Portfolio Choice and Mental Health

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Abstract. Close to 30% of the US population experiences at least one mental or substance abuse disorder each year. Given the prevalence of mental health issues, this paper analyzes the role of mental health and cognitive functioning in household portfolio choice decisions. Generally, we find that households affected by mental health issues decrease investments in risky instruments. Various mental health issues can reduce the probability of holding risky assets by up to 19%. Moreover, single women diagnosed with psychological disorders increase investments in safe assets. We also find that cognitive functioning issues are associated with an increase in financial assets devoted to retirement accounts.

JEL Classification: G11, I10

1. Introduction

> "Hubris, fear, impatience, complacency—these are examples of emotional responses that can get us into financial trouble."
> Anonymous

During economic downturns, there is generally a re-emergence in the collective consciousness of the importance of household financial decision making and the negative consequences of allowing irrational exuberance, emotions, or other nonrational factors to influence an individual's financial decision-making process. Given the critical connection between mental health and an individual's decision-making ability, the question of whether mental health influences household portfolio choice is an open issue in the literature.

The purpose of this paper is to investigate whether differences in mental health status can help to explain differences in household portfolio composition.

Specifically, we analyze the effect of cognitive limitations and psychiatric problems (such as depression, anxiety, phobias, alcoholism, or obsessive compulsive disorder) on the probability of owning different types of financial assets and the share of financial wealth held in each asset category. It has been estimated that close to 30% of the US population experiences at least one mental or substance abuse disorder each year (Kessler *et al.*, 1994). In addition, severe cognitive impairments associated with aging affect 7% of older adults (U.S. Dept. of Health and Human Services, 1999; Pastor and Reuben, 2008). Given the lengthening life spans and the aging of the baby boom generation, there is a premium placed on learning more about how declines in mental health might affect financial decisions. Moreover, given the prevalence of mental health issues and the evidence that mental health issues are on the rise among high school and college age individuals (Twenge *et al.*, 2010), the question of how mental health issues affect household financial decisions is becoming an increasingly key issue.

Mental health could affect household portfolio choice for a variety of reasons. First, mental health may alter cognitive abilities, which would affect investment decisions. Second, mental health may affect one's ability to regulate mood and emotion that could affect a person's ability to evaluate investment opportunities. Third, mental health may alter an individual's degree of risk aversion that has been shown to be an important determinant of portfolio choice. Fourth, mental health may affect an individual's discount rate thereby affecting his motivation to invest for future returns. Finally, having any health shock, physical or mental, reduces productivity and increases medical spending, thereby reducing the availability of funds to invest. Health shocks may also cause a household to change its portfolio allocation toward more liquid assets or may change the likelihood that a financial planner (or other "agent") will manage the household assets.

Within the finance arena, there is an extensive theoretical literature demonstrating how portfolio decisions depend on factors such as risk aversion [see Gollier (2002) for a comprehensive survey of this literature]. However, very little of the cross-sectional variation in portfolio behavior has been explained in the empirical finance literature on portfolio choice. Mental health status could be a potential omitted variable that should be considered in future financial models of portfolio choice. Moreover, understanding how individuals with mental issues make financial decisions could provide insights into how all households make financial decisions.

The relationship between mental health and portfolio choice is of interest not only because it may contribute to our understanding of individual investment behavior but also because it may illuminate another mechanism demonstrating that health affects economic status. If mental health status affects household portfolio composition, mental health may result in systematic differences in economic status. Historically, portfolio choices of stock have been vital to economic advancement and wealth building, particularly during prosperous economic times. There is an

ongoing debate in the economic and medical literature about the causes of the connection between income and health. If the determinants of the connection were better understood, policymakers might be able to target interventions to reduce health disparities and improve overall population health and well-being.

While theory strongly suggests that mental health could affect investment decisions, to our knowledge, no empirical assessment of this issue exists. Using longitudinal data, we use fixed-effects logit and tobit models to study whether changes in mental health exert an independent effect on the probability that a household holds a particular type of asset and on the household share of total financial assets allocated to particular assets. We generally find that households affected by mental illness decrease their investments in risky instruments. We also find that single women diagnosed with psychological disorders significantly increase their share devoted to safe investments and have an increased probability of holding safe assets. Finally, we find, especially among men with cognitive functioning issues, an increase in financial assets devoted to retirement and pension accounts, which tend to be less information intensive. These findings suggest that various mental issues affect males, females, and couples differently. They also suggest that mental health could affect households in a way that has long-term consequences for wealth building among those with mental illness.

2. Background and Theory

Health economists have long studied the relationship between economic status and health, often referred to as the gradient.[1] There is an ongoing debate in the literature about the direction of causality. Epidemiologists favor explanations involving the negative health effects of low economic status. Economists, on the other hand, tend to argue that the effects of poor health on income through labor market productivity may be the more important cause of the gradient (Cutler, Deaton, and Lleras-Muney, 2006). A few of these economic studies showing that health affects economic status have focused on mental health (Bartel and Taubman, 1986; Ettner, Frank, and Lessler, 1997; Cseh, 2008). While the outcomes in these studies primarily have been related to the labor market, there is much reason to believe that mental health may have a profound effect on economic status through financial market outcomes as well.

As mentioned previously, we argue that a mental health affliction could directly affect investment behavior by affecting an individual's optimization ability. There is considerable literature investigating the effects of cognitive abilities on financial choices.[2] For example, Christelis, Jappelli, and Padula (2010) find that, with other

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[1] See Smith (1999) for a review.
[2] Cognitive abilities include numeracy, verbal fluency, and memory abilities.

factors held constant, cognitive impairments reduce the propensity to hold stocks and increase the propensity to hold less information-intensive assets such as bonds. Thus, mental health problems that limit cognitive abilities could directly contribute to a lack of participation in financial markets. However, in response to cognitive limitations, individuals may choose to obtain outside financial advice. Elmerick, Montalto, and Fox (2002) document that 18.5% of US households utilize financial planners for savings and investment decisions. A different pattern of soliciting outside financial advice could differentially influence the household portfolio choices of individuals with mental health issues.

Mental health problems also influence human emotions that can affect an individual's ability to evaluate investment opportunities. Research has shown that various emotional states can alter an individual's risk valuation ability. Individuals with better than normal mood tend to weigh gain and loss probabilities more optimistically, whereas individuals with worse than normal mood weigh gain and loss probabilities more pessimistically (Wright and Bower, 1992; Fehr-Duda *et al.*, 2011). Rick and Loewenstein (2008) show that emotions are an important part of assessing the desirability of an outcome or assessing "utility." Additionally, Shiv *et al.* (2005) find that a lack of emotional reaction to investment decisions may lead to more advantageous decisions in certain situations. Thus, a mentally impaired person, who may experience different emotions than a normal investor, could make different investment decisions.

Scholars have used mental health problems in correlation with mood changes to explain fluctuations in capital markets such as stock returns, bond returns, and mutual fund flows. For instance, seasonal affective disorder (SAD) is a commonly used example of a seasonal factor affecting the capital market. SAD has been purported to cause emotional fluctuations that affect investor risk aversion, resulting in predictable changes in stock returns (Kamstra, Kramer, and Levi, 2003) and bid-ask spreads (DeGennaro, Kamstra, and Kramer, 2008).[3] Similarly, Lo and Repin (2002) demonstrate that emotional reactions, measured by factors such as skin conductance and blood volume pulse, affect trade performance for day-traders. Traders who react more emotionally to gains and losses exhibited worse performance. Finally, Koenigs and Tranel (2007) show that subjects with prefrontal brain damage have irrational economic decision making due to defective emotion control. This study concludes that emotional regulation is an important part of normal economic decision making. Thus, individuals with mental health issues that affect emotions or mood may have more difficulties appropriately assessing investment options.

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[3] However, Kelly and Meschke (2010) argue that emotions do not affect stock prices as long as rationality holds for the marginal investor.

Mental health also could affect household portfolio choice by its effect on an individual's risk aversion. Edwards (2010) develops a theoretical model in which health risk increases risk aversion as individuals try to hedge their risky health by investing their financial wealth in safe assets. He demonstrates that health risk can explain more than 60% of the reduction in post-retirement financial risk taking. Similarly, Berkowitz and Qiu (2006) show that a physical health shock causes households to restructure their portfolios by reducing their stock holdings. Likewise, Rosen and Wu (2004) find that households in poor health are less likely to hold risky financial assets, hold smaller shares of their wealth in risky assets and greater shares of their wealth in safe assets. Thus, as with a physical health shock, a mental health problem could affect financial decisions that could have long-term consequences on economic status.

Similarly, mental health may affect an individual's rate of time preference, which in turn would affect his/her propensity to invest in assets with returns in the distant future. Becker and Mulligan (1997) argue that physical health affects time preference because poor health curtails one's life span, which reduces one's planning horizons and future utility. Mental health issues, like physical health problems, could also reduce one's expected or perceived life span or the quality of the remaining years which could cause an individual to discount future utility more heavily. There is only one empirical test of this theory to our knowledge. Using a small sample ($n = 175$) from South Africa, Chao et $al.$ (2009) find that individuals' physical health and survival expectation have a U-shaped relationship with respect to their subjective discount rates, implying that individuals in very poor and very good health have high discount rates. They also examine the relationship between mental health and subjective discount rates but find no empirical association.

There is support for a connection between mental health and discount rates in both the economic literature and the psychology literature which documents that substance abusers have high discount rates (see Becker and Murphy, 1988; Bickel, Odum, and Madden, 1999; Bretteville-Jensen, 1999; Kirby and Petry, 2004). Danielson, Overholser, and Butt (2003) demonstrate that mentally ill individuals report higher rates of binge drinking and involvement with substance abuse, suggesting a link between psychological problems and discount rates. Additionally, Frederick (2005) also shows that individuals with more limited cognitive abilities have higher discount rates for short-term choices.

The discussion above focuses on the effect of mental health on preferences and the ability to optimize. However, having a health problem can affect one's budget constraint as well by influencing earnings and/or medical expenses. Several studies find that individuals with mental health illnesses earn less than healthy individuals (Bartel and Taubman, 1986; Ettner, Frank, and Lessler, 1997; Cseh, 2008). Bartel and Taubman (1986) find that the reduction in wealth comes largely from financial

wealth rather than non-financial wealth, as the former is much more liquid than the latter. Health problems are also associated with medical expenses, which can erode one's wealth. Individuals with mental health problems tend to have a higher rate of comorbidity and thus higher general and mental health medical expenditures. One study found that individuals with behavioral health insurance claims had almost double the claims of individuals with only general and/or pharmacy service claims and that 80% of their claims were for nonbehavioral services/medications (Kathol *et al.*, 2003). These medical expenses can cause individuals with health problems to prefer liquid assets. Kochar (2004) shows that in developing economies, expectations of future ill-health reduce investments in illiquid productive assets. Thus, individuals with mental health problems may invest less than healthy individuals because they have less money available for investing or a need to hold more liquid assets.

The theories discussed thus far all argue that mental health influences financial behavior through effects on an individual's utility function, optimization ability, or budget constraint. However, it may also be the case that past financial outcomes affect mental health. If an individual loses a substantial sum as a result of their investing decisions, the stress associated with the loss or the resulting debt may be an environmental trigger for some mental health conditions (Vinokur, Price, and Caplan, 1996; Zimmerman and Katon, 2005). In addition, past financial outcomes may also result in marital conflict (Kerkmann *et al.*, 2000), which can also lead to mental health problems (Bruce and Kim, 1992). Since financial behavior can affect mental health, some endogeneity issues exist, which we address in our empirical strategy.

In contrast to the literature in this area that focuses on physical health (Rosen and Wu, 2004; Berkowitz and Qiu, 2006; Fan and Zhao, 2009; Love and Smith, 2010), this paper attempts to add to the literature by investigating the effect of *mental* health issues on household portfolio allocation. Moreover, instead of focusing merely on mental health diagnoses, we analyze this issue along four dimensions of mental health: doctor-diagnosed mental health issues, depression, cognitive limitations, and memory complaints. Similar to the approach of Fan and Zhao (2009) who utilize physical health indices to measure the effect of physical health status on household portfolio choices, we construct mental health indices for both depression and cognitive limitations. Also, by using US panel data for both risky and safe asset investments, we build on the work of Christelis, Jappelli, and Padula (2010) who study the relationship between cognitive abilities and stockholding using cross-sectional European data. Our analysis also illustrates for the first time the existence of differences along gender lines in the effects of mental health issues on household investment decisions.

3. Data

The data used in this study come from the 1996, 1998, 2000, 2002, 2004, 2006, and 2008 waves of the Health and Retirement Survey (HRS).[4] This panel data set contains standard demographic information, information about financial assets, and detailed physical health, mental health, and cognition variables. While the data set tracks only older individuals and consequently is not a representative sample of the population, the HRS has the best available measures of mental health and cognition among data sources with detailed financial asset information.[5] While the Panel Study of Income Dynamics (PSID) is a nationally representative longitudinal data set, we focus on the HRS since the mental health questions in the PSID are more limited.[6]

3.1 SUBGROUPS

We separately study three groups of HRS households: households headed by single men, households headed by single women, and households of couples (where we observe the mental health of both partners). We separate the sample in this way because empirical evidence suggests that the financial decisions of couples differ from single individuals (Barber and Odean, 2001; Lundberg, Startz, and Stillman, 2003; Kirchler, Hoelzl, and Kamleitner, 2008; Love, 2010) and women have different preferences than men (Jianakoplos and Bernasek, 1998; Browning, 2000; Barber and Odean, 2001; Croson and Gneezy, 2009).[7] Couples are different from single individuals because there may be some bargaining between partners or sharing of decision-making power with respect to financial behaviors where singles are lone decision-makers (Lundberg, Startz, and Stillman, 2003; Kirchler, Hoelzl, and

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[4] The HRS is sponsored by the National Institute of Aging and conducted by the University of Michigan. While the HRS does contain two other waves (1992 and 1994), we do not use those waves since they do not contain the same mental health variables as the subsequent waves.

[5] The objective of the HRS has been to provide information about the US population over age 50 through biennial surveys with samples of that population. Since 1998, the target population has been defined as those born in 1947 or before, and thus approximately those age 51 and older. New cohorts were not added in 2000 or 2002. Thus, the target populations were approximately 53 and older in 2000 and 55 and older in 2002. In 2004, a supplementary sample was added to make the total sample representative of those born in 1953 or before, and thus, once again, approximately age 51 and older. New cohorts were not added in 2006 and 2008 so the target populations were 53 and older in 2006 and 55 and older in 2008.

[6] We performed some robustness checks using the PSID and find consistent results. Results available upon request.

[7] A Chow test indicates that the coefficients on specifications using single men are significantly different than those for single women ($F = 1.55$ with a p-value of 0.0259).

Kamleitner, 2008). For this reason, we expect to see a greater investing effect of mental health, whatever the direction, among single-headed households. Men and women have different levels of risk aversion (Jianakoplos and Bernasek, 1998; Croson and Gneezy, 2009) and different discount rates (Browning, 2000; Bradford, 2010). These considerations would suggest that men and women prefer different portfolio strategies. In general, these various differences imply that mental health problems may have differing impacts on a family's portfolio depending on the household composition.

Table I shows that our sample consists of 5,859 households of single men, 18,190 households of single women, and 28,261 households of couples when all waves of data are pooled.[8] The 1996 data are used to provide lagged variables for the 1998 household observations, and thus, the sample is pooled from six waves of data.[9] We limit our sample by including only those who responded without proxies (6% omitted), those who responded to most of the control variables (32% omitted), and those who responded to the mental health diagnosis question (29 observations omitted).[10] We imputed missing values using mean substitution with missing indicators for six control variables.[11] In addition, the cognitive limitation score and the asset values used in this analysis (described below) include observations that have been imputed using regression-based techniques by the HRS (Cao, 2001; Fisher *et al.*, 2011).

Table I. Size of sample by household type

Year	Single-male head	Single-female head	Couple household	Total
1998	488	1,359	3,468	5,315
2000	1,160	3,544	5,502	10,206
2002	1,062	3,454	4,795	9,311
2004	999	3,237	4,625	8,861
2006	1,126	3,489	5,200	9,815
2008	1,024	3,107	4,671	8,802
Total	5,859	18,190	28,261	52,310

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[8] Because women outlive men on average, there are over three times as many single women as single men in this sample of older Americans, and couples tend to be younger on average.

[9] The sample is small in 1998 because some lagged variables from 1996 are necessary and thus cannot be missing from any sample observations. The 1996 sample is half the size of the 1998 sample, which included for the first time the cohorts from both the HRS and the AHEAD (the Asset and Health Dynamics among the Oldest Old Study).

[10] The remaining sample of 52,310 person-year observations answered the key financial questions, and thus none was omitted based on this restriction.

[11] The six control variables are head's occupation was manager/professional, household received an inheritance, household received help managing money, number of children, home ownership, and medical expenditures.

3.2 MENTAL HEALTH MEASURES

Table II provides summary statistics for the four mental health measures used in this analysis. The two measures presented in Panel A are used to analyze mental health effects on financial decisions either through their influence on an individual's utility function or through their ability to optimize as described in Section 2. We will isolate these theories about the relationship between mental health and portfolio choice from those based on changes in the budget constraint with a rich set of control variables described in a later section.

The first measure comes from a question that asks whether the respondent has ever been diagnosed with any emotional, nervous, or psychiatric problems by a doctor.[12] We create a dummy variable from this question. Self-reports of lifetime diagnosis are shown to demonstrate high reliability cross-sectionally (Andreasen *et al.*, 1981) but are often inconsistent longitudinally as "individuals alter their reports to make past states consistent with current states" (Aneshensel *et al.*, 1987). As a result, this measure is more likely to capture a current diagnosis rather than a past diagnosis.[13]

Table II. Mental health statistics

a Mental health diagnosis is a self-report of lifetime diagnosis but, given that the survey permits inconsistent reports over time, is likely to reflect current diagnosis.

	Single-male heads ($n = 5,859$)	Single-female heads ($n = 18,190$)	Couple heads ($n = 28,261$)	Couple wives ($n = 27,197$)
Panel A				
% With mental health diagnosis[a]	0.152	0.202	0.134	0.124
Mean CES-D score (range 0–8)	1.865	1.971	1.201	1.155
% With CES-D score of 6–8 (worst)	0.080	0.097	0.044	0.041
Panel B				
Mean cognition score (range 0–35)	13.987	13.432	12.054	11.636
% With cognition score of 9–14	0.444	0.437	0.501	0.520
% With cognition score of 15–20	0.311	0.280	0.216	0.192
% With cognition score of 21–35 (worst)	0.115	0.107	0.054	0.042
Mean self-rated memory status (range 1–5)	3.010	2.974	2.931	2.908
% With good self-rated memory status	0.395	0.423	0.443	0.439
% With fair self-rated memory status	0.247	0.234	0.213	0.212
% With poor self-rated memory status	0.065	0.048	0.040	0.036

[12] Examples of emotional, nervous, or psychiatric problems include depression, anxiety, bipolar, schizophrenia, phobias, alcoholism, drug addiction, and obsessive compulsive disorder. However, the specific condition is not asked.

[13] We use the raw survey data to create the mental health diagnosis variable that notes but allows inconsistent answers over time.

The second measure is created using a series of eight HRS questions about depression symptoms, which is a subset of the 20-question Center for Epidemiologic Studies Depression Scale (CES-D). These questions ask the respondent to "think about the past week and the feelings you have experienced." They are asked to respond yes if they have felt for much of the week, (1) depressed, (2) everything was an effort, (3) sleep was restless, (4) happy, (5) lonely, (6) enjoyed life, (7) felt sad, and (8) could not get going. We create a scale from these eight questions that is a count of the number of positive responses (where happy and enjoyed life are reverse coded). Following the literature (Turvey, Wallace, and Herzog, 1999), we use this scale to create a dummy variable that is given a value of 1 if the CES-D score is greater than 5 and is set to 0 otherwise.[14] Evidence indicates that the CES-D is a reliable measure of depression and anxiety that is associated with physician diagnoses and psychiatric treatment (Turvey, Wallace, and Herzog, 1999).

The measures presented in Panel B of Table II are used to analyze the mental health effects on financial decisions primarily through their influence on an individual's optimization ability as described in Section 2. These measures of cognitive functioning are less likely to influence preferences than they are to influence a person's ability to optimize. Cognitive function tests have been shown to predict future limitations in activities of daily living (Moritz, Kasl, and Berkman, 1995), dementia (Jorm, 1997), and Alzheimer's disease (Morris *et al.*, 2001). Thus, for the first measure in Panel B, we use a summary variable provided by the Survey Research Center at the University of Michigan based on a series of cognitive tasks the respondent is asked to complete. The tasks include word recall, naming objects, and the like and are described in detail in Appendix A. This scale takes a value between 0 and 35 and is coded such that a higher value implies more cognitive limitations. Given the nature of how this scale is constructed, we argue that small changes in the total score may not reflect significant changes in cognitive functioning. In addition, cognitive functioning has been found to follow a nonlinear growth pattern across time (McArdle *et al.*, 2002). As a result, we create three dummy variables for the cognitive limitation score to capture a nonlinear pattern of effects: a cognitive limitation score between 9 and 14, a score between 15 and 20, and a score greater than or equal to 21.

Finally, respondents are asked to rate their memory at the present time on a scale from 1 to 5, where 1 is excellent and 5 is poor. As we do not want to restrict the size of the effect of changing from good to fair to be the same as the effect of changing from fair to poor, we create three dummy variables for self-rated memory status:

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[14] We also obtain similar results when we perform the empirical analysis using a continuous variable for the CES-D score that takes a value between 0 and 8 such that a higher value implies more depression symptoms.

self-rated memory status good, self-rated memory status fair, and self-rated memory status poor.[15] Memory complaints have been shown to predict dementia, even for those with no indication of cognitive impairment (Jonker, Geerlings, and Schmand, 2000).

There are benefits and drawbacks to mental health screens, "test" scores, and diagnosis questions. The CES-D screen and self-rated mental status are useful because they capture current status and they do not require a doctor diagnosis, which is less likely for individuals with low socioeconomic status. They also take on a range of values, which captures mild as well as severe conditions. However, they are subjective measures of mental health that may reflect cultural or social norms or other factors. The diagnosis question is a simple dichotomous variable, whose timing is vague, that captures socioeconomic status and preferences along with mental health status. The specific condition is not revealed with the diagnosis question, and different conditions could have varying effects on portfolio choice, thus it may be difficult to observe a clear relationship with this measure of mental health. However, it is an objective measure of mental health status, capturing cases where the symptoms of the illness may be most pronounced, thus inducing the individual to seek treatment. Finally, the cognitive score does not require a doctor, reflects current status, takes on a range of values, and is objective but may be affected by testing or performance anxiety, language ability, and other factors. For these reasons, we use all four measures of mental health in this analysis.

We use the mental health measures "lagged" one interview wave (2 years) in our analysis because we argue that it may take time for a mental health state to affect investment decisions.[16] More importantly, by lagging mental health, we minimize the possibility of reverse causality.[17]

From Table II, we see that between 12.4% and 20.2% of the survey participants have a diagnosed psychological problem, with women in couple households having the lowest rate and single women having the highest.[18] The depression (CES-D) variable indicates a similar pattern to the mental health diagnosis variable but has lower prevalence rates given that this is one type of psychiatric disorder. In contrast, single men have the highest prevalence rate of high cognitive limitation scores

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[15] We obtain similar results, particularly for the specifications without fixed effects, when we perform the empirical analysis using continuous variables for the cognitive limitation score and the self-rated memory status.

[16] Thus, the mental health variables are taken from the 1996 through the 2006 interview waves.

[17] While it is unlikely that current investment decisions affect past mental health, both variables could have been influenced by long-standing situations. We will further address this issue in our econometric analysis.

[18] Given the question requires a physician diagnosis, our sample of respondents with mental health issues is smaller than average estimates of the prevalence of mental health issues in the general US population.

(11.5%) and poor memory (6.5%) and wives in couple households have the low-est rates (4.2% and 3.6%). A detailed description of all variables can be found in Appendix A.

From Table III, we see that, during our sample period, only between 13% and 18% of the samples change their report of a mental health diagnosis and 12% to 23% of the samples have a CES-D score that changes relative to the cutoff used in this analysis. However, between 69% and 100% of the households have a change in cognitive score category or memory status rating across waves. Among those in this sample whose mental health diagnosis or CES-D score category changes across interview waves, 14–29% involve the onset of mental illness or depressive

Table III. Changes in mental health (MH) variables (1996–2006)

	Single all (%)	Men if Δ (%)	Single all (%)	Women if Δ (%)	Couple all (%)	Head if Δ (%)	Couple all (%)	Wife if Δ (%)
MH diagnosis								
Any change	15		18		17		13	
MH status is variable	10	64	12	64	10	58	8	63
MH status goes from 0 to 1 (onset)	2	14	3	19	4	22	3	21
MH status goes from 1 to 0 (remission)	3	21	3	17	3	20	2	17
MH status always 1	10		12		6		7	
MH status always 0	75		70		77		80	
CES-D score above depression threshold								
Any change	19		23		14		12	
Score is variable	9	47	12	52	7	51	6	52
Score goes from below to above threshold	5	27	6	25	4	29	3	27
Score goes from above to below threshold	5	25	5	23	3	20	3	21
Score always above threshold	0		0		0		0	
Score always 0	80		77		86		88	
Cognitive limitation score category								
Any change	79		86		69		71	
Score is variable	37	46	40	46	34	50	31	44
Score increases over time	8	11	10	12	9	13	11	15
Score decreases over time	34	43	36	42	26	37	29	41
Score >0 but always same	20		12		30		28	
Score always 0	1		1		0		0	
Self-rated memory (1 = excellent/very good, 5 = poor)								
Any change	100		100		100		100	
Score is variable	45		48		47		46	
Score increases over time	37		33		33		34	
Score decreases over time	18		19		20		20	
Score always same	0		0		0		0	

symptoms, 17–25% experience a remission of their mental health problems, and the remainder (47–64%) report a more variable pattern of mental health problems over time. Among those with changes in symptoms or problems reflected in the cognitive limitation score categories or memory status ratings, 11–37% involve an increase in problems, 18–43% involve a decline in problems over time, whereas 44–50% report a variable pattern of mental health problems over time.

3.3 ASSET MEASURES

When studying portfolio choice, a common strategy is to collapse financial assets into classes based upon risk (Rosen and Wu, 2004). We will focus on "safer" assets (savings and checking accounts, money market funds, CDs, government bonds, T-bills, cash in a life insurance policy, a valuable collection, bond funds, or rights in a trust or estate) and "risky" assets [shares of stock in publicly held corporations, mutual funds, or investment trusts, not including assets in individual retirement accounts (IRAs), Keogh accounts, 401Ks, or similar defined contribution pension plans]. Because differences in portfolio allocation due to mental health may come from the extensive margin, the intensive margin, or both, we examine the effect of mental health both on the probability of holding a type of asset (the extensive margin) and on the household share of total financial assets allocated to safe and risky assets (the intensive margin). Financial assets include neither the value of physical assets, such as homes and automobiles, nor the value of one's human capital.[19] Financial assets that are neither risky nor safe, as defined above, include assets in IRAs, Keogh accounts, 401Ks, or similar defined contribution pension plans. We do not include these as safe assets because these accounts can include stock investments and other financial securities with risk profiles more volatile than stocks (e.g., real estate investment trusts or venture capital funds).

Table IV gives the asset variable statistics for the samples. These statistics indicate that over 36% of couples hold stocks but between 19% and 24% of singles do so. The majority of households hold cash or cash equivalent assets, although couples are more likely to hold these assets than singles. Because there are a small number of investors who have very high holdings (even after outliers are removed),[20] we report mean and median values of asset amounts.

Table V shows that during our sample period, 26–42% of households, depending on the household type, changed their stock or safe asset holdings over time.

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[19] It has been well documented that different pictures can develop if one uses financial assets, all physical assets (including homes and automobiles), or physical assets plus human capital (Heaton and Lucas, 2000). Consistent with Rosen and Wu (2004), we exclude the most illiquid assets: homes, automobiles, and human capital.

[20] Those with stock or asset values above two times the 99th percentile were dropped.

Table IV. Asset and wealth summary statistics (means and medians)

All dollar values are adjusted to 2008 US$ using an all-item Consumer Price Index for all urban consumers (CPI-U) from the Bureau of Labor Statistics. Note that the means of the shares do not sum to 100% because the means are taken from different samples, where the stockholder sample is much smaller than the cash account sample.

	Single-male households ($n = 5,859$)	Single-female households ($n = 18,190$)	Couple households ($n = 28,261$)
% Who own stock	0.236	0.197	0.363
% Who have cash or cash equivalent holdings	0.801	0.793	0.901
Means			
Stock value (if own any)	189,129	162,357	191,068
Share of financial assets devoted to stocks (if any)	0.447	0.477	0.356
Cash or cash equivalent value (if have any)	91,750	70,007	126,006
Share of financial assets devoted to cash (if any)	0.625	0.688	0.478
Medians			
Stock value (if own any)	68,385	56,988	69,417
Share of financial assets devoted to stocks (if any)	0.408	0.464	0.280
Cash or cash equivalent value (if have any)	14,361	7,256	23,936
Share of financial assets devoted to cash (if any)	0.789	1.000	0.366

Table V. Changes in asset holding variables (1998–2008)

	Single all (%)	Men if Δ (%)	Single all (%)	Women if Δ (%)	Couples	
					All (%)	If Δ (%)
Stock holdings						
Any change	31		27		42	
Asset status is variable	18	58	16	59	23	54
Asset status goes from 0 to 1 (invest)	4	14	3	12	6	15
Asset status goes from 1 to 0 (divest)	9	28	8	29	13	31
Asset status always 1	10		8		15	
Asset status always 0	59		66		42	
Safe holdings						
Any change	37		37		26	
Asset status is variable	23	63	24	65	15	59
Asset status goes from 0 to 1 (invest)	7	18	7	19	6	22
Asset status goes from 1 to 0 (divest)	7	19	6	16	5	19
Asset status always 1	58		56		72	
Asset status always 0	6		7		2	

Among the sample of individuals whose stock or safe asset holdings change across time, 12–22% begin holding stocks or safe assets, 16–31% held stocks or safe assets at the beginning of the period but did not at the end of the period, and 54–65% report a variable pattern of holding stocks and safe assets over time.

Figure 1 presents the unconditional correlations between the three interval measures of lagged mental health and risky and safe asset holding variables. From these graphs, we generally see a negative relationship between mental health issues and asset holding.[21] This relationship may be driven by a number of factors, such as increased medical expenses, as discussed above. Thus, we now turn to a discussion of our control variables.

3.4 CONTROL VARIABLES

Table VI provides summary statistics on the control variables we use in this analysis. The control variables include characteristics of the head and the household capturing demographic characteristics, socioeconomic status, financial sophistication, physical health, and medical expenses. The demographic variables include age dummy variables, race and ethnicity, the divorce status of the head, and the number of biological children.[22] The variables that capture socioeconomic status are education, whether currently employed, whether currently retired, total household financial assets, household net worth, and whether they own their own home. Household net worth includes financial assets, nonfinancial assets (including a primary residence), and retirement accounts.

The financial sophistication variables include whether the head or spouse has a voluntary contribution pension, whether the head has an occupation that can be classified as professional or managerial, whether the household has received any type of inheritance, whether the household received help managing money, and a lagged financial distress indicator. The voluntary contribution pension variable serves to control for aspects of a household head's occupation or training that could lead to increased stock market participation. The occupation dummy variable and the received inheritance dummy variable are variables previously shown to be significant in explaining the probability of holding stock in the US (see, e.g., Bertaut, 1998; Hong, Kubik, and Stein, 2004). The received help managing money dummy variable controls for influence that outside financial advice may have on household portfolio choice.

As a household member may have mental health issues because the household was in financial distress, we create a measure of financial distress to use as a control in the analysis. We calculate a lagged financial distress scale for each household by dividing the value of household consumer debt by household income. Household consumer debt includes credit card charges, student loans, medical or legal bills, or

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[21] We observe an uptick for the relationship between percent of safe asset held and cognitive limitation scores of 34 and 35 due to the small number of observations for these scores. There was one observation of a 35 cognitive limitation score and nine observations of a 34 cognitive limitation score.

[22] Because women outlive men on average, there are over three times as many single women as single men in this sample of older Americans, and couples tend to be younger on average.
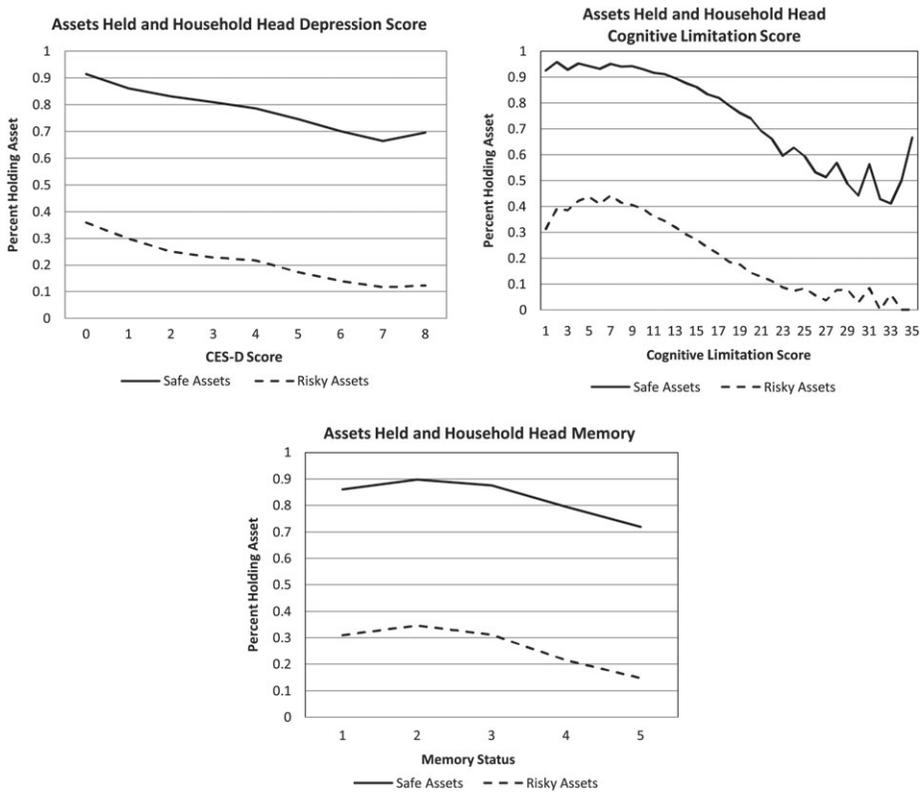
Figure 1. Mental health variables and asset holding.

loans from relatives but does not include any mortgage on a primary residence or vehicle loans. The scale goes from 0 to 1, where 1 is distressed. This financial distress variable is lagged one interview wave to control for individuals who could have held risky assets in the past and incurred losses that both precipitated a mental health issue and prompted them to switch to safer holdings.

Finally, we control for physical health, out-of-pocket medical expenses, and receipt of Medicare if under age 65. Physical health controls are included because physical and mental health are highly correlated (Vaillant, 1979), and we want to isolate the effect of mental health. To control for physical health, we use three measures of physical health: (1) head had 3+ chronic conditions at the last wave, which indicates if a doctor has ever told the head that he/she has three or more of the following six chronic conditions—high blood pressure, diabetes, cancer (excluding skin), lung disease, heart condition, or arthritis; (2) head was often troubled with pain at the last wave; and (3) head had 4+ activities of daily living limitations at the last wave, which indicates that the head reported that he/she had difficulty doing four

Table VI. Control variable statistics

All dollar values are adjusted to 2008 US$ using an all-item Consumer Price Index for all urban consumers (CPI-U) from the Bureau of Labor Statistics.

	Single male (n = 5,859)	Single female (n = 18,190)	Couple (n = 28,261)
Demographics			
Age ≤ 64	0.353	0.277	0.414
Age ≤ 85	0.118	0.146	0.035
African-American (%)	0.196	0.227	0.098
Hispanic (%)	0.073	0.084	0.083
Other race (%)	0.021	0.022	0.020
Head ever divorced (%)	0.470	0.353	0.050
Number of children	2.2	3.0	2.9
Socioeconomic status			
Years of education of head	12.0	11.8	12.6
Head currently working (%)	0.282	0.230	0.362
Head is retired (%)	0.572	0.488	0.421
Household total financial assets value ($)	180,145	109,309	323,677
Household net worth (including main home equity) ($)	291,000	206,017	533,097
Own home (%)	0.602	0.614	0.898
Financial sophistication			
Voluntary contribution pension (%)	0.751	0.762	0.902
Manager or professional occupation (%)	0.287	0.267	0.445
Received inheritance (%)	0.041	0.038	0.066
Receives help managing money	0.048	0.064	0.021
Financial distress scale last wave (range 0–1)	0.071	0.075	0.059
Physical health			
Head had 3+ chronic conditions last wave (%)	0.261	0.311	0.199
Head was often troubled with pain last wave (%)	0.272	0.340	0.280
Head had 4+ activities of daily living limitations last wave (%)	0.222	0.351	0.176
Total medical expenditures ($)	1,574	1,638	1,782
Household receives Medicare and aged <65 (%)	0.052	0.043	0.033

or more of the following nine activities of daily living due to a health problem—walking several blocks; sitting for 2 hours; getting up from a chair after sitting for long periods; climbing several flights of stairs without resting; stooping, kneeling, or crouching; reaching or extending your arm above shoulder level; pulling or pushing large objects like a living room chair; lifting or carrying weights above 10 pounds, like a heavy bag of groceries; or picking up a dime from a table. Medical expenses are included so that we do not capture an effect of mental health on financial decisions through the channel of its effect on disposable income. We control for Medicare receipt because a large fraction of those who receive mental health services are covered by Medicare (Frank and Glied, 2006). This variable may help us control for differences in the effect of mental health across the treated and the untreated.

The HRS does ask questions about discount rates and risk aversion for individuals. However, the discount rate questions are not asked during each wave and are a part of supplementary modules asked of fewer than 1,000 people in 2004 and 2008. The risk aversion questions are asked in each wave, but the questions are not asked of every person in each wave. Thus, we cannot include discount rates or risk aversion in our primary analysis.[23,24]

4. Empirical Strategy

Our data allow us to develop two main testable implications. We have information to control for mental health–created budget constraint effects on financial decisions. Hence, we can use our specific mental health variables to analyze the relationship between mental health and financial decisions through mental health effects on an individual's utility function and through mental health effects on individual optimization ability. We speculate that the mental health diagnosis and depression variables could influence financial decisions through either of these channels and that the cognitive limitations and self-rated memory status variables are more likely to influence financial decisions through the optimization ability channel.

The goal of our empirical analysis is two-fold: (1) to ascertain whether various mental health issues exert an independent effect on the probability that a household holds a particular type of asset ("risky" or "safer" assets) and (2) to determine how mental health issues affect the household share of total financial assets allocated to "risky" and "safer" assets.

4.1 OWNERSHIP PROBABILITIES

To examine the effect of mental health on the probability of holding a particular type of asset (the extensive margin), we use the following specification as our baseline model:

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[23] While we cannot use the discount rate questions, we can investigate whether expectations about longevity are affected by mental health and whether these expectations affect their investment decisions. We find that depression (measured by the CES-D) and self-rated memory status significantly reduce an individual's expectations that they will live until an age that is at least 10 years in the future. A psychological diagnosis and cognitive limitations have no significant effect on life span expectations. However, we find that controlling for expectations of longevity does not change the effects of these mental health measures on portfolio choice.

[24] While we cannot conduct regression analysis with the risk aversion variables, we can examine the unconditional correlation between risk aversion and mental health conditions. We find that single men and husbands with almost any mental or cognitive problems are less risk averse than their mentally healthy counterparts. In contrast, we find that the mental health of single women and wives are not correlated with risk aversion.

$$A_{it} = MH_{it-1}\alpha + X_{it}\beta + \varepsilon_{it}^{\text{own}}. \tag{1}$$

The dependent variable, A_{it}, represents holding a particular type of asset for household i in interview year t. MH_{it-1} represents one of our four measures of lagged mental health problems.[25] We perform separate regressions for each subsample. For single-headed households, MH_{it-1} represents the mental health of the head only; for couple households, it is a vector of two variables—one for the head and one for the spouse. We do not run separate regressions for the two partners because there is some evidence that mental health outcomes are correlated between spouses (Fletcher, 2009). X_{it} is a vector of characteristics of the head and the household listed in Table VI capturing demographic characteristics, socioeconomic status, financial sophistication, physical health, and medical expenses.[26,27,28]

We apply the logit model to Equation (1) using the pooled HRS data.[29] The standard errors in all regressions are adjusted for intracluster correlations at the household level. We also estimate Equation (1) using a conditional fixed-effects logit model in order to difference out time-invariant sources of individual heterogeneity. We argue that the coefficients estimated using the fixed-effects logit model could be more likely to capture the causal relationship from mental illness to financial choices because unobservable time-invariant characteristics are held constant (see also Love and Smith, 2010). In the fixed-effects logit model, identification hinges on changes in mental health status or severity causing changes in asset holdings.[30]

For the causality reasons stated above, we contend that the conditional fixed-effects model is the more appropriate specification. Nonetheless, if a mental health issue surfaced prior to the beginning of our sample period, this could influence

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[25] We do not include quadratic terms because additional analyses not shown revealed that there were very few nonlinear effects of the mental health measures. Nonlinearities may have occurred if individuals with severe symptoms sought treatment that reduced the effect of their mental health on financial decisions. Since we do not observe nonlinear effects, we argue that treatment is not playing an important role in this relationship.

[26] Four of the control variables are lagged one interview wave, as indicated in Table VI, but for simplicity we include them in X_{it}.

[27] We specify this model with and without using total financial assets as a control variable and obtain similar results in both specifications. The extensive margin results presented in Tables VII–X do include total financial assets as a control and hence are the more conservative estimates of the effects of mental health. Furthermore, our mental health estimates are downward biased since we utilize household wealth as a control variable and we know that poor mental health is negatively related to wealth.

[28] For the couples subsample, we have a version in which we control for the household member who responded to the financial questions in the survey and find no significant changes in the effects of the mental health measures.

[29] We utilize logit models instead of probit models to facilitate comparisons across specifications.

[30] Since the fixed-effects model using panel data is susceptible to the "errors-in-variables" problem identified by Griliches and Hausman (1986), we also perform a long differences analysis and find consistent results.

portfolio choice throughout the entire period and would not be captured in a fixed-effects model. Also, if the respondent receives a diagnosis long after the onset of the illness and we observe the diagnosis but not the true onset, the fixed-effects results will underestimate the effect of mental illness. Consequently, while we assert that our preferred specification includes fixed effects, we present the results with and without fixed effects.

4.2 PORTFOLIO SHARES

To examine the effect of mental health on the share of total household financial assets allocated to a particular type of asset (intensive margin), we use the following baseline specification:

$$S_{it} = MH_{it-1}\gamma + X_{it}\eta + \varepsilon_{it}^{share}. \tag{2}$$

The dependent variable, S_{it}, represents the share of total financial assets invested in a particular type of asset for household i in interview year t. The right-hand-side variables are the same as those in Equation (1). We apply a tobit model to Equation (2). The standard errors are adjusted for intracluster correlations at the household level. As discussed above, because there may be unobserved characteristics that are correlated with mental health and financial choices, our preferred specification adds fixed effects to the baseline specification given in Equation (2). However, we also present these results without fixed effects.[31]

5. Results

The results of the identified mental health issues on portfolio choice are presented in Tables VII–X. In each of the tables, there are four panels reporting the results of each mental health issue on the extensive and intensive margin of risky and safe asset holding. Tables VII and VIII analyze how mental health affects portfolio choice through an individual's utility function or optimization ability. Tables IX and X analyze how mental health affects portfolio choice primarily through an individual's optimization ability. The first column for each household type is the model without fixed effects and the second column includes the fixed effects.

Consistent with Fan and Zhao (2009) and Love and Smith (2010) who study the relationship between physical health status and portfolio choice, we see that some of the relationships between the mental health variables and portfolio choices disappear once we account for unobserved heterogeneity with fixed-effects models.

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[31] We utilize the censored fixed-effects specification developed by Honorè (1992).

However, the relationships may also vanish if mental health symptoms surfaced prior to the beginning of our sample period but the report of illness or problems occurs during our observation period. The fixed effect will have absorbed all the effects on portfolio choice of the onset of mental illness because it occurred before our observation window. Given this possibility, both the fixed-effects and the non–fixed-effects models provide useful information.[32]

5.1 MENTAL HEALTH DIAGNOSIS

In Table VII, we find that single women with a mental health diagnosis hold more safe assets and hold a greater share of their portfolios in safe assets. Notably, these results are significant in both the fixed-effects and the non–fixed-effects models. Also, mental diagnoses among wives are associated with a higher share of safe assets in the household, although this result is not significant in the fixed-effects model.

5.2 DEPRESSION

In Table VIII, we find that single men with high CES-D scores are less likely to hold risky assets and tend to have smaller shares of their portfolios in risky instruments. Correspondingly, single men with depression tend to have a larger share of their assets in safe investments. These results are highly significant in the fixed-effects models.

For the specifications without the fixed effects, we see that single women with high CES-D scores are less likely to hold both risky and safe assets. Single women with depression also have a smaller share of their portfolios in safe instruments. Wives with high CES-D scores in couple households negatively affect the probability of the couple holding risky assets and influence the couple to hold a smaller share of their portfolios in risky assets. On the other hand, men in couple households with high CES-D scores negatively influence the probability that the couple will hold safe assets.

Thus, the fixed-effects results from the mental health issues that influence mood suggest that poor mental health causes single-headed households to reduce risk in their household portfolio. Single women with a mental health diagnosis are more likely to hold safe assets and to have a larger share of their portfolio devoted to safe assets. Single men with high depression symptoms are less likely to hold stocks and have a smaller share of their portfolio in stocks and a greater share of their portfolio

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[32] Note that the sample size is reduced for the conditional fixed-effects logit models; this is because the observations that do not change asset holdings over the six interview waves do not contribute information and thus are dropped from the conditional model.

in safe assets. There are no significant fixed-effects results for couples in Table VII or VIII. Hence, holding constant mental health–created budget constraint effects on financial decisions, it appears that mental health problems affect an individual's utility function or individual optimization ability such that risk is avoided. The next two mental health measures allow us to test this further.

5.3 COGNITIVE LIMITATIONS

In Table IX, we find in the logit models that cognitive limitations significantly reduce the probability of holding risky assets for single men and for couples in which either the husband or the wife has cognitive limitations. Additionally, in the tobit models we find that single men and both husbands and wives with cognitive limitations significantly reduce risky shares. The marginal effects are generally larger in magnitude for the higher cognitive limitation categories. These findings are consistent with Christelis, Jappelli, and Padula (2010) who use data on older Europeans to find that cognitive limitations reduce stockholding. However, when we include fixed effects [which Christelis, Jappelli, and Padula (2010) cannot do because they only have cross-sectional data], most of the results, but not all, are no longer significant. In particular, single men and husbands with cognitive limitations still appear to reduce stockholding in the fixed-effects specifications.

Table IX also shows that cognitive limitations reduce the probability of holding safe assets for single men whether or not fixed effects are taken into account. Single women and wives in couple households also have a reduced probability of holding safe assets. However, when fixed effects are included, these effects disappear. Single women, husbands, and wives with cognitive limitations increase the share of their portfolio devoted to safe assets, but these results mostly disappear when fixed effects are included in the model.

Thus, it appears that single men with cognitive limitations reduce investment in both risky and safe assets, implying a relative increase in their holdings in retirement accounts or pension plans, which often require little input from the account holder after established. There is also some evidence in the fixed-effects models that husbands with cognitive limitations reduce their risky assets and increase the share of safe assets in their portfolios. There is little evidence supporting an effect of cognitive limitations in women in the fixed-effects models.

5.4 MEMORY ISSUES

In Table X, when fixed effects are not included, we find that single men, single women, and wives with memory issues reduce both their stock holdings and the share of risky assets in their portfolios. In the fixed-effects models, single women with

good self-rated memory are less likely to hold stocks and single women with fair self-rated memory have a significantly reduced share of risky assets. In contrast, husbands with a good self-rated memory in couple households increase the probability of holding risky assets in models with and without fixed effects. Finally, in the fixed-effects models, single men with memory issues are less likely to hold safe assets and hold a significantly smaller share of their assets in safe holdings. Overall, the marginal effects are larger (more negative) as the memory status is rated more poorly.

In sum, the mental health measures that capture whether an individual's optimization ability is compromised suggests that portfolio risk is reduced in these households. Single men and husbands with cognitive limitations and single women with memory complaints are less likely to hold stocks. However, we also observe among single men with these types of mental health problems a move away from both risky and safe assets toward retirement accounts that are less information intensive.

5.5 DISCUSSION

Tables VII–X present compelling evidence that various mental health issues do have a significant effect on the portfolio choice decisions of households. Consistent with other empirical literature (Jianakoplos and Bernasek, 1998; Browning, 2000; Barber and Odean, 2001; Lundberg, Startz, and Stillman, 2003; Kirchler, Hoelzl, and Kamleitner, 2008; Croson and Gneezy, 2009; Bradford, 2010; Love, 2010), we find evidence that single men, single women, and couple households respond differently to mental health issues. Overall, the magnitude of the mental health effects for single men is much larger than for the other two subgroups studied. As predicted, we also find that overall the effect of mental illness in couples is muted compared to single-headed households. As in Lundberg, Startz, and Stillman (2003) and Kirchler, Hoelzl, and Kamleitner (2008), we argue that this occurs because singles are lone decision-makers in the household.

The magnitude of the marginal effects that we find is economically significant. Depression can reduce the probability of holding risky assets between 3% and 19%. Cognitive limitations can reduce the probability of holding risky assets between 2% and 18%, and memory complaints can reduce risky asset holding between 1% and 5%. Moreover, as Smith (1999) found with physical health, we find in our data that the onset of a psychological diagnosis results in an average (unconditional) decline in wealth of $28,593, but medical expenses only increase by $682 and earnings only fall by $3,448 on average. The explanation for this fall in wealth is unlikely to be due to an increase in consumption, as Smith hypothesizes, because Dahal and Fertig (2010) find a reduction in household spending among individuals with mental illness. The reduction in financial risk taking that we document may explain part of this fall in wealth.

Table VII. Effect of mental health (MH) diagnosis on portfolio choice

Marginal effects reported. In the fixed-effects (FE) specifications, marginal effects are evaluated at zero and assume that the FE is zero. Regressions include the controls listed in Table VI plus interview wave dummy variables and missing indicators for five control variables. Robust standard errors in parentheses. *Significant at the 10% level. **Significant at the 5% level. ***Significant at the 1% level.

	Single men		Single women		Couples	
	No FE	FE	No FE	FE	No FE	FE
Own risky assets (logit)						
MH diagnosis	−0.003	0.123	−0.003	−0.063	−0.008	0.013
	(0.013)	(0.086)	(0.003)	(0.048)	(0.012)	(0.032)
Wife has MH diagnosis					−0.011	−0.056
					(0.012)	(0.034)
Person-years	5,810	1,398	17,994	3,849	26,184	9,671
Individuals	2,030	341	5,276	893	7,390	2,109
Share of assets that are risky (tobit)						
MH diagnosis	0.018	0.095	−0.027	0.014	0.000	0.022
	(0.055)	(0.093)	(0.028)	(0.037)	(0.017)	(0.024)
Wife has MH diagnosis					−0.017	−0.027
					(0.016)	(0.026)
Person-years	5,773	5,773	17,924	17,924	25,997	25,997
Individuals	2,025	2,025	5,273	5,273	7,374	7,374
Own safe assets (logit)						
MH diagnosis	−0.013	0.036	0.008**	0.082*	−0.003	−0.021
	(0.009)	(0.093)	(0.003)	(0.049)	(0.003)	(0.043)
Wife has MH diagnosis					−0.001	−0.052
					(0.000)	(0.045)
Person-years	5,810	1,680	17,994	5,615	26,184	5,179
Individuals	2,030	432	5,276	1,325	7,390	1,196
Share of assets that are safe (tobit)						
MH diagnosis	−0.024	−0.043	0.043***	0.033*	−0.002	−0.014
	(0.028)	(0.044)	(0.015)	(0.020)	(0.012)	(0.019)
Wife has MH diagnosis					0.029**	0.014
					(0.012)	(0.017)
Person-years	5,373	5,373	16,327	16,327	24,333	24,333
Individuals	1,960	1,960	5,134	5,134	7,226	7,226

Table VIII. Effect of depression on portfolio choice

Marginal effects reported. In the fixed-effects (FE) specifications, marginal effects are evaluated at zero and assume that the FE is zero. Regressions include the controls listed in Table VI plus interview wave dummy variables and missing indicators for five control variables. Robust standard errors in parentheses. *Significant at the 10% level. **Significant at the 5% level. ***Significant at the 1% level.

	Single men		Single women		Couples	
	No FE	FE	No FE	FE	No FE	FE
Own risky assets (logit)						
CES-D score >5	−0.018	−0.187**	−0.007**	0.031	−0.010	−0.035
	(0.013)	(0.085)	(0.004)	(0.055)	(0.021)	(0.046)
Wife's CES-D score >5					−0.033*	−0.047
					(0.019)	(0.048)
Person-years	5,650	1,359	17,527	3,751	22,917	8,441
Individuals	1,994	333	5,178	870	6,728	1,859
Share of assets that are risky (tobit)						
CES-D score >5	−0.084	−0.194**	−0.051	0.009	0.014	0.020
	(0.064)	(0.094)	(0.039)	(0.040)	(0.031)	(0.035)
Wife's CES-D score >5					−0.058**	−0.014
					(0.029)	(0.042)
Person-years	5,614	5,614	17,457	17,457	22,759	22,759
Individuals	1,990	1,990	5,175	5,175	6,713	6,713
Own safe assets (logit)						
CES-D score >5	−0.016	0.051	−0.009*	0.025	−0.009**	−0.016
	(0.011)	(0.072)	(0.004)	(0.039)	(0.004)	(0.043)
Wife's CES-D score >5					−0.004	0.005
					(0.004)	(0.049)
Person-years	5,650	1,618	17,527	5,426	22,917	4,167
Individuals	1,994	418	5,178	1,279	6,728	979
Share of assets that are safe (tobit)						
CES-D score >5	0.004	0.105***	−0.045**	0.014	−0.033	0.025
	(0.032)	(0.038)	(0.019)	(0.019)	(0.020)	(0.025)
Wife's CES-D score >5					0.022	0.032
					(0.021)	(0.026)
Person-years	5,223	5,223	15,886	15,886	21,333	21,333
Individuals	1,921	1,921	5,038	5,038	6,562	6,562

Table IX. Effect of cognitive limitation on portfolio choice

The omitted cognitive limitation category is "Cognitive limitation score <9". Marginal effects reported. In the fixed-effects (FE) specifications, marginal effects are evaluated at zero and assume that the FE is zero. Regressions include the controls listed in Table VI plus interview wave dummy variables and missing indicators for five control variables. Robust standard errors in parentheses. *Significant at the 10% level. **Significant at the 5% level. ***Significant at the 1% level.

	Single men		Single women		Couples	
	No FE	FE	No FE	FE	No FE	FE
Own risky assets (logit)						
Cognitive limitation score 9–14	−0.020*	−0.106	0.000	0.037	−0.005	−0.028
	(0.011)	(0.077)	(0.002)	(0.036)	(0.011)	(0.032)
Cognitive limitation score 15–20	−0.025**	−0.176**	−0.005	0.084*	−0.030**	−0.001
	(0.013)	(0.085)	(0.003)	(0.049)	(0.015)	(0.044)
Cognitive limitation score 21–34	−0.038**	−0.125	−0.007	0.083	−0.083***	−0.145*
	(0.015)	(0.147)	(0.004)	(0.089)	(0.026)	(0.081)
Wife's cognitive limitation score 9–14					−0.032***	−0.044
					(0.011)	(0.030)
Wife's cognitive limitation score 15–20					−0.061***	−0.011
					(0.014)	(0.044)
Wife's cognitive limitation score 21–34					−0.081***	0.011
					(0.025)	(0.095)
Person-years	3,986	795	13,449	2,485	12,124	3,043
Individuals	1,815	216	5,009	628	5,862	798
Share of assets that are risky (tobit)						
Cognitive limitation score 9–14	−0.091**	−0.020	0.003	−0.003	0.002	−0.035**
	(0.042)	(0.042)	(0.023)	(0.023)	(0.013)	(0.016)
Cognitive limitation score 15–20	−0.099*	−0.030	−0.024	0.009	−0.029	−0.026
	(0.051)	(0.059)	(0.032)	(0.033)	(0.019)	(0.025)
Cognitive limitation score 21–34	−0.116	0.087	−0.064	0.038	−0.088**	−0.050
	(0.087)	(0.097)	(0.055)	(0.071)	(0.042)	(0.063)
Wife's cognitive limitation score 9–14					−0.011	0.004
					(0.013)	(0.014)
Wife's cognitive limitation score 15–20					−0.051**	0.028
					(0.020)	(0.025)

Continued

Table IX. Continued

	Single men		Single women		Couples	
	No FE	FE	No FE	FE	No FE	FE
Wife's cognitive limitation score 21–34					−0.105**	−0.030
					(0.041)	(0.054)
Person-years	3,959	3,959	13,409	13,409	12,041	12,041
Individuals	1,805	1,805	5,000	5,000	5,826	5,826
Own safe assets (logit)						
Cognitive limitation score 9–14	−0.035**	−0.237**	−0.018***	−0.023	−0.003	−0.077
	(0.015)	(0.107)	(0.006)	(0.051)	(0.004)	(0.062)
Cognitive limitation score 15–20	−0.059***	−0.182	−0.031***	0.011	−0.001	−0.036
	(0.020)	(0.130)	(0.008)	(0.061)	(0.005)	(0.077)
Cognitive limitation score 21–34	−0.115***	−0.281**	−0.040***	0.007	−0.009	−0.152
	(0.037)	(0.122)	(0.011)	(0.077)	(0.007)	(0.093)
Wife's cognitive limitation score 9–14					−0.006	−0.073
					(0.004)	(0.059)
Wife's cognitive limitation score 15–20					−0.011**	−0.095
					(0.006)	(0.070)
Wife's cognitive limitation score 21–34					−0.021**	−0.064
					(0.009)	(0.110)
Person-years	3,986	947	13,449	3,432	12,124	1,452
Individuals	1,805	258	5,000	883	5,826	393
Share of assets that are safe (tobit)						
Cognitive limitation score 9–14	0.002	−0.002	0.029**	−0.015	0.010	0.009
	(0.030)	(0.034)	(0.014)	(0.014)	(0.010)	(0.014)
Cognitive limitation score 15–20	0.022	0.040	0.056***	0.001	0.028**	0.039*
	(0.033)	(0.038)	(0.017)	(0.018)	(0.014)	(0.020)
Cognitive limitation score 21–34	−0.099**	0.054	0.035	0.011	−0.019	0.042
	(0.047)	(0.059)	(0.025)	(0.027)	(0.027)	(0.038)
Wife's cognitive limitation score 9–14					0.011	−0.007
					(0.009)	(0.014)
Wife's cognitive limitation score 15–20					0.026*	−0.002
					(0.014)	(0.020)
Wife's cognitive limitation score 21–34					−0.013	0.048
					(0.028)	(0.039)
Person-years	3,725	3,725	12,407	12,407	11,456	11,456
Individuals	1,710	1,710	4,754	4,754	5,554	5,554

Table X. Effect of memory status on portfolio choice

The omitted memory status is ''Excellent and very good''. Marginal effects reported. In the fixed-effects (FE) specifications, marginal effects are evaluated at zero and assume that the FE is zero. Regressions include the controls listed in Table VI plus interview wave dummy variables and missing indicators for five control variables. Robust standard errors in parentheses. *Significant at the 10% level. **Significant at the 5% level. ***Significant at the 1% level.

	Single men		Single women		Couples	
	No FE	FE	No FE	FE	No FE	FE
Own risky assets (logit)						
Self-rated memory status good	−0.005	−0.009	−0.004*	−0.050*	0.016**	0.031*
	(0.008)	(0.046)	(0.002)	(0.028)	(0.008)	(0.018)
Self-rated memory status fair	−0.015*	−0.042	−0.006**	−0.062	−0.008	−0.010
	(0.009)	(0.063)	(0.003)	(0.041)	(0.011)	(0.026)
Self-rated memory status poor	−0.034**	−0.134	−0.003	−0.033	−0.022	0.036
	(0.013)	(0.124)	(0.005)	(0.078)	(0.020)	(0.051)
Wife's self-rated memory status good					−0.003	−0.026
					(0.008)	(0.018)
Wife's self-rated memory status fair					−0.009	−0.040
					(0.011)	(0.026)
Wife's self-rated memory status poor					−0.040**	−0.054
					(0.020)	(0.052)
Person-years	5,693	1,377	17,627	3,773	23,046	8,506
Individuals	1,996	336	5,185	872	6,735	1,867
Share of assets that are risky (tobit)						
Self-rated memory status good	−0.038	0.007	−0.031	−0.022	0.024**	0.014
	(0.031)	(0.033)	(0.020)	(0.022)	(0.010)	(0.011)
Self-rated memory status fair	−0.062	0.024	−0.048*	−0.058*	−0.006	0.011
	(0.042)	(0.044)	(0.028)	(0.034)	(0.015)	(0.017)
Self-rated memory status poor	−0.180**	−0.062	−0.022	−0.051	−0.033	0.062
	(0.083)	(0.109)	(0.056)	(0.074)	(0.029)	(0.044)
Wife's self-rated memory status good					−0.004	−0.002
					(0.010)	(0.011)

Continued

Table X. Continued

	Single men		Single women		Couples	
	No FE	FE	No FE	FE	No FE	FE
Wife's self-rated memory status fair					−0.013 (0.015)	−0.015 (0.017)
Wife's self-rated memory status poor					−0.054* (0.032)	−0.023 (0.040)
Person-years	5,657	5,657	17,557	17,557	22,885	22,885
Individuals	1,992	1,992	5,182	5,182	6,721	6,721
Own safe assets (logit)						
Self-rated memory status good	−0.008 (0.008)	−0.119** (0.056)	−0.001 (0.003)	0.001 (0.033)	−0.001 (0.002)	0.049 (0.030)
Self-rated memory status fair	−0.018* (0.009)	−0.125* (0.067)	−0.006 (0.004)	0.008 (0.039)	−0.001 (0.003)	0.057 (0.036)
Self-rated memory status poor	−0.010 (0.012)	−0.147 (0.098)	−0.007 (0.006)	−0.052 (0.059)	−0.006 (0.005)	0.048 (0.053)
Wife's self-rated memory status good					−0.001 (0.002)	0.012 (0.030)
Wife's self-rated memory status fair					−0.004 (0.003)	−0.027 (0.036)
Wife's self-rated memory status poor					−0.006 (0.005)	0.029 (0.057)
Person-years	5,693	1,636	17,627	5,467	23,046	4,225
Individuals	1,996	421	5,185	1,284	6,735	988
Share of assets that are safe (tobit)						
Self-rated memory status good	0.009 (0.019)	−0.045** (0.020)	0.017 (0.012)	0.000 (0.011)	−0.010 (0.008)	−0.004 (0.010)
Self-rated memory status fair	−0.003 (0.024)	−0.064** (0.026)	0.007 (0.015)	0.004 (0.015)	0.005 (0.010)	0.003 (0.013)
Self-rated memory status poor	0.033 (0.038)	−0.096** (0.042)	−0.019 (0.027)	−0.000 (0.026)	−0.017 (0.020)	0.015 (0.025)
Wife's self-rated memory status good					0.007 (0.007)	0.004 (0.009)
Wife's self-rated memory status fair					0.015 (0.010)	−0.008 (0.013)
Wife's self-rated memory status poor					−0.008 (0.022)	−0.005 (0.027)
Person-years	5,264	5,264	15,983	15,983	21,448	21,448
Individuals	1,922	1,922	5,044	5,044	6,572	6,572

6. Concluding Remarks

Given the fact that close to 30% of the US population experiences at least one mental or substance abuse disorder each year, the question of how mental health problems affect household financial decisions is a key issue. This paper investigates whether differences in mental health status can help to explain differences in household portfolio composition, which can result in systematic differences in economic status. Specifically, we analyze the effect of cognitive limitations, memory complaints, depression, and psychiatric diagnoses (such as depression, anxiety, phobias, alcoholism, drug addiction, or obsessive compulsive disorder) on the probability of owning different types of financial assets and the share of financial wealth held in each asset category.

Our results indicate that mental health, like physical health, does have a significant influence on investment decision making. In particular, our overall findings suggest that mental illness is associated with a reduction in financial risk taking (with a corresponding reduction in expected returns). The results are not inconsistent with the theory that mental health problems affect financial decisions by changing an individual's optimization ability. Cognitive limitations and memory complaints appear to increase the holdings of retirement accounts or pension plans, which tend to be less information intensive, especially among single men. It may also be that mental health problems reduce financial risk taking by changing an individual's utility function, although we cannot identify this effect separately with these data. Our findings further suggest that various mental health issues affect males, females, and couples differently. Single women diagnosed with a psychological disorder significantly increase their share of financial assets devoted to safe investments and have an increased probability of holding safe assets. We also find that cognitive functioning issues have a particularly strong effect on the portfolio choice decisions of single men.[33]

As the US population ages, the increasing ratio of retirees to workers continues to strain the ability of the social security system to provide adequate pensions and magnifies the need for households to exploit wealth accumulation opportunities (Christelis, Georgarakos, and Haliassos, 2011). Correspondingly, stocks serve an increasingly important role in household portfolios due to their wealth creation potential over longer investment horizons. If mental health issues hinder households that must make active portfolio choices in lieu of depending on a pension, this could worsen these households' long-term economic status, thereby contributing to the gradient between health and economic status.

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[33] Whereas previous literature has shown men and women to have different basic levels of risk aversion and different discount rates, it is not surprising that mental health would affect these distinct male and female utility functions and generate different effects on portfolio choice.

The effect of mental illness to increase holdings in retirement or pension accounts also has important implications when one considers the impact of setting default options for employer-defined contribution plans (see, e.g., Thaler and Benartzi, 2004). Consequently, better understanding the link between mental health and investment decisions could facilitate the appropriate application of default options in employer-sponsored retirement plans or inform policy interventions that may improve the economic sufficiency of the large fraction of the US population that suffers from mental illness. Furthermore, examining how the effect of mental health issues on financial decision making differs by gender poses some interesting behavioral finance questions and is a rich area for future research.

Appendix A:

DESCRIPTION OF VARIABLES USED IN ANALYSIS

A.1 MENTAL HEALTH VARIABLES

- Mental health diagnosis dummy variable (lagged one wave)—A dummy variable that is given a value of 1 if the individual self-reports having ever been told by a doctor that he/she has or had any emotional, nervous, or psychiatric problems and is set to 0 otherwise.
- CES-D dummy variable (lagged one wave)—A dummy variable that is given a value of 1 if there are more than five positive responses given to eight questions about feelings experienced for much of the time during the past week: (1) depressed, (2) everything was an effort, (3) sleep was restless, (4) happy (reverse coded), (5) lonely, (6) enjoyed life (reverse coded), (7) felt sad, and (8) could not get going. This variable is set to 0 otherwise.
- Cognitive limitation score dummy variables (lagged one wave)—The cognitive limitation score is a variable based on a series of cognitive tasks the respondent is asked to complete. The tasks include 10 immediate recall words (listen to 10 nouns and immediately say all that you can remember), 10 delayed recall words (say all the 10 nouns you can remember 5 min later), serial 7s (subtract 7 from 100, then subtract 7 from the subsequent number, for a total of five trials), name two objects (What do you use to cut paper? What do you call a kind of prickly plant that grows in the desert?), name the current President and Vice President, name the date (month, day, year, and day of the week), and count backward from 20 to 10 (2 points if correct on the first try, 1 point if correct on the second try). The cognitive limitation score takes a value between 0 and 35 and is reverse coded such that a higher value implies more cognitive limitations. From this score, three dummy variables are created: a dummy variable for a cognitive limitation score between 9 and 14, a dummy variable for

a cognitive limitation score between 15 and 20, and a dummy variable for a cognitive limitation score greater than or equal to 21. The omitted category is a cognitive limitation score of less than 9.

- Self-rated memory status dummy variables (lagged one wave)—Respondents are asked to rate their memory at the present time. We create three dummy variables for self-rated memory status: good self-rated memory status, fair self-rated memory status, and poor self-rated memory status. The omitted category is excellent or very good self-rated memory status.

A.2 ASSET AND WEALTH VARIABLES

- Own stock dummy variable—A dummy variable that is given a value of 1 if the household owns stock in a given year and is set to 0 otherwise. Stock ownership includes owning shares of stock in publicly held corporations, mutual funds, or investment trusts. It does not include assets in IRAs, Keogh accounts, 401Ks, or similar defined contribution pension plans.
- Share of financial assets devoted to stocks—The value of stock holdings divided by the value of total financial assets. Total financial assets include the combined value of stock holdings, savings accounts, checking accounts, government bonds, T-bills, cash in a life insurance policy, a valuable collection, bond funds, rights in a trust or estate, holdings in a farm or business, real estate other than the main home, and assets in IRAs, Keogh accounts, 401Ks, or similar defined contribution pension plans, net of the value of debt from credit card charges, student loans, medical or legal bills, or loans to relatives. It does not include main home equity or the net value of vehicles. (All dollar values are adjusted to 2008 US\$ using an all-item Consumer Price Index for all urban consumers (CPI-U) from the Bureau of Labor Statistics.)
- Cash or cash equivalent dummy variable—A dummy variable that is given a value of 1 if the household has savings accounts, checking, CDs, money market accounts, government bonds, T-bills, a valuable collection, bond funds, rights in a trust or estate, etc., and is set to 0 otherwise. It does not include assets in IRAs, Keogh accounts, 401Ks, or similar defined contribution pension plans.
- Share of financial assets devoted to cash or cash equivalents—The combined value of savings accounts, checking accounts, government bonds, T-bills, a valuable collection, bond funds, rights in a trust or estate, etc., divided by the value of total financial assets. Total financial assets include the combined value of stock holdings, savings accounts, checking accounts, government bonds, T-bills, cash in a life insurance policy, a valuable collection, bond funds, rights in a trust or estate, holdings in a farm or business, real estate other than the main home, and assets in IRAs, Keogh accounts, 401Ks, or similar

defined contribution pension plans, net of the value of debt from credit card charges, student loans, medical or legal bills, or loans to relatives. It does not include main home equity or the net value of vehicles. (All dollar values are adjusted to 2008 US$ using an all-item CPI-U from the Bureau of Labor Statistics.)

A.3 DEMOGRAPHIC CHARACTERISTIC VARIABLES

- Household head age dummy variables—Two dummy variables: one dummy variable that is given a value of 1 if the individual is less than 65 years of age and is set to 0 otherwise and another dummy variable that is given a value of 1 if the individual is older than 84 years of age and is set to 0 otherwise.
- African-American dummy variable—A dummy variable that is given a value of 1 if the household head is African-American and is set to 0 otherwise.
- Hispanic dummy variable—A dummy variable that is given a value of 1 if the household head is Hispanic and is set to 0 otherwise.
- Other race dummy variable—A dummy variable that is given a value of 1 if the household head is not Caucasian, Hispanic, or African-American and is set to 0 otherwise.
- Ever divorced variable—A dummy variable that is given a value of 1 if the household head reports himself or herself as divorced anytime between 2000 and the current interview wave and is set to 0 otherwise.
- Number of children ever variable—A variable indicating the number of children fathered or given birth to ever.

A.4 SOCIOECONOMIC STATUS VARIABLES

- Years of education of household head—The years of education of the head of the household.
- Head current working variable—A dummy variable that is given a value of 1 if the household head is working at the time of the interview and is set to 0 otherwise.
- Head is retired variable—A dummy variable that is given a value of 1 if the household head is retired at the time of the interview and is set to 0 otherwise.
- Log of total financial assets—The natural logarithm of the combined value of stock holdings, savings accounts, checking accounts, government bonds, T-bills, cash in a life insurance policy, a valuable collection, bond funds, rights in a trust or estate, holdings in a farm or business, real estate other than the main home, and assets in IRAs, Keogh accounts, 401Ks, or similar defined contribution pension plans, net of the value of debt from credit card charges, student loans, medical or legal bills, or loans to relatives. It does not include main home equity or the net value of vehicles. (All dollar values are adjusted to 2008 US$ using an all-item CPI-U from the Bureau of Labor Statistics.)

- Log of household net worth—The natural logarithm of the combined value of stock holdings, savings accounts, checking accounts, government bonds, T-bills, a valuable collection, bond funds, rights in a trust or estate, holdings in a farm or business, real estate other than the main home, and assets in IRAs, Keogh accounts, 401Ks, or similar defined contribution pension plans, net of the value of debt from credit card charges, student loans, medical or legal bills, or loans to relatives. It also includes main home and second home equity and the net value of vehicles. (All dollar values are adjusted to 2008 US$ using an all-item CPI-U from the Bureau of Labor Statistics.)
- Own home (primary residence) dummy variable—A dummy variable that is given a value of 1 if the respondent owns or is buying a home and is set to 0 otherwise.

A.5 FINANCIAL SOPHISTICATION VARIABLES

- Voluntary contribution pension dummy variable—A dummy variable that is given a value of 1 if the household contributed or contributes to a defined contribution pension plan and is set to 0 otherwise.
- Managerial and professional occupation dummy variable—A dummy variable that is given a value of 1 if the household head has an occupation code between 1 and 235, which includes management specialty operation and professional specialty operation and technical support. The variable is set to 0 otherwise.
- Received an inheritance dummy variable—A dummy variable that is given a value of 1 if the household has received a large amount of money or property in the form of an inheritance, a trust fund, or a settlement from an insurance company and is set to 0 otherwise.
- Received help managing money dummy variable—A dummy variable that is given a value of 1 if the individual reports that because of a health or memory problem, he/she has difficulty with managing money (such as paying bills and keeping track of expenses), and he/she reports that someone helps them manage their money, and is set to 0 otherwise.
- Financial distress indicator (lagged one wave)—The value of household consumer debt (household consumer debt includes credit card charges, student loans, medical or legal bills, or loans from relatives but does not include any mortgage on a primary residence or vehicle loans) divided by household income, $\frac{\text{consumer debt}}{\text{household income}}$. The scale goes from 0 to 1, where 1 is distressed.

A.6 PHYSICAL HEALTH-RELATED VARIABLES

- Head has 3+ chronic conditions (lagged one wave)—A dummy variable that takes the value of 1 if a doctor has ever told the head that he/she has three or

more of the following six chronic conditions: high blood pressure, diabetes, cancer (excluding skin), lung disease, heart condition, or arthritis. The variable is set to 0 otherwise.

- Head is often troubled with pain (lagged one wave): A dummy variable that takes the value of 1 if the head reports that he/she is often troubled with pain and is set to 0 otherwise.
- Head has 4+ activities of daily living limitations (lagged one wave): A dummy variable that takes the value of 1 if the head reports that he/she has difficulty doing four or more of the following nine activities of daily living due to a health problem: walking several blocks; sitting for 2 hours; getting up from a chair after sitting for long periods; climbing several flights of stairs without resting; stooping, kneeling, or crouching; reaching or extending your arm above shoulder level; pulling or pushing large objects like a living room chair; lifting or carrying weights above 10 pounds, like a heavy bag of groceries; or picking up a dime from a table. The variable is set to 0 otherwise.
- Log of total medical expenditures—The natural logarithm of the combined out-of-pocket expenditures over the last year on nursing home care and hospital bills; doctor, outpatient surgery, and dental bills; prescriptions, in-home medical care, special facilities, and other services. Does not include health insurance premiums. (All dollar values are adjusted to 2008 US$ using an all-item CPI-U from the Bureau of Labor Statistics.)
- Household receives Medicare and under age 65—A dummy variable that is given a value of 1 if someone in the household is covered by Medicare and is under the age 65 and is set to 0 otherwise. An individual under age 65 who received Medicare is likely disabled and would have mental health treatment covered.

A.7 OTHER CONTROL VARIABLES

- Year dummy variables—Dummy variables for years 2000, 2002, 2004, 2006, and 2008.

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