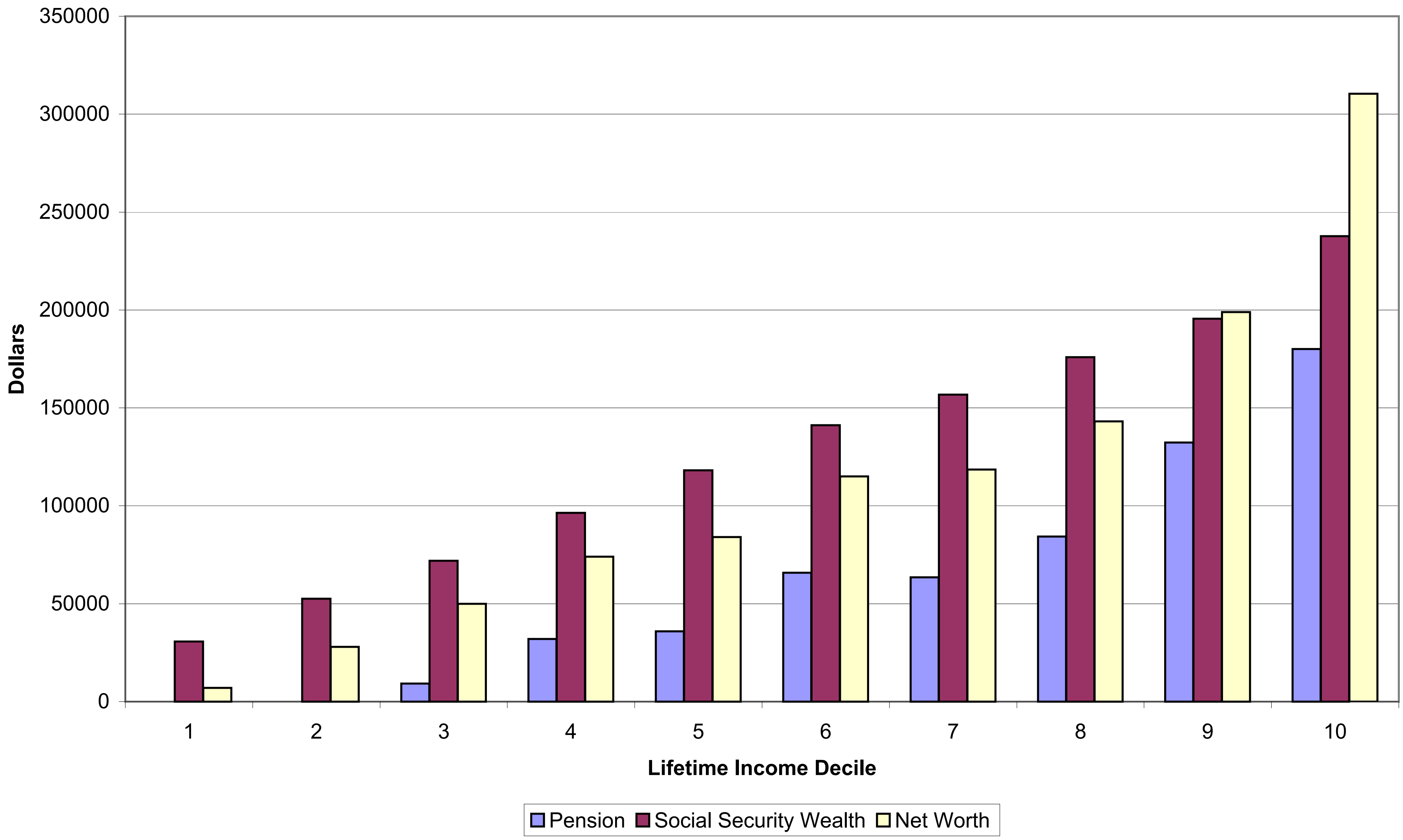
Log likelihood = -6628.91
Number of observations = 5,115
LR chi2(20) = 744.7
Pseudo R2 = 0.0532

Figure 1: Median Pension Wealth, Social Security Wealth, and Non-Pension Net Worth by Lifetime Income Decile (1992 dollars)



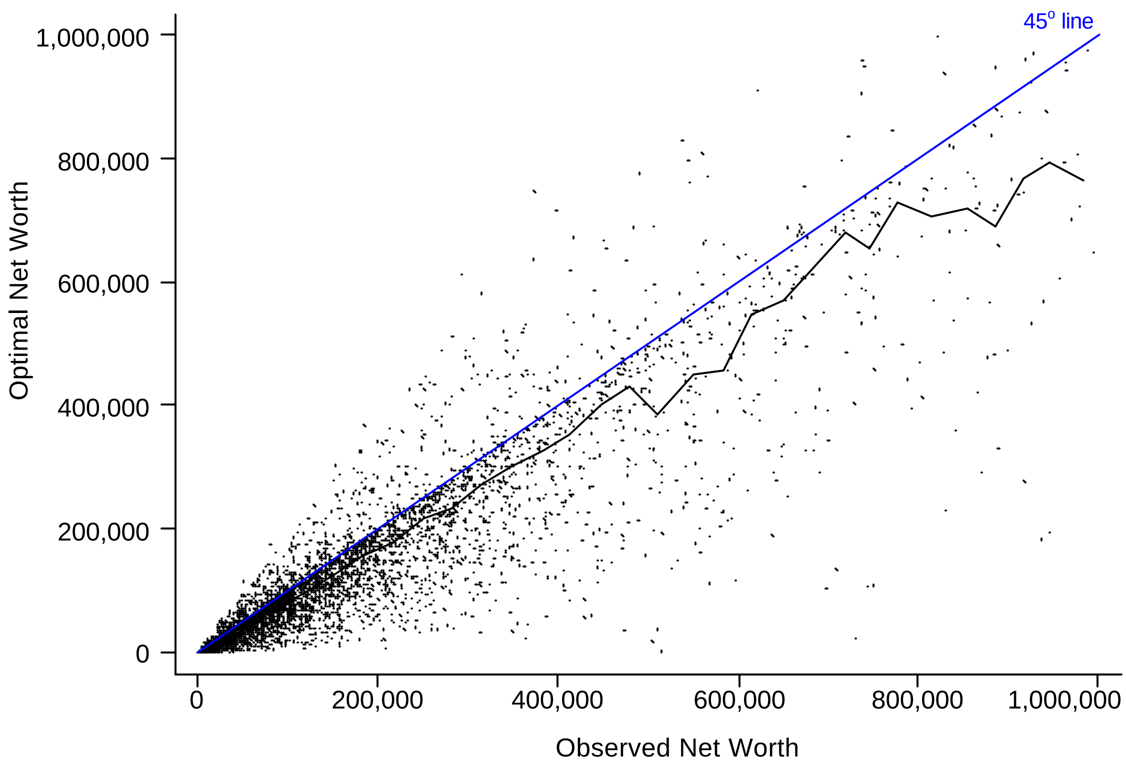


Figure 2: Scatterplot of Optimal and Actual Wealth

Figure 3: Difference between Observed and Simulated Non-DB-Pension Net Worth (All Households)

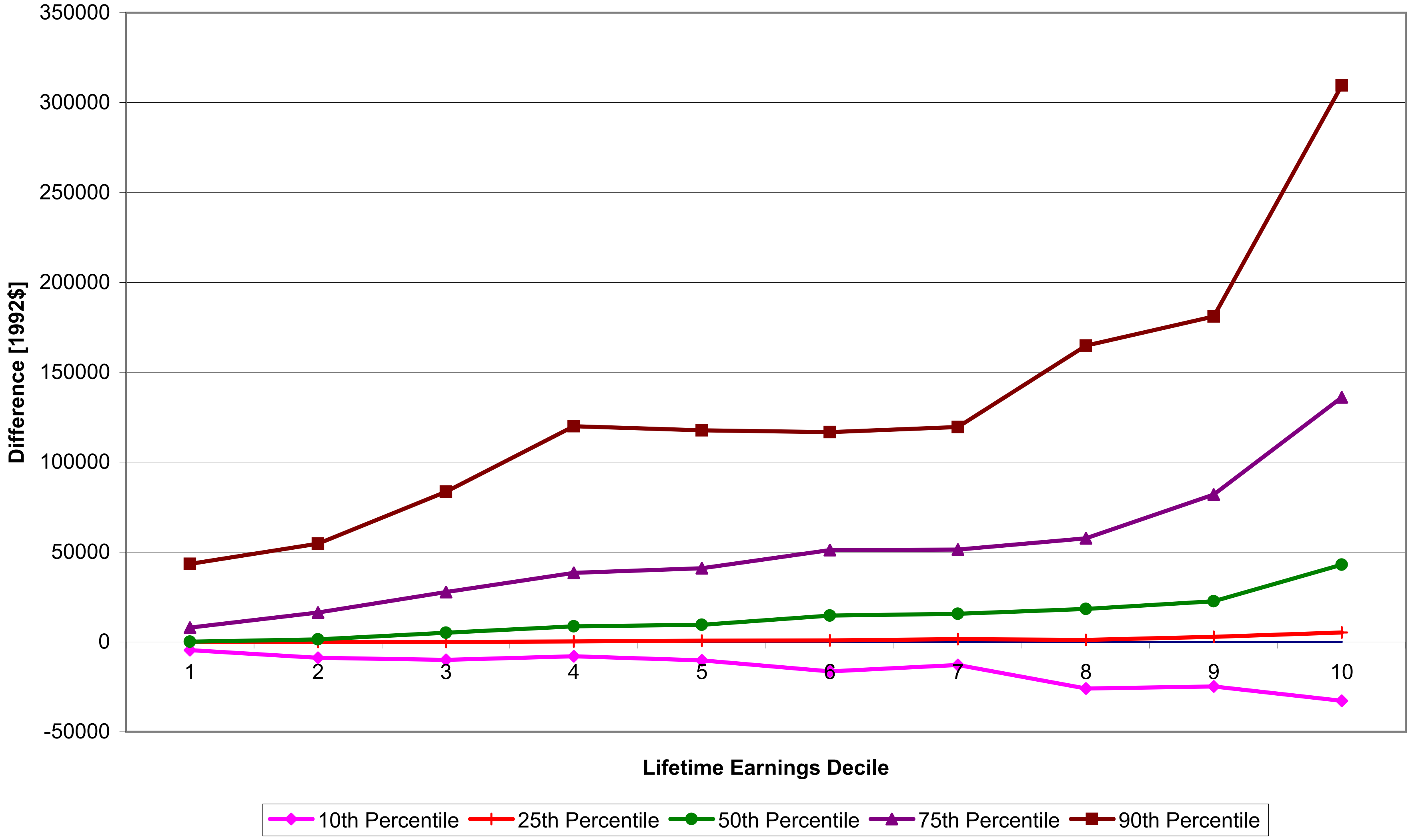


Figure 4: Difference between Observed and Simulated Non-DB-Pension Net Worth, Excluding a Half of the Observed First-Home Housing Wealth (All Households)

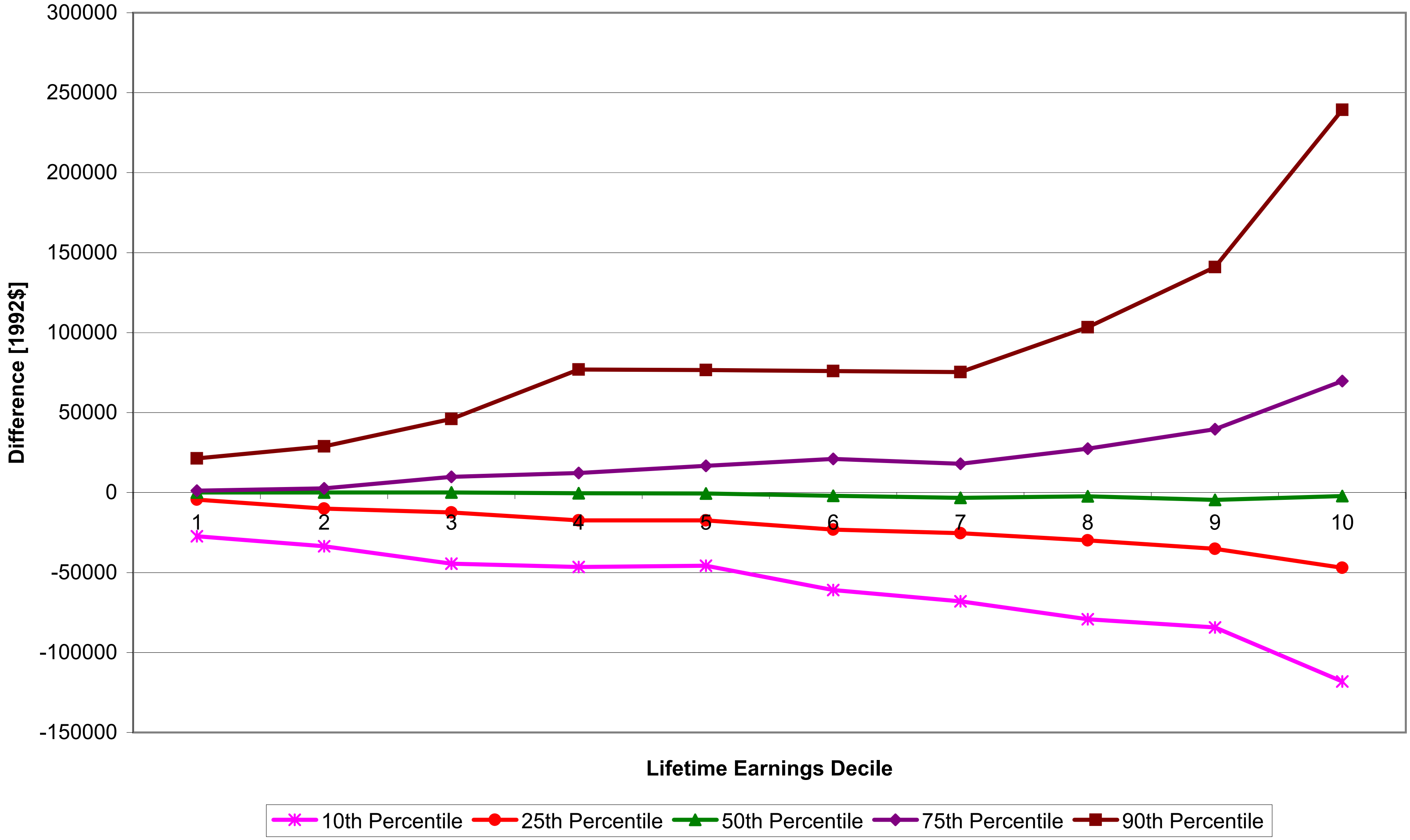


Figure 5: Difference between Observed and Simulated Non-DB-Pension Net Worth, Excluding All of the Observed First-Home Housing Wealth (All Households)