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HOW HOUSEHOLD PORTFOLIOS EVOLVE AFTER RETIREMENT: THE EFFECT OF AGING AND HEALTH SHOCKS

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We study how the portfolios of U.S. households evolve after retirement, using data from the Health and Retirement Study (HRS). In particular, we investigate the influence of aging and health shocks on a household's ownership of various assets and on the share of total assets held in each asset class. We find that households decrease their ownership of principal residences, vehicles, financial assets, businesses, and real estate as they age, while increasing the share of assets held in liquid assets and time deposits. We find that widowhood and other health shocks are associated with the same kinds of portfolio changes, and that the effect of shocks strengthens with time since the shock. Finally, we show that the effect of a shock is greatly magnified when households have physical or mental impairments. This suggests that factors other than standard risk and return considerations weigh heavily in many older households' portfolio decisions.

1. INTRODUCTION

The typical older household in the U.S. has considerable financial resources. In 2004, median net worth (excluding Social Security and defined benefit pension wealth) was $190,100 for households with heads ages 65 to 74 and $163,100 for households with heads ages 75 and above, figures that are well in excess of the $93,100 median net worth of all U.S. households (Bucks *et al.*, 2006). The combined net worth of these older households was $14.5 trillion, or nearly one-third of total U.S. household net worth.[1] Older households in other developed countries such as Canada, Italy, and the United Kingdom display similarly high levels of net worth (OECD, 2008).

These assets are critical for the financial security of older households, as they may be used to finance routine consumption during retirement and to protect the household against financial risks in old age, such as those posed by a severe illness

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[1]This figure was calculated by the authors using the 2004 Survey of Consumer Finances.

or the death of a spouse. Management of household portfolios may become even more critical to the well-being of older households in the near future, due to an ongoing shift in public and private pension schemes from defined benefit toward defined contribution plans, which can put more responsibility on the household to manage financial assets during retirement. Moreover, because these assets represent a sizeable share of total household net worth, the spend-down patterns of older households may also have important implications for asset markets, particularly as large baby boom cohorts enter retirement in the U.S. and other countries.

Despite the importance of these assets for older households' financial security and for asset markets, relatively little is known about how the portfolios of older households evolve during retirement. In the U.S. literature, several studies look at household portfolio allocation by age (Poterba and Samwick, 2001; Ameriks and Zeldes, 2002) but do not focus on older households. The literature on older households generally centers on housing equity (Venti and Wise, 1989, 1990, 2002) but does not look at other assets. A few studies explore the effect of health on the portfolios of older households, but are limited to looking at the effect of health on portfolio allocation in a cross-section (Rosen and Wu, 2004) or how changes in health affect total assets (Feinstein and Ho, 2001; Wu, 2003).

We build on the existing literature in several ways. First, we document how asset holdings evolve during old age, looking comprehensively at holdings in numerous asset classes. Second, we examine whether changes in asset holdings during old age are related to health and mortality shocks including the death of a spouse and events such as a stroke or new cancer diagnosis. Third, we explore why health shocks affect asset holdings by examining whether physical, mental, and financial capacity influence households' responses to shocks.

The data for our analysis is the first six waves of the Health and Retirement Study (HRS), which allows us to follow older U.S. households for up to ten years, 1992–2002. In our examination of asset holdings, we look at both the decision to hold a particular type of asset and the share of the household's portfolio invested in that asset class. This allows us to study both the extensive and the intensive margins of response. In our analysis, assets are grouped into five asset classes: principal residence; vehicles; financial assets including IRAs, stocks, and bonds; liquid assets and time deposits; and businesses and other real estate.[2]

In examining how portfolios evolve with age, we attempt to distinguish the true effect of aging from other effects. We begin simply by looking at how household portfolios vary with age in a cross-section, where age effects, cohort effects, and the effects of survivorship bias may be mingled. We then take advantage of the panel nature of the HRS to explore how the assets of the same households vary over time and to estimate models with cohort and household fixed effects. In our analysis of the effect of health shocks, we look at the effect of shocks first in a static context that compares households before and after a shock and then in a dynamic analysis that allows us to observe how the response varies over time. We explore several types of health and mortality shocks in our analysis.

We have a number of principal findings. First, there are large changes in asset holdings with age. The ownership rates for principal residences, vehicles, financial

[2]See below for a more complete description of these asset categories.

assets, businesses, and real estate fall dramatically with age, while the ownership rate and share of total assets invested in liquid assets and time deposits rises with age. Second, health and mortality shocks play an important role in explaining changes in household portfolios over time. We find that a widow shock is a strong predictor of selling the principal residence, as in the previous literature, but that widow shocks also decrease ownership of vehicles, businesses, and real estate and increase the share of assets held in liquid assets and time deposits. Moreover, we find that other health shocks have similar and equally strong effects on household portfolios and that these effects generally strengthen with time since the shock. Finally, we find that the responses to health shocks are highly dependent on households' physical and mental capacity.

2. Literature Review

Our work builds on three literatures. The first concerns portfolio allocation across the lifecycle. The theoretical literature in this area, which dates back to the 1960s, established that under certain assumptions the optimal household portfolio does not vary with age.[3] There is an empirical literature examining lifecycle patterns in portfolios in the U.S., but it generally does not focus on the period after retirement.[4] Furthermore, most of these studies are based on a single cross-section, which requires the authors to assume that there are no cohort effects. One exception is Poterba and Samwick (2001), who use pooled cross-sections from the Survey of Consumer Finances; they find that there are large differences in the age-paths for different asset classes and that these paths vary substantially across cohorts.

Despite the relative lack of evidence on this topic in the U.S., there is a growing international empirical literature on the portfolio allocation of older households. Volumes by Guiso *et al.* (2001) and Börsch-Supan (2003) provide little evidence that older households draw down their assets substantially during retirement, but there is evidence of reallocation across asset categories as households age. For example, studies in Guiso *et al.* find that the ownership of risky assets peaks when households are in their 50s and declines thereafter in Germany, Italy, and the United Kingdom but rises continuously with age in the Netherlands, although many of these results are based on cross-sectional data and should be viewed cautiously as a result. The six country studies in the Börsch-Supan volume break down total wealth into real estate, financial, and pension wealth, finding large differences in the accumulation patterns across these broad asset types. Milligan (2005) looks at household portfolios in Canada using three cross-section wealth surveys. He uncovers evidence that older households do not sell their houses or vehicles until late in life, and suggestive evidence that liquid assets

[3]Early papers in this literature include Samuelson (1969) and Merton (1969). Subsequent analyses have shown how relaxing the assumptions made in these early papers may alter their key conclusion. See Gomes and Michaelides (2005) for a survey of recent research on the correspondence between theoretical models of lifecycle asset allocation and empirical evidence on household portfolios.

[4]One exception is Hurd (2001), who looks at asset holdings of older households by five-year age groups. However, he makes no attempt to disentangle the effect of age from cohort effects and survivorship bias, as we do in our empirical analysis, discussed further below.

increase with age. Our paper contributes to this literature by using the Health and Retirement Study to document the age-paths for asset holdings of older households in the U.S.

The second relevant branch of the past literature looks at the special role of housing in the financial decisions households make after retirement. Many studies have found that older households are unlikely to consume their housing equity, including Venti and Wise (1989, 1990, 2002) and Feinstein and McFadden (1989). Skinner (1996) finds that windfall housing gains are more likely to be consumed by younger (pre-retirement) households than by older households and suggests that older households may view housing wealth as a "buffer" that can be cashed out in the case of a negative event during retirement. Venti and Wise (1989) demonstrate that moving is best predicted by a severe shock, such as the death of a spouse, and find that transactions costs—broadly conceived to include the psychic costs of leaving behind familiar people and surroundings—play a significant role. Our work contributes to this literature by showing how housing equity fits into the portfolios of older households and how health shocks other than the death of a spouse affect both housing and other asset choices.

The third literature that is relevant for our work investigates the effects of health on portfolio decisions. Several studies have examined how changes in health affect total assets. Feinstein and Ho (2001) note the strong predictive power of the death of a spouse on draw-downs of total wealth. Wu (2003) finds key gender differences, as men's health problems lead to more caregiving by wives but women's health problems lead to more wealth decumulation. Hurd (2001) is more similar in spirit to our analysis, as he looks at the effect of transitions from being married to single on the holding of various asset classes. Our work is distinguished from his by virtue of looking at the effect of other health shocks in addition to widowhood, looking at the long-term as well as immediate response, including household fixed effects, and exploring reasons why households reallocate their portfolios in response to shocks. Finally, Rosen and Wu (2004) find that households in poor health are less likely to own risky assets than other households. However, their analysis is based on a cross-section, raising the possibility that poor health is correlated with unmeasured characteristics that affect portfolio allocation. By looking at a wider variety of health shocks, examining their effect on multiple asset categories, and exploring the dynamic nature of and some reasons for the response to shocks, our work allows us to draw more precise conclusions about the effects of health on portfolio choices.

3. Data and Empirical Strategy

In this analysis, we use the Health and Retirement Study (HRS). The HRS began in 1992 as a survey of individuals born 1931–41 and their spouses, with re-interviews of these individuals every two years. In 1998, the HRS was expanded through a merger with the Study of Assets and Health Dynamics among the Oldest Old (AHEAD), which had interviewed households born before 1924 in 1993 and 1995. At the same time, the survey added two new cohorts, the Children of the Depression (CODA, born 1924–30) and the War Babies (WB, born 1942–47). In

total, the enhanced HRS had nearly 22,000 respondents in 1998 and continues to interview these individuals every other year. We use the first six waves of the HRS, 1992–2002.

The HRS is extremely well-suited for our purposes because it contains a substantial amount of information on assets and health and follows the same older households over time.[5] For most analyses, we use data on all households for all waves they participate in the sample; thus, each household may provide up to six observations if from the original HRS cohort, five if from the AHEAD cohort, and three if from the CODA and WB cohorts.[6] We use the RAND version of the HRS, a user-friendly subset of the HRS with cleaned and consistent variables. Of particular note, we use RAND's model-based imputations for any missing wealth data.

Our analysis proceeds in two parts. First, we explore how household wealth evolves with age, looking at five asset categories: principal residence; vehicles; financial assets including stocks, bonds, and Individual Retirement Accounts (IRAs); liquid assets and time deposits; and businesses and other real estate.[7] Our asset measures correspond to the net value of the assets for the household.[8] We start with a simple cross-sectional analysis of wealth holdings by category and age using the 2002 HRS. However, differences by age in such an analysis may also reflect cohort and time effects and be tainted by survivorship bias, as wealthy individuals tend to live longer. We begin to address these concerns by graphing the evolution of asset holdings over time for the same HRS households. Finally, we formalize this analysis by regressing asset holdings on age. To the basic regression

[5]While it is notoriously difficult to collect reliable wealth data through household surveys, the HRS data are generally believed to be quite good in this regard. One important feature of the HRS is the use of unfolding bracket questions to identify a dollar value range for assets where the respondent is unable to give a specific dollar value; see Juster and Smith (1997) for more on this approach. Moon and Juster (1995) compare wealth data from the HRS with data from the Survey of Income and Program Participation (SIPP) and argue that the HRS does a much better job of collecting data on non-housing equity. The Survey of Consumer Finances (SCF) is generally acknowledged to be the premiere dataset on U.S. wealth holdings; we are not aware of any article that directly compares the quality of the HRS wealth data with that in the SCF. However, the SCF is not suitable for our purposes because it is not a longitudinal dataset.

[6]AHEAD data from 1993 and 1995 is treated as having been collected at waves 2 and 3; thus, there is no wave 1 observation. Rohwedder *et al.* (2006) note that changes in wealth holdings between the 1993 and 1995 AHEAD survey are due in part to survey design; we have experimented with dropping the affected observations from the analysis and our results are not substantively different. As detailed below, some analyses are conditioned on remaining in the sample through 2002 or are limited to certain age groups only. Because we have differing numbers of observations for each household in the panel, our strategy results in an unbalanced panel. The primary econometric issue arising with unbalanced panels is with non-random selection and attrition. However, duration in our panel is primarily determined by the wave in which the household begins taking part in the HRS, so it is largely unrelated to individual characteristics (besides birth cohort). The HRS has very high re-interview rates (about 95 percent) and continues to interview respondents even if they enter an institutional living arrangement, using a proxy respondent if necessary.

[7]"IRAs" includes all funds in Individual Retirement Accounts or Keoghs. "Stocks" includes stocks, mutual funds, and investment funds. "Bonds" includes bonds and bond funds. "Liquid assets" includes checking, savings, and money market accounts and "time deposits" includes certificates of deposit (CDs), government savings bonds and treasury bills. "Other savings," which we include in Table 1, includes items such as jewelry, money owed to the respondent by others, a collection for investment purposes, rights in a trust or estate where the respondent is the beneficiary, or an annuity.

[8]We note that by focusing on the net value within each asset class, we are not examining what is happening to the household's overall level of debt as it ages or experiences health shocks. Exploring this question could be an interesting area for future research.

specification shown below we add cohort dummies and then household fixed effects, accounting for any time-invariant unmeasured effects and biases.

Our basic regression using data for household i in time period t takes the form:

$$(1) \qquad Asset\ holdings_{it} = \beta_0 + \beta_1 age_{it} + \beta_2 X_{it} + \gamma_t + \varepsilon_{it},$$

where $Asset\ holdings_{it}$ is a measure of the household's holdings in a particular asset class, age_{it} is the age of the household, X_{it} is a set of control variables, and γ_t is a set of wave dummies. The control variables include dummy variables for the household's marital status (widowed, married, or divorced/ separated), region, religion, race, Hispanic status, U.S. born status, and educational category.[9] Here and elsewhere in the paper we measure the age of the household by taking the age of the older spouse; the age of the household continues to be calculated in this way even if the older spouse dies. While the linear age specification is very simple, it will provide some indication of which assets vary strongly with age.[10] Throughout our analysis, we examine two measures of asset holdings, positive holdings of the asset class and share of total assets in the asset class, and estimate the models via ordinary least squares for ease of interpretation.[11] We do so for the five asset classes listed above.

In the second part of the analysis, we explore how health shocks affect asset holdings. We use several definitions of a health (or mortality) shock: (1) becoming widowed; (2) experiencing an "acute event" (heart attack, stroke, or new cancer diagnosis); and (3) receiving a new diagnosis of a chronic illness (high blood pressure, diabetes, lung disease, psychological problems, or arthritis).[12] In all cases, we treat the household as experiencing a shock if either spouse receives a shock.

To begin our analysis of the effect of health on portfolio allocation, we add health shock dummies to the richest version of our first regression model, which incorporates household fixed effects, to obtain regressions of the following form:

$$(2) \qquad Asset\ holdings_{it} = \beta_0 + \beta_1 widow_{it} + \beta_2 acute_{it} + \beta_3 chronic_{it} + \beta_4 age_{it} + \alpha_i + \gamma_t + \varepsilon_{it}.$$

Here $widow_{it}$ is a dummy equal to 1 if household i has experienced a widow shock in period t or an earlier period in our sample and $acute_{it}$ and $chronic_{it}$ are similarly

[9]The demographic control variables (e.g. race, education) are defined based on the value for the household head. Within the set of control variables, there is also a dummy variable equal to one if the financial respondent has changed since the previous wave, in the event that this has any systematic effect on reports of asset holdings. This is the only control variable that is included in the specification with household fixed effects.

[10]We also tried a quadratic specification. These results are discussed later in the paper with the discussion of the linear results.

[11]We have also estimated models using the dollar value in each asset class as the dependent variable and find that the results are very similar to those from the positive asset holding models; these results are not reported here but are available from the authors upon request.

[12]More discussion of the latter two health shocks definitions can be found in Coile (2004). All of the health shock variables are based on respondents' answers to a detailed set of questions about their health. For example, the question "In the last two years, have you had a heart attack or myocardial infarction?" is used to identify respondents who have experienced a heart attack. In the case of chronic illnesses, the questions generally focus on whether a doctor has diagnosed the condition rather than whether the respondent has experienced symptoms. For example, respondents are asked "Has a doctor ever told you that you have diabetes or high blood sugar?"

defined. In effect, this compares those household-wave observations after a shock to observations before a shock or observations of households who never experience a shock.[13]

Equation (2) gives us some sense of the effect of health shocks on household portfolios, but gives no sense of the dynamics of this process over time. We therefore also estimate regressions of the form:

$$(3)\quad Asset\ holdings_{it} = \beta_0 + \beta_1 shockminus3_{it} + \beta_2 shockminus2_{it} + \beta_3 shockplus1_{it} + \beta_4 shockplus2_{it} + \beta_5 shockplus3_{it} + \beta_6 age_{it} + \alpha_i + \gamma_t + \varepsilon_{it}.$$

In this case, we estimate models separately for each health shock and restrict the sample to those households who experience the shock at some point during the observed sample period.[14] We consider the shock to have occurred between periods, so that the $shockplus1_{it}$ is a dummy equal to 1 if the household-wave observation corresponds to the wave immediately after the shock, and the other *shockplus* and *shockminus* variables are similarly defined. The wave immediately before the shock, *shockminus*1, is the omitted category. This specification allows us to see whether there is any change in asset holdings prior to the shock and whether the response to the shock occurs immediately or later.

4. Results for Age Patterns of Household Asset Holding

Table 1 provides a cross-sectional analysis of household asset holdings by age in the 2002 HRS.[15] The top panel indicates how the rate of ownership of various assets evolves with age and it reveals some interesting patterns. Home ownership is flat at 80 percent until age 80, but then drops consistently in every successive age group, to a rate of 54 percent in the age 90 and above group. Vehicle ownership displays a similar pattern of being relatively flat until age 80 and falling dramatically thereafter, from 82 percent in the age 75–79 group to 40 percent in the age 90 and above group. Three other asset categories—other real estate, business, and other savings—start at a lower level, but in all cases asset ownership is cut in half between the 60–64 age group and the 90 and above age group. IRA ownership falls dramatically after age 70, no doubt due to the automatic withdrawal provisions. On the other hand, ownership of time deposits and bonds rises over time, perhaps due to the greater liquidity or lower risk properties of these assets. Stock and liquid asset ownership are essentially flat with age.

[13]We choose to have the shock variables correspond to having ever experienced a shock rather than to experiencing a shock in this period since the effect of a shock is likely to persist into future periods. We include all three shocks in the same specification to allow for the possibility that households may experience multiple shocks during the full sample period; indeed, about one-fifth of households who experience any health shock during our sample period have more than one shock during the observed period.

[14]To test for the possibility that observed changes in asset holdings before or after a health shock might be attributable to another health shock the household had experienced (e.g. an acute shock that preceded the widow shock), we have added to this specification dummy variables for whether the household has experienced either of the other health shocks. We find that our results are robust to the inclusion of these variables.

[15]Data are weighted by HRS household weights; age patterns in unweighted data are largely similar. The regression results shown below do not incorporate weights, although results are qualitatively similar when weights are included.

TABLE 1

HOUSEHOLD ASSETS BY AGE, 2002 HRS (IN $2003)

	Age							
Asset Type	55–59	60–64	65–69	70–74	75–79	80–84	85–89	90+
% with positive asset holdings								
Princ. resid.	0.80	0.82	0.80	0.80	0.79	0.73	0.65	0.54
Vehicles	0.88	0.89	0.87	0.83	0.82	0.74	0.61	0.40
IRAs	0.42	0.42	0.41	0.40	0.33	0.25	0.09	0.03
Stocks	0.35	0.33	0.33	0.31	0.33	0.31	0.30	0.29
Bonds	0.07	0.07	0.07	0.09	0.09	0.08	0.08	0.11
Liquid assets	0.87	0.86	0.87	0.86	0.86	0.88	0.86	0.84
Time deposits	0.18	0.19	0.24	0.27	0.31	0.33	0.34	0.32
Business	0.11	0.12	0.10	0.08	0.08	0.06	0.06	0.06
Real estate	0.16	0.18	0.18	0.16	0.12	0.12	0.12	0.08
Other savings	0.17	0.16	0.16	0.13	0.10	0.08	0.08	0.06
Median value, conditional on positive asset holding								
Princ. resid.	127,849	122,735	121,712	117,621	104,325	102,279	86,937	81,312
Vehicles	12,273	10,228	10,228	10,228	9,205	6,137	5,114	4,091
IRAs	39,888	46,189	59,833	61,367	51,140	32,474	20,456	N/A
Stocks	40,400	46,026	51,140	61,367	51,140	76,709	51,140	84,380
Bonds	12,273	25,570	40,912	31,707	43,469	35,798	51,140	N/A
Liquid assets	5,114	5,114	7,160	8,182	8,182	9,001	7,160	6,137
Time deposits	10,228	11,251	17,387	20,456	25,570	30,684	31,707	29,661
Business	156,556	153,419	130,406	153,419	153,419	168,760	N/A	N/A
Real estate	61,367	71,595	76,709	71,595	91,540	76,709	81,823	N/A
Other savings	20,456	20,456	20,456	25,570	23,524	20,456	17,899	N/A
Total assets	185,636	169,783	175,920	184,153	174,999	142,168	122,735	92,460
Mean share of total assets								
Princ. resid.	0.506	0.493	0.451	0.479	0.480	0.430	0.397	0.367
Vehicles	0.138	0.130	0.125	0.102	0.088	0.073	0.057	0.037
IRAs	0.082	0.091	0.098	0.095	0.066	0.047	0.013	0.006
Stocks	0.064	0.064	0.064	0.067	0.083	0.094	0.091	0.119
Bonds	0.003	0.007	0.007	0.008	0.011	0.011	0.014	0.024
Liquid assets	0.096	0.098	0.126	0.129	0.150	0.197	0.238	0.280
Time deposits	0.016	0.017	0.027	0.035	0.049	0.078	0.104	0.101
Business	0.037	0.034	0.034	0.027	0.029	0.023	0.023	0.026
Real estate	0.037	0.048	0.048	0.040	0.033	0.035	0.051	0.031
Other savings	0.020	0.018	0.020	0.017	0.012	0.012	0.012	0.008
# of HHs	1,268	2,400	2,274	1,797	1,518	1,333	700	358

Notes:
(1) Age of household is defined based on the age of the oldest member of the couple.
(2) N/A indicates fewer than 50 observations with positive asset value.
(3) Values are weighted by HRS household weights.
(4) Liquid assets include checking, saving, and money market accounts; time deposits include CDs, government savings bonds, and Treasury bills.

The other two panels in Table 1 display the share of total assets in each category and the median value conditional on positive asset holding. The assets that experience a drop in ownership with age in the top panel also experience a slide in asset share. In the case of homes and vehicles, the median value conditional on holding the asset also falls over time. Asset shares rise with age in stocks, bonds, time deposits, and liquid assets; the increase in the liquid asset share is particularly dramatic, rising from 10 percent at ages 60–64 to 28 percent in the oldest age

group, while time deposits also rise sharply, from 2 to 10 percent. The median value of total assets falls considerably starting at age 80, potentially reflecting some dissaving to finance retirement consumption.

As noted above, however, there are several potential problems with this analysis. Observed patterns may reflect cross-cohort differences or time effects as well as age effects. Moreover, since wealthier households are more likely to survive, observed patterns may reflect the selection of a wealthier sample in the higher age groups.

To begin to address these concerns, we conduct a graphical cohort-based analysis that tracks asset holdings of the same households over time. Specifically, we divide the sample into 20 groups, each of which consists of two single birth cohorts (e.g. 1931–32). Depending on whether the group is part of the original HRS, AHEAD, WB, or CODA cohorts, households appear in the survey 3–6 times. We drop households that do not stay in the survey for all waves where they might be observed, to avoid having the composition of the group change over time as households leave the survey due to death or attrition; however, we acknowledge that older cohorts may still be wealthier due to differential mortality, as cohorts enter the HRS at different ages (e.g. the AHEAD cohorts are not observed until they are age 70 or older, so by definition all survey participants survived to this age).

Figures 1a–1e display the results of this analysis. Each of the short lines on a graph represents the asset holdings for a particular group at the ages they are observed. So, for example, the 1931–32 group, which is part of the original HRS cohort, appears in all 6 waves of the survey and contributes information for ages 60–61, 62–63, etc through 70–71. Any given line shows the effect of aging for a fixed sample of households; if the various lines that cover the same age range are close together, this will indicate that cohort effects are small, at least for cohorts that are relatively close together.

The graphs largely confirm that the results from Table 1 remain when we do a better job of controlling for cohort effects and survivorship bias. Home and vehicle ownership rates fall dramatically after age 80, with the slide in vehicle ownership clearly visible at much younger ages as well. There is also a steady decline in the business and other real estate ownership rate starting at age 60. Ownership of liquid assets and time deposits are roughly flat, with perhaps a small decrease at the oldest ages. Ownership of financial assets (IRAs, stocks, or bonds) is declining over time, driven primarily by a steady drop in IRA ownership, though there is a small drop in stock ownership as well. Figure 1c is the one case where cohort effects are apparent—the AHEAD cohorts are significantly less likely to own IRAs, stocks, and bonds.

We now turn to some basic regression analysis to document more precisely the effect of age on household portfolios. This analysis, the results of which are shown in Table 2, is based on equation (1) above. We provide results for the five asset classes and two asset holding measures, positive asset value and share of total portfolio. We also employ three econometric specifications: no fixed effects, cohort fixed effects, and household fixed effects. The sample is all HRS households-wave observations in which the older spouse is age 60 or above. The regressions are estimated by OLS, with robust standard errors

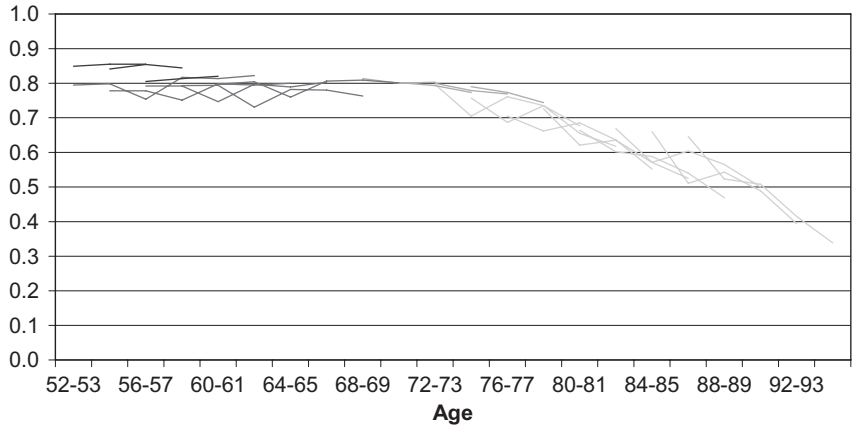

Figure 1a. Home Ownership Rate by Age and Cohort

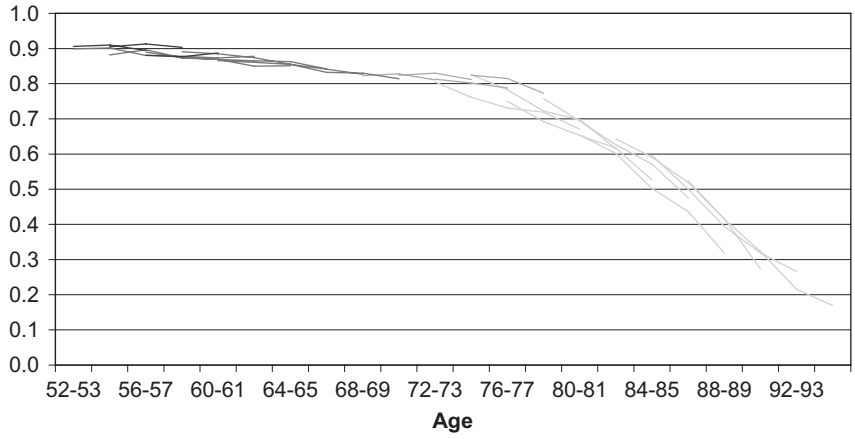

Figure 1b. Vehicle Ownership Rate by Age and Cohort

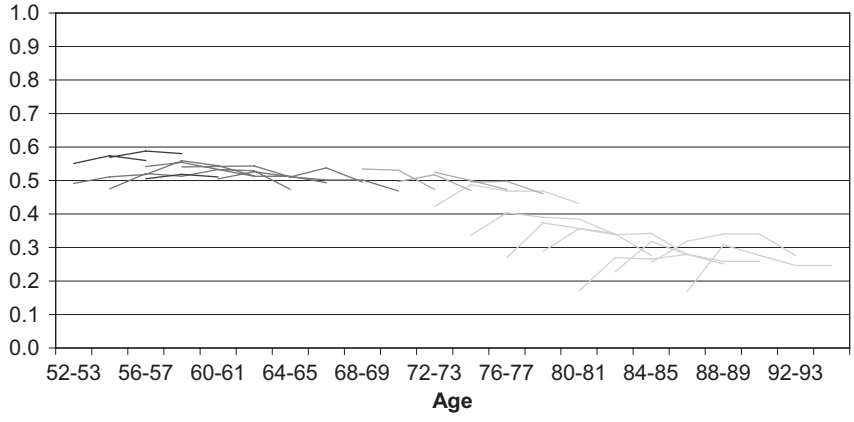

Figure 1c. Ownership of IRAs, Stocks, and Bonds by Age and Cohort

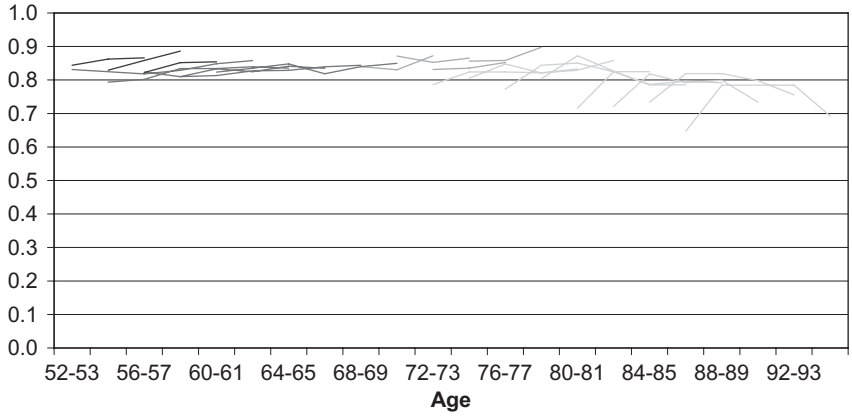

Figure 1d. Ownership of Liquid Assets and Time Deposits by Age and Cohort

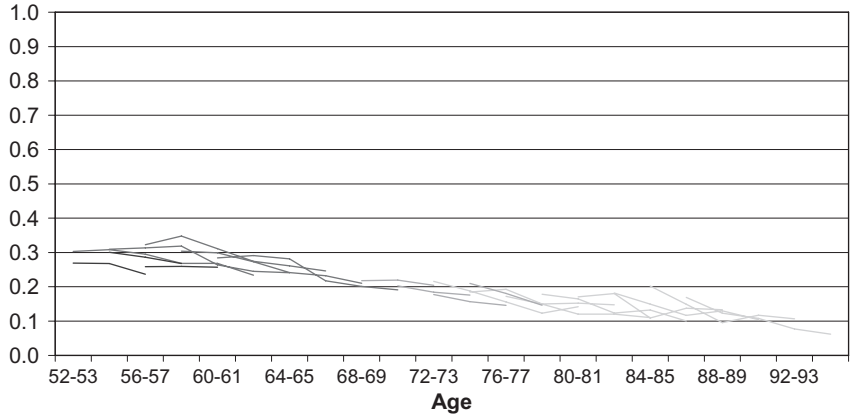

Figure 1e. Ownership of Business and Real Estate by Age and Birth Cohort

clustered to account for repeated observations on the same cohorts and households.[16]

We first discuss the results for positive asset holdings, which are in the top panel. The first column shows the results from a specification with a linear age term and no cohort or household fixed effects.[17] This is similar to the analysis in Table 1, as no attempt is made to disentangle the age from the cohort effects. The principal

[16]Models are estimated via OLS for ease of interpretation and for ease of estimation of the household fixed effect models, where nonlinear estimation is complicated by the relatively few observations per household. We have estimated the positive asset holding specifications as probit models and found that the resulting marginal probabilities are very similar to the OLS estimates. The same is true when the asset share specifications are estimated as Tobit models. We have also estimated the positive asset holding, asset share, and dollar value models jointly via seemingly unrelated regression, and found these results to be qualitatively similar to the OLS results obtained from estimating these models independently.

[17]Results for the quadratic specifications revealed similar patterns to the linear specifications. For vehicle ownership, for example, the marginal effects of the quadratic coefficients implied that ownership trends turned negative around age 69, and approached the linear effect in the 80s.

TABLE 2
EFFECT OF AGE ON ASSET HOLDINGS

Asset Class	Mean	Linear Age	With Cohort Dummies	With Household Fixed Effects
(N = 51,017)		*Positive holdings of asset class*		
Principal residence	0.756	–0.0046***	–0.0006	–0.0028***
		[0.0003]	[0.0011]	[0.0007]
Vehicles	0.792	–0.0087***	0.0013	–0.0066***
		[0.0002]	[0.0008]	[0.0007]
IRAs/stocks/bonds	0.470	–0.0052***	–0.0023*	–0.0029***
		[0.0003]	[0.0012]	[0.0008]
Liquid assets/time deposits	0.851	0.0002	–0.0003	0.0019**
		[0.0002]	[0.0008]	[0.0008]
Business/real estate	0.219	–0.0033***	–0.0014	–0.0090***
		[0.0003]	[0.0009]	[0.0008]
(N = 48,142)		*Share of holdings in asset class*		
Principal residence	0.451	–0.0031***	–0.0025***	–0.0007
		[0.0002]	[0.0010]	[0.0006]
Vehicles	0.104	–0.0028***	0.0006	–0.0017***
		[0.0001]	[0.0005]	[0.0004]
IRAs/stocks/bonds	0.153	–0.0005***	0.0003	0.0033***
		[0.0002]	[0.0008]	[0.0004]
Liquid assets/time deposits	0.198	0.0076***	0.0018***	0.0028***
		[0.0002]	[0.0006]	[0.0006]
Business/real estate	0.076	–0.0009***	–0.0001	–0.0028***
		[0.0001]	[0.0004]	[0.0004]

Notes: Coefficient reported is for linear age. Standard errors appear in parentheses. Statistical significance at the 10%, 5%, and 1% levels is indicated by one, two, or three asterisks, respectively.

residence coefficient suggests that as a household ages by one year, the probability that it owns a home declines by 0.46 percentage points. Given the mean of 0.756, this suggests a 6.1 percent (or 4.6 percentage point) decline in the probability of ownership over a decade. The probability of asset ownership also declines significantly for vehicles, financial assets (stocks, bonds, and IRAs), and businesses or real estate, with the latter coefficient being the largest in percent terms—it suggests a 15.1 percent (3.3 percentage point) decline in ownership over a decade.

In the second column, we add a set of dummy variables for the household's year of birth. This specification effectively compares household-wave observations of different ages within the same year-of-birth cohort, allowing the effect of age to be separated from the effect of cohort.[18] Many coefficients become smaller and less statistically significant in this specification.

The final column provides the results using household fixed effects. In this specification, the age coefficient is identified by variation within each household over time, exploiting the panel structure of the data. In comparing these specifications, the usual trade-offs apply—the specification with household fixed effects likely does the best job of controlling for unobservable heterogeneity, but there is a

[18]Observations on households of different ages from the same year-of-birth cohort will necessarily be taken at different points in time. Thus there is the possibility that differences in asset holdings reflect not only age effects but also time effects (e.g. observations from 1998 will have experienced a higher recent rate of return on their stock assets than observations from 1994). As is well known, even with longitudinal data there is no way to separately identify age, cohort, and time effects. We assume that time effects are likely small, particularly with respect to asset ownership.

risk of being left with too little variation to estimate statistically significant relationships. We find, however, that all of the results are statistically significant at the 5 percent level or better in this specification. The results are similar to those in the first column—the probability of owning a principle residence, vehicle, financial assets, and business or real estate declines with age, and there is now a statistically significant increase in the probability of holding liquid assets and time deposits with age.

The second panel of Table 2 shows the effect of age on the share of the household's portfolio held in a particular asset class. Because the shares must sum to one across the asset categories, an increase in one category must necessarily lead to a decrease in another, so we expect to see both positive and negative coefficients.[19] We exclude households with negative net assets from this analysis.

In the first specification (without cohort or household fixed effects), age is associated with a decrease in the share of assets invested in principal residence, vehicles, financial assets, and businesses or real estate and an increase in the share of assets invested in liquid assets and time deposits. All coefficients are highly significant. The second and third columns display the results of incorporating cohort and household fixed effects. With the exception of the principal residence, all the coefficients are significant in the third specification, where we would expect to have the most difficulty in obtaining significant results. The coefficients imply sizeable effects of age on asset allocation over the long term. For example, over a 20-year period, the share held in liquid assets and time deposits is projected to increase by 5.6 percentage points, or 28 percent relative to the average share.

The result for liquid assets and time deposits is intriguing. These assets are generally dominated by other assets on a risk–return basis, yet an increasing share of the household's portfolio is devoted to them with age. This finding resonates with earlier results for bank accounts found in Milligan (2005) in a cross-section and Poterba and Samwick (2001) in stacked cross-sections. Extending these results to our panel-data setting allows us to verify that the finding remains even after controlling for cohort and individual fixed effects.

There are several potential explanations for this finding. It may be a transitory result as windfalls of insurance money, pension lump sums, or proceeds from the sales of housing pass through liquid assets and time deposits on their way to other asset classes. Alternatively, older households may exhibit greater loss aversion due to their inability to work in order to make up for investment losses. Or it may be that the complexity of financial arrangements leads seniors, particularly those with diminished mental or physical capacity, to select portfolios that are easier to manage. We investigate some of these possibilities later in the paper.

More generally, the results from Table 2 suggest behavior that is more discrete than suggested by simple models of lifetime portfolio allocation. Moreover, aspects other than risk and return seem to be important for decisions surrounding primary residences, vehicles, and liquid assets such as bank accounts. An obvious candidate to explain some of this behavior is changes in the health condition of the household. We pursue this analysis in the next section.

[19]Recall, however, that we do not report results for the "other savings" category. The share coefficients for this variable were typically positive, but not very large in magnitude.

5. Results for the Effect of Health Shocks

Could health shocks help to explain the age-trends in asset decisions observed in Table 2? Figure 2 graphs the incidence (over a two-year period) by age of the three health (or mortality) shocks we consider. Because our asset data is at the household level, we consider a shock to have hit the household when either member of the couple experiences the change in health. In the 60s, the shock with the highest incidence is the diagnosis of new chronic illnesses; this incidence rate peaks at age 76, when 6.8 percent of households experience such a diagnosis (over a two-year period), and by the mid-to-late 80s, the incidence of new chronic illnesses has fallen sharply. The incidence of acute shocks is fairly constant over time, at about 2–4 percent of households at each age. The probability that a couple will experience the death of one partner increases from less than 3 percent at age 60 to over 6 percent at age 80. Overall, this figure demonstrates the relatively high incidence of health shocks for older individuals.

More striking than the period-by-period rate of incidence is the overall incidence in the time a household is seen in the HRS panel. We have on average 2.7 observations per household, which equates to 5.4 years. For widowhood, 13 percent of households are observed suffering the loss of one of the spouses in the time they are in the HRS. Moreover, only 21 percent of the households we observe at age 89 have survived without one or the other partner dying. For acute shocks and chronic illness diagnoses, we observe 12 and 20 percent of households suffering a shock during the window we see them in the HRS. The fact that health shocks are so common suggests that changes in asset holdings could conceivably be related to health shocks.

To more rigorously examine the link between health shocks and asset changes, we next estimate regressions based on equation (2) and present the results in Table 3. These regressions incorporate household fixed effects in order to control for unobserved heterogeneity. In these specifications, we compare

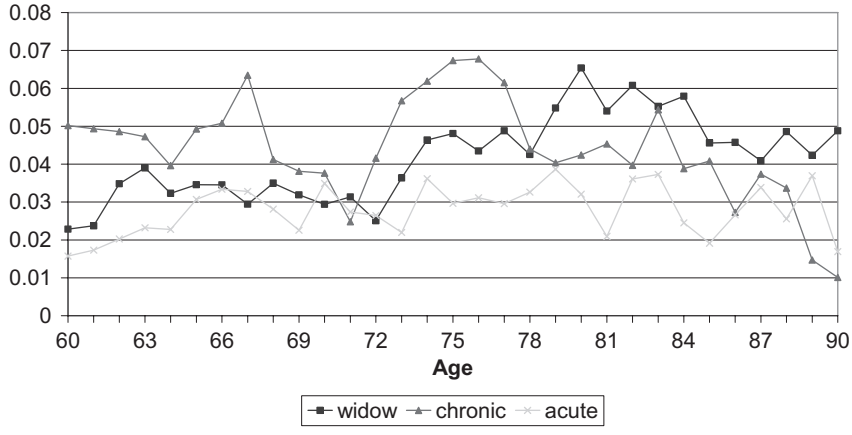

Figure 2. Proportion of Households Suffering Health Shocks by Age

TABLE 3
SIMPLE EFFECTS OF HEALTH SHOCKS ON ASSET HOLDINGS

Asset Class	Mean	Median	Widow	Chronic	Acute
51,070 obs			*Positive holdings of asset class*		
Principal residence	0.756	–	–0.036***	–0.003	–0.011
			[0.006]	[0.007]	[0.008]
Vehicles	0.792	–	–0.067***	0.019***	0.018**
			[0.006]	[0.007]	[0.008]
IRAs/stocks/bonds	0.470	–	–0.004	–0.015*	–0.002
			[0.007]	[0.008]	[0.009]
Liquid assets/time deposits	0.851	–	0.011	–0.006	–0.010
			[0.007]	[0.008]	[0.010]
Business/real estate	0.219	–	–0.008	–0.005	–0.019**
			[0.007]	[0.008]	[0.009]
48,191 obs			*Share of holdings in asset class*		
Principal residence	0.451	0.436	–0.020***	–0.001	–0.005
			[0.006]	[0.006]	[0.007]
Vehicles	0.104	0.035	–0.011***	–0.003	0.011**
			[0.004]	[0.004]	[0.005]
IRAs/stocks/bonds	0.153	0.000	–0.004	–0.003	0.002
			[0.004]	[0.004]	[0.005]
Liquid assets/time deposits	0.199	0.067	0.030***	0.003	0.003
			[0.005]	[0.005]	[0.006]
Business/real estate	0.076	0.000	0.003	0.001	–0.011***
			[0.003]	[0.004]	[0.004]

Notes: Coefficient reported is for a dummy variable indicating the given health shock was suffered in a previous period.

Standard errors appear in parentheses. Statistical significance at the 10%, 5%, and 1% levels is indicated with one, two, or three asterisks, respectively.

household-wave observations after a health shock to those before the shock and those who do not experience the shock.

In the first column of the upper panel, we show that having experienced a widowhood shock is associated with a sharp decrease in the probability of owning a principal residence or car. Households who have experienced widowhood are 3.6 percentage points (or 4.8 percent, relative to the average home ownership rate of 76 percent) less likely to own a home and 6.7 percentage points (8.5 percent) less likely to own a vehicle. These effects are highly significant. The same responses are seen for the share of holdings in each asset class. Having experienced an acute shock is associated with a decrease in both the probability of owning a business or real estate and the share of assets held in that asset class. There is some evidence that having experienced a chronic illness shock affects the probability of holding various assets, but there are no significant effects on the share of holdings in each asset class.

The results from Table 3 on the effect of widowhood on home ownership are in line with the previous literature. We augment previous studies by looking at numerous asset classes and controlling for multiple health shocks simultaneously. But our analysis is quite simple, in that we compare pre- and post-shock observations. A dynamic analysis may provide a richer picture of how households reallocate their portfolios over time following health shocks.

To pursue this, we estimate the model laid out earlier in equation (3), once again controlling for household fixed effects. For this analysis, we select the sample

for each shock by choosing any household in which one member of the couple experiences the shock between one HRS wave and the next. We then use the panel structure of the dataset to observe their asset choices several periods before and after the onset of the shock. For some households, we might see a shock occur between waves 1 and 2. For that household, we would observe one "pre-shock" period and several "post-shock" periods. For other households, we might observe a shock between waves 5 and 6. For that household, we could observe up to five "pre" periods (waves 1 to 5) as well as one period after the shock. In practice, we limited the sample to three periods before and three periods after the shock. Across all the households in the sample, therefore, we can develop a very complete picture of the effect of health shocks on asset decisions both before and after the onset of a shock.[20]

The coefficients reported in Table 4 are for the dummy variables indicating the distance in periods (of two years each) from the shock period. The omitted category is the period just before the shock occurred, so all of the coefficients should be interpreted as the change in the probability of holding positive values of the asset category *relative to* the period before the shock. We also report the mean of the dependent variable for each asset class, which corresponds to the proportion of the sample that holds a positive value of the asset.

We begin with an analysis of the widow shock in the top panel of Table 4. This marks a sensible starting point because earlier research by Venti and Wise (2002) highlights the importance of widow shocks on housing changes. As in Table 3, there is a sharp drop in ownership of both principal residences and vehicles following the death of one of the spouses. For the principal residence, the drop in ownership is 4.6 percentage points in the first period after the shock, and the effect is fairly constant over time. This represents a 6–7 percent drop from the mean ownership rate of 76 percent. For vehicles, the drop is estimated to be 8.6 percentage points in the first period after the shock, rising to 13.2 points three periods after the shock; since there are two years between waves, three periods after the shock corresponds to about 6 years. This 13.2 point drop represents 16 percent of the 80 percent average vehicle ownership rate. Interesting, a pre-existing trend toward reduced vehicle ownership is evident even before the widow shock.[21]

Another interesting result from the top panel of Table 4 is that widowhood is associated with an increased probability of owning liquid assets or time deposits. The effect is 2.5 percentage points in the first period and grows to 4.6 percentage points three periods after. This indicates that the shift into these assets is not temporary, but rather marks a long-lasting move into assets that offer a low return but also low risk, and in the case of bank accounts, high liquidity. This dismisses the possibility raised earlier that the move into these assets is a transitory step before wealth is redeployed elsewhere. There is also a strong effect of widowhood on the probability of owning a business or real estate: widowhood reduces this probability by 6.6 percentage points three periods after the shock, or 35 percent

[20]Including extra periods beyond the –3/+3 window does not change the results.

[21]This is evident even when we control for the presence of other health shocks in the household, such as an acute event that preceded the widow shock. One possible explanation is that these controls do not pick up the severity of the other shock or that there are some households in which the other shock occurred before the beginning of our sample period and thus is not observed.

TABLE 4

Dynamic Effects of Health Shocks on Positive Holdings of Asset Class

Asset Class	Mean	Distance from Shock: 3 Before	2 Before	1 After	2 After	3 After
9,326 obs				*Widow shock*		
Principal residence	0.757	–0.016	–0.003	–0.046***	–0.055***	–0.044***
		[0.013]	[0.010]	[0.009]	[0.012]	[0.015]
Vehicles	0.802	0.038***	0.019*	–0.086***	–0.107***	–0.132***
		[0.013]	[0.010]	[0.009]	[0.012]	[0.015]
IRAs/stocks/bonds	0.428	0.003	0.028***	0.003	–0.020	–0.008
		[0.014]	[0.010]	[0.010]	[0.012]	[0.016]
Liquid assets/time deposits	0.844	–0.019	0.006	0.025**	0.043***	0.046***
		[0.014]	[0.011]	[0.010]	[0.013]	[0.017]
Business/real estate	0.188	0.059***	0.034***	–0.005	–0.042***	–0.066***
		[0.013]	[0.010]	[0.009]	[0.012]	[0.016]
8,369 obs				*Chronic shock*		
Principal residence	0.880	–0.019	–0.010	–0.018**	–0.035***	–0.062***
		[0.012]	[0.009]	[0.009]	[0.011]	[0.014]
Vehicles	0.929	0.002	–0.007	–0.006	–0.040***	–0.058***
		[0.012]	[0.010]	[0.009]	[0.011]	[0.014]
IRAs/stocks/bonds	0.585	0.018	0.008	–0.020*	–0.025*	–0.041**
		[0.017]	[0.013]	[0.012]	[0.015]	[0.019]
Liquid assets/time deposits	0.901	0.013	0.011	–0.003	–0.002	–0.015
		[0.016]	[0.012]	[0.011]	[0.014]	[0.017]
Business/real estate	0.280	0.043**	0.021	–0.017	–0.018	–0.055***
		[0.017]	[0.013]	[0.012]	[0.015]	[0.019]
5,421 obs				*Acute shock*		
Principal residence	0.876	0.011	0.011	–0.013	–0.031**	–0.056***
		[0.015]	[0.012]	[0.011]	[0.014]	[0.018]
Vehicles	0.934	–0.011	0.016	–0.013	–0.042***	–0.060***
		[0.014]	[0.011]	[0.010]	[0.012]	[0.016]
IRAs/stocks/bonds	0.577	0.009	0.018	–0.025*	–0.001	–0.033
		[0.019]	[0.015]	[0.014]	[0.018]	[0.022]
Liquid assets/time deposits	0.902	–0.002	0.001	–0.012	0.005	–0.011
		[0.018]	[0.014]	[0.013]	[0.016]	[0.020]
Business/real estate	0.277	0.012	0.015	–0.036**	–0.064***	–0.112***
		[0.020]	[0.015]	[0.014]	[0.018]	[0.023]

Notes: Coefficient reported is for a dummy variable "X" periods away from the health shock. The excluded dummy is for the period before the shock. Standard errors appear in parentheses. Statistical significance at the 10%, 5%, and 1% levels is indicated with one, two, or three asterisks, respectively.

relative to the 19 percent average ownership rate of these assets. As with vehicles, a pre-existing trend is evident.

The second and third panels of Table 4 examine the effect of chronic and acute shocks on having positive holdings in a particular asset class. The effects of the two types of shocks are quite similar. Both eventually lead to significant drops in the ownership of principal residence—a 6.2 percentage point drop in the case of a chronic shock and a 5.6 percentage point drop in the case of an acute shock three periods after the shock. Unlike the widow shock, however, the response is not immediate, indicating that these shocks may foretell future health deterioration that will eventually force a sale. There is a large drop in vehicle ownership as well, which is evident one period after the shock.

There is also a significant effect of chronic and acute shocks on the probability of owning a business or real estate that appears immediately and grows to be quite

large by three periods after the shock. It appears that following such a shock, it becomes increasingly difficult for the household to manage this type of asset. There is a decrease in ownership of IRAs, stocks, and bonds following a chronic shock, indicating that households may draw upon these assets as health deteriorates. In the case of chronic shocks, there is some evidence of pre-existing trends, suggesting that for some households there may be measurement error in the timing of the shock, with symptoms commencing before a diagnosis is made. There is no evidence of this for an acute shock, which seems sensible given that this measure is comprised of health events that would presumably come on more suddenly, such as a heart attack or stroke.

In Table 5, we look at the effect of the three shocks on the share of household assets invested in each asset class, which allows us to consider portfolio realloca-

TABLE 5

Dynamic Effects of Health Shocks on Asset Shares

		Distance from Shock				
Asset Class	Mean	3 Before	2 Before	1 After	2 After	3 After
8,846 obs		*Widow shock, no other shock controls*				
Principal residence	0.466	–0.019	–0.013	–0.031***	–0.027**	–0.017
		[0.012]	[0.009]	[0.008]	[0.010]	[0.014]
Vehicles	0.110	0.018**	0.002	–0.018***	–0.023***	–0.027***
		[0.008]	[0.006]	[0.005]	[0.007]	[0.009]
IRAs/stocks/bonds	0.135	–0.002	0.007	0.005	0.010	0.020**
		[0.007]	[0.005]	[0.005]	[0.006]	[0.008]
Liquid assets/time deposits	0.210	–0.007	–0.006	0.041***	0.047***	0.037***
		[0.010]	[0.008]	[0.007]	[0.009]	[0.012]
Business/real estate	0.063	0.008	0.011**	0.003	–0.006	–0.012
		[0.006]	[0.005]	[0.004]	[0.006]	[0.008]
8,239 obs		*Chronic shock, no other shock controls*				
Principal residence	0.468	–0.022*	0.001	–0.001	–0.014	–0.012
		[0.012]	[0.009]	[0.009]	[0.011]	[0.014]
Vehicles	0.101	0.015*	0.002	–0.007	–0.017**	–0.025***
		[0.008]	[0.006]	[0.005]	[0.007]	[0.008]
IRAs/stocks/bonds	0.174	–0.013	–0.004	0.005	0.016**	0.024**
		[0.008]	[0.006]	[0.006]	[0.007]	[0.009]
Liquid assets/time deposits	0.149	–0.001	–0.010	0.009	0.025***	0.038***
		[0.010]	[0.007]	[0.007]	[0.008]	[0.011]
Business/real estate	0.090	0.016**	0.012**	–0.007	–0.012*	–0.022***
		[0.007]	[0.006]	[0.005]	[0.006]	[0.008]
5,353 obs		*Acute shock*				
Principal residence	0.463	0.015	0.001	0.000	–0.005	0.005
		[0.014]	[0.011]	[0.010]	[0.013]	[0.016]
Vehicles	0.098	0.002	0.007	0.005	–0.009	–0.004
		[0.008]	[0.006]	[0.006]	[0.008]	[0.009]
IRAs/stocks/bonds	0.179	–0.012	–0.004	0.000	0.016*	0.015
		[0.010]	[0.008]	[0.007]	[0.009]	[0.011]
Liquid assets/time deposits	0.155	–0.012	–0.016*	0.009	0.017*	0.027**
		[0.011]	[0.009]	[0.008]	[0.010]	[0.013]
Business/real estate	0.087	0.003	0.010	–0.012*	–0.020**	–0.044***
		[0.009]	[0.007]	[0.006]	[0.008]	[0.010]

Notes: Coefficient reported is for a dummy variable "X" periods away from the health shock. The excluded dummy is for the period before the shock. Standard errors appear in parentheses. Statistical significance at the 10%, 5%, and 1% levels is indicated with one, two, or three asterisks, respectively.

tions on the intensive as well as extensive margin.[22] The most notable new result is a significant increase in the share of assets in liquid assets and time deposits as a result of all three types of shock. For a chronic shock, for example, the effect is a 3.8 percentage point increase three periods after the shock, or 25 percent relative to the mean share of 15 percent. Many of the other results are what would be expected based on Table 4, such as the decrease in business and real estate investments following chronic and acute shocks, though surprisingly the effects of those shocks on the share of assets invested in a principal residence are small and statistically insignificant.

It is clear from Tables 4 and 5 that households make substantial changes to their portfolios following health shocks, but the reasons why households make these changes are less clear. We explore this question in Table 6. For simplicity, we focus on the widow shock, which is where some of the biggest changes in portfolio allocation seem to occur. We select some of the asset holding measures where the biggest changes were evident: ownership of principal residences, vehicles, and business or real estate, and share invested in liquid assets and time deposits. In each case, we estimate a model with dummy variables for periods before and after the shock, as in Tables 4 and 5, but we also interact these period dummies with measures of physical, mental, and financial capacity that may influence the household's response. The measures we use are: a dummy indicating that the household has difficulty with any activities of daily living (ADLs), a dummy equal to 1 if the household reports difficulty in managing money, and a dummy equal to 1 if the household experienced out-of-pocket medical expenses in excess of $5,000.[23] Our hypothesis is that these factors may strengthen the effect of the health shock, providing some insight as to why households reallocate their portfolios following a shock.

The results of this analysis are shown in Table 6. We report the coefficients from the main effect for each of the five period dummies along with the interaction of these period dummies with the three measures indicated above. Because there are household fixed effects in the model, the main effects for the three measures are redundant and so drop out of the regression.

In the case of physical and mental capacity, we find that these limitations greatly magnify the effect of a shock. For example, three periods after, the effect of a widow shock is to lower the probability of home ownership by 2.9 percentage points if there is no capacity limitation, but by 11.8 percentage points when there

[22]We do not present the effect of shocks on the dollar value invested in each asset class in the interest of space and because we face a greater risk of measurement error with this measure than with our other dependent variables. However, results for the dollar value in each asset class are broadly similar to those for the share of assets.

[23]In each case, the value of these measures for the household is fixed at its value in the period immediately after the shock. We have experimented with other measures designed to get at physical, mental, and financial capacity. For ADLs, we tried setting the dummy equal to 1 only if a member of the household had difficulty with multiple ADLs; results were similar. For mental capacity, we also looked at the household members' scores on tests of memory and cognition; these generated similar results, but we chose the ability to manage money because it seemed most relevant here. For financial constraints, we tried a higher dollar cutoff for out-of-pocket medical expenditures, scaling this by income, and simply dividing the sample by household income; results were similarly insignificant. We also tried a variable in the HRS measuring individual risk aversion but found no consistent relationship to asset choices—a finding limited by the fact that the question is only asked in some waves of the survey.

TABLE 6
REASONS WHY WIDOW SHOCK AFFECTS ASSET HOLDINGS

	3 Before	2 Before	1 After	2 After	3 After
Principal residence ownership					
Base	–0.014	–0.007	–0.035***	–0.037***	–0.029
	[0.017]	[0.013]	[0.011]	[0.014]	[0.019]
ADL limitation	0.017	–0.002	–0.031	–0.065**	–0.089**
	[0.029]	[0.024]	[0.021]	[0.026]	[0.035]
Manage money	0.024	0.068**	–0.101***	–0.087**	–0.091*
	[0.040]	[0.032]	[0.029]	[0.038]	[0.055]
Medical costs	–0.020	–0.020	0.037	0.003	–0.020
	[0.030]	[0.023]	[0.024]	[0.027]	[0.032]
Vehicle ownership					
Base	0.031*	0.008	–0.064***	–0.093***	–0.128***
	[0.016]	[0.013]	[0.011]	[0.014]	[0.019]
ADL limitation	0.060**	0.039*	–0.075***	–0.087***	–0.098***
	[0.028]	[0.023]	[0.021]	[0.026]	[0.035]
Manage money	0.058	0.023	–0.147***	–0.185***	–0.217***
	[0.039]	[0.032]	[0.028]	[0.038]	[0.054]
Medical costs	0.004	0.027	0.044*	–0.007	–0.007
	[0.030]	[0.023]	[0.024]	[0.026]	[0.032]
Business/real estate ownership					
Base	0.048***	0.035***	–0.005	–0.049***	–0.073***
	[0.017]	[0.013]	[0.012]	[0.015]	[0.019]
ADL limitation	0.035	0.000	0.017	0.040	0.027
	[0.029]	[0.024]	[0.022]	[0.027]	[0.036]
Manage money	–0.033	0.018	0.008	0.012	–0.013
	[0.041]	[0.033]	[0.029]	[0.039]	[0.056]
Medical costs	0.040	–0.006	–0.022	–0.002	–0.030
	[0.031]	[0.024]	[0.025]	[0.027]	[0.033]
Bank accounts/CDs share					
Base	0.002	–0.004	0.029***	0.034***	0.007
	[0.013]	[0.010]	[0.009]	[0.011]	[0.015]
ADL limitation	–0.028	–0.006	0.017	0.031	0.092***
	[0.023]	[0.019]	[0.017]	[0.021]	[0.028]
Manage money	–0.005	0.013	0.080***	0.071**	0.172***
	[0.032]	[0.026]	[0.023]	[0.031]	[0.046]
Medical costs	0.000	0.009	0.000	0.014	0.042*
	[0.023]	[0.018]	[0.019]	[0.021]	[0.025]

Notes: Coefficient reported is for a dummy variable "X" periods away from the health shock. The excluded dummy is for the period before the shock. Standard errors appear in parentheses. Statistical significance at the 10%, 5%, and 1% levels is indicated with one, two, or three asterisks, respectively.

is ADL impairment and by 12.0 percentage points when there is difficulty managing money. The results are even more striking in the case of vehicle ownership, with the effect jumping from 12.8 percentage points to 22.6 points with ADL impairment and 34.5 points with difficulty managing money. Interestingly, for business and real estate, the interaction terms have no effect, indicating that these assets are sold off for other reasons. For the share of assets invested in liquid assets and time deposits, these capacity factors are also very important. The base effect of a widow shock is essentially zero, but the effect on the share of assets in liquid assets and time deposits jumps to 9.9 points when there is an ADL impairment and 17.9 points when there is difficulty managing money. Thus it seems that responses to shocks are heterogeneous, with the tendency to sell homes and vehicles and to

put that money in safe, low-return, and liquid assets much stronger when widows have physical or mental impairments.

Table 6 does not reveal much impact of out of pocket medical expenses. One potential explanation for sales of big assets like the primary residence or vehicles is that households are pressured by medical costs to liquidate assets. However, using the out of pocket expense measure available in the HRS, we find no evidence in support of this explanation. The result persisted with the use of a $10,000 threshold.

6. Conclusions

In this paper, we explore the effects of aging and health shocks on portfolio allocation of older households. Although previous studies have examined some aspects of these relationships, we make several important contributions to this literature. First, we undertake a comprehensive analysis of the effect of age on asset holdings in many asset classes, with a special focus on separating the direct effect of aging from cohort effects or survivorship bias. Second, we examine how health shocks are associated with changes in asset holdings; while many previous studies have focused on the effect of widowhood on home ownership, we expand this analysis to look at other asset holdings and other health shocks and to chart the dynamic path of adjustment to a health shock. Finally, we begin to explore the reasons for responses to health shocks by testing how the response depends on physical, mental, and financial capacity.

On the first question, we document declines in the ownership of homes, vehicles, financial assets (IRAs, stocks, and bonds), and business or real estate assets with age and an increase in both the probability of ownership and the share of assets held in liquid assets and time deposits. These effects are generally robust to the inclusion of household fixed effects. On the second question, we find that health shocks have significant effects on asset holdings. As has been found in the previous literature, we find being widowed is associated with a significant drop in the probability of home ownership. However, we also document that widowhood lowers the probability of ownership of vehicles, businesses, and real estate and raises the share of assets held in liquid assets and time deposits. Furthermore, the effects of acute events such as a heart attack or stroke or of the diagnosis of a new chronic illness are very similar. We show that the effects of these shocks generally strengthen with time since the shock. On the third question, we find that the observed responses to health shocks are many times greater when the respondent has physical incapacity (difficulties with activities of daily living) or mental incapacity (difficulty managing money), but not when out of pocket medical expenses are high.

Our results suggest that factors other than standard risk and return considerations may weigh heavily in many older households' portfolio decisions. For example, the finding that the share of assets held in liquid assets and time deposits rises with age and widowhood and that the effect is stronger for widows with physical impairments or difficulty managing money indicates that households may place more value on liquidity or ease of portfolio management than on the higher returns that could be earned in other financial assets. Future research, particularly work incorporating recent insights from behavioral economics, may help to clarify

the relative importance of factors such as liquidity, simplicity, and loss aversion in the portfolio decisions of older households. While this study has focused on the U.S., further research into the effect of health on the portfolios of households in other countries would help to confirm and extend our findings.

In the future, older households in the U.S. and around the world are likely to face more responsibility for managing their portfolios during retirement in order to ensure their financial security. First, as life expectancies increase, households can be expected to accumulate larger portfolios, but also must be more careful in how they use these portfolios to finance retirement consumption, given the growing uncertainty over how many years these resources will need to last. Second, shifts in both public and private pension schemes from defined benefit to defined contribution plans, such as those seen for employer-provided pensions in the U.S. and in the public pension systems of Sweden and the United Kingdom, can place more responsibility on households for saving for retirement and for managing assets during retirement. Our findings may be of interest to policy makers seeking to ensure the well-being of traditionally vulnerable groups, such as elderly widows, during this time of transition.

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