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Dementia Risk and Financial Decision Making by Older Households: The Impact of Information

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Abstract

The knowledge and reasoning ability needed to manage one's finances is a form of human capital. Alzheimer's disease and other dementias cause progressive declines in cognition that lead to a complete loss of functional capacities. In this paper we analyze the impact of information about cognitive decline on the choice of household financial decision-maker. Using longitudinal data on older married couples in a novel application of survival analysis, we find that as the financial decision maker's cognition declines, the management of finances is eventually turned over to his cognitively intact spouse, often well after difficulties handling money have already emerged. However, a memory disease diagnosis increases the hazard of switching the financial respondent by over 200 percent for couples who control their retirement accounts, like 401(k) accounts, relative to those who passively receive retirement income. This finding is consistent with a model of the value of information: households with the most to gain financially from preparation are most responsive to information about cognitive decline.

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1 Introduction

The knowledge and reasoning ability needed to manage one's resources during retirement is a form of human capital. This capital is acquired over a lifetime. The degree of expertise achieved depends on the both the capabilities of the individual and the benefits from improved management which tend to be proportional to the amount of wealth under management (Delavande, et al., 2008; Kezdi and Willis, 2011). Like the depreciation of health capital caused by physical illness (Grossman. 1972), Alzheimer's disease and other dementias cause a depreciation of the capacity to manage one's finances.

Alzheimer's disease (AD) and other dementias cause progressive, largely irreversible, declines in cognition that lead to a complete loss of functional capacities. Such declines may pose enormous financial risk to all members of a household. First, dementia is associated with high costs of care, including the costs of identifying and paying for nursing home services and home care. Second, cognitive impairment of a financial decision-maker can lead to financial mismanagement. The financial risks highlight the potential benefits of preparing for the loss of functional capacities and raise the questions: do households change how they manage their assets when such cognitive difficulties set in? And, do they respond to signs of cognitive impairment and medical diagnoses of a memory-related disease?

Older individuals often have difficulties handling money, for example, forgetting to pay bills, participating in fraudulent schemes, and signing contracts they don't understand.[1] These difficulties often later give way to a diagnosis of Alzheimer's, as well as serious financial problems. Indeed, medical research has shown that such problems are an early sign of dementia.

The emergence of difficulties handling money can be extremely problematic if one does not have assistance with this task. Married individuals could potentially rely on their cognitively intact spouses to assume responsibility of finances. Using the Health and Retirement Study (HRS), a longitudinal, nationally representative study of older Americans, we employ survival analysis and other regression methods to examine if and when financial responsibility is transferred from one spouse to another as a result of cognitive decline. We find that as the cognition of the primary financial decision-maker declines, the management of finances is eventually turned over to the unimpaired spouse. However, the switch often does not occur until well after the impaired spouse reports difficulties handling money. This occurrence suggests that a cognitively impaired individual often continues to make financial decisions even after he is aware of his difficulties handling money or has even received a diagnosis of a memory-related disease.

[1] Anecdotal accounts can be found in a series of *New York Times* articles on aging (Kolata, 2010a, 2010b).

To understand the variation in the responsiveness of the switch to a diagnosis of a memory-related disease, we analyze an economic model of the value of information about future cognitive impairment. There is surprisingly little consensus among medical professionals—let alone patients and loved ones—about the value of early diagnosis of Alzheimer's. On one hand, given the irreversibility of the disease, a diagnosis may introduce unnecessary emotional trauma. On the other hand, a diagnosis allows couples to alter their plans and prepare for the future, which can be financially beneficial. In this paper, we highlight both the emotional cost of new information and the financial benefits of using that information to re-optimize for the future.

We hypothesize that couples whose financial assets require a high level of individual oversight face greater gains from re-optimization and therefore greater incentive to respond to signs of cognitive impairment. In their model about forms of human capital that are useful for the management of wealth, Delavande et al. (2008) show that the benefits of financial competence are proportional to the amount of wealth one manages. Households who rely on fixed income sources, such as pensions and Social Security, need only a modest amount of day-to-day oversight of finances relative to those who actively manage wealth, such as savings in 401(k) accounts. Protecting household finances against mismanagement by a cognitively impaired husband may involve establishing trusts, assigning power-of-attorney, or otherwise transferring financial responsibility to the wife.

We find that couples who actively manage their retirement accounts transfer responsibility more quickly after the emergence of money difficulties and at higher levels of cognition. A diagnosis increases the hazard function of switching the financial respondent by a factor of 2.7 for couples who control their retirement accounts relative to those who passively receive retirement income. These results hold even after controlling for education, wealth, stock ownership, and spousal cognition. This finding is consistent with an economic model of the value of information: households with the most to gain financially from preparation are most responsive to information about cognitive decline.

The next section provides additional background information on cognitive impairment and diagnoses, financial capacity, and the household division of labor. Section 3 presents empirical patterns of financial responsibility, financial capacity, and diagnoses over the full spectrum of cognition. We discuss these patterns in the context of potential variation of the value of information, and how individuals might alter their choices and behaviors in light of new information given by a diagnosis. We hypothesize that households with individually managed retirement wealth are more responsive to a diagnosis than those who do not manage their wealth. Section 4 presents regression analyses that test the hypothesis with respect to the household division of labor for financial decision-making tasks, and Section 5 concludes.

2 Background

In this section, we will provide some background on the issues at hand. We will begin with a description of declines in cognition that may result in the diagnosis of a memory-related disease, the relationship between cognitive impairment and financial capacity, and impact of impairment on the division of labor. In particular, we focus on the management of finances and the financial vulnerability of older persons.

2.1 Cognitive impairment, dementia, and functional capacity

Dementia is defined as the loss of cognitive and mental functions severe enough to impair a person's daily functioning. These losses reflect declines from a previous baseline, and they must include the impairment of memory and at least one other cognitive function.[2] One of the earliest signs of dementia is forgetfulness, which is often accompanied by functional difficulties in areas like language, social skills, and reasoning skills. Estimates show that nearly 15 percent of Americans over the age of 70, or 3.4 million individuals, suffer from some form of dementia (Plassman et al. 2007).

Dementia represents a set of symptoms, characterized by reduced functional capacity, that can be caused by a number of diseases or conditions. Alzheimer's disease is the most common form of dementia and accounts for an estimated 60 to 90 percent of all dementia cases (Brookmeyer et al., 2011; Alzheimer's Association, 2011). Individuals with dementias like Alzheimer's suffer progressive declines in cognition that worsen continuously over a period of years.[3]

Dementing disorders are distinct from normal aging in that dementia is characterized by diminished functional capacity. A person experiencing typical aging will be largely independent in his daily activities, in spite of possible complaints about memory loss. A person aging with dementia becomes dependent on others for activities necessary for daily living and will begin behaving in socially inappropriate ways. During typical aging, a person may complain about memory loss but can generally recount in detail these bouts of forgetfulness, whereas a demented person would generally be unable to recall these incidents (American Medical Association, n.d.).

[2] These functions are, as defined by the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition*, cited in Holsinger et al. (2007): agnosia, failure to recognize or identify objects despite intact sensory function; aphasia, deterioration of language function (impairment); apraxia, impaired ability to execute motor activities despite intact motor abilities, sensory function, and comprehension of the required task; delirium, a disturbance of consciousness that is accompanied by a change in cognition that cannot be better accounted for by a preexisting or evolving dementia; executive functioning, the ability to think abstractly and to plan, initiate, sequence, monitor, and stop complex behavior.

[3] For simplicity, we use Alzheimer's interchangeably with dementia. Other common forms of progressive dementia include vascular dementia, dementia with Lewey bodies, or Parkinson's disease, although it is now commonly accepted that most dementia is mixed vascular and Alzheimer's (Langa et al., 2004). In this respect, it is possible that actions taken that reduce risk factors for stroke, would reduce the risk of AD as well as the risk of vascular dementia.

Doctors assess a patient's cognition using neuropsychological tests, including tests for memory, problem-solving skills, and thinking and reasoning skills. One of the more widely used (and commonly studied) tests for screening and assessing the severity of dementia is the Mini-Mental State Examination, which covers a number of cognitive functions in about 10 minutes (Holsinger et al., 2007), and the similar Telephone Interview for Cognitive Status.

Health professionals rely on a standardized list of activities, known as the Activities of Daily Living (ADLs), to determine the functional status of patients. Basic activities include walking, bathing, toileting, and other requirements of personal care and hygiene. Instrumental activities refer to more complicated tasks, like those involved in managing a household and its finances. Pérès et al. (2008) find that individuals who are eventually diagnosed with dementia perform more poorly on instrumental activities than those who do not develop dementia.

At this time, Alzheimer's and most other forms of dementia are progressive and have no cure.[4] While research on the prevention, treatment, and early detection of AD is underway, reactions to the value of early diagnosis are quite varied.

2.2 Cognition and functional capacity in financial management

Financial management can be a very complex task that generally requires high cognitive function and human capital. This task has become more complicated as regular streams of retirement income from defined benefit pensions have been replaced by retirement plans that need to be actively managed. Some studies have found that older consumers make poorer financial choices than middle-aged consumers, which may be attributed to aging-related cognitive decline (Agarwal et al. 2009). Korniotis and Kumar (2011) find evidence that older investors "exhibit worse stock selection ability and poor diversification skill," which the authors attribute to aging-related cognitive declines. Reduced cognitive function predicts both low asset accumulation as well as less participation in the financial markets (Benjamin et al., 2006). Other studies have found similar patterns with respect to numeracy and the accumulation of wealth (Banks and Oldfield, 2007; Banks et al., 2010; Smith et al., 2010).

Declines in financial capacity— the productivity of financial human capital—have been detected in Alzheimer's patients. Studies have shown that those with mild and moderate cases of Alzheimer's have significantly impaired financial abilities (Marson et al., 2000), even though their basic calculation

[4] Some dementias are brought about by a single event, such as cardiac arrest or brain injury; these dementias are static but are also generally irreversible. Others with certain causes, like infection, nutritional deficiencies, or drug interactions, may be reversible. A meta-analysis of dementia studies showed that less than 10 percent of cases were potentially reversible and only 0.6 percent of cases reversed at least partially (Clarfield, 2003). Current treatments include drugs that can help manage the cognitive symptoms of AD for a limited period of time (http://www.alz.org/alzheimers_disease_standard_prescriptions.asp).

skills may still be intact (Martin et al., 2003). Studies have also found particularly rapid declines in financial skills among AD subjects, particularly in their susceptibility to simple fraud (Martin et al., 2008). The worsening of financial abilities can occur even prior to the onset of dementia and AD. Triebel et al. (2009) detect declining financial skills in patients with mild cognitive impairment in the year before developing AD.[5]

Financial vulnerability of older Americans

Regardless of cognitive status, older Americans are more financially vulnerable than the general population. Not only have most of the elderly left the labor market, but they face greater medical costs in their declining health, and they are frequently targets of financial abuse. At the same time, their financial tasks can be quite complex. These tasks include budgeting, managing credit and debt, dealing with bills (including medical bills), managing retirement wealth, planning for medical or nursing home care, bequests, and so on. Even seemingly minor oversights can lead to large problems: the *New York Times* describes a former lawyer who forgot to pay his bills, and then later stopped paying creditors altogether. By the time his wife noticed something was wrong, most of their money had vanished (Kolata, 2010a). Financial abuse and exploitation is endemic among older Americans.[6] In 2004, financial exploitation was one of the most common forms of elder abuse investigated and substantiated by Adult Protective Services (Teaster et al., 2006).

Self-awareness of impairment

Knowing that preparation and protection against the financial vulnerability of cognitive impairment is necessary requires some awareness of one's current or future cognitive status. Lack of self-awareness of one's cognitive capacity is a common symptom among AD patients. For example, when asked to self-assess their ability to pay bills, Williamson, et al. (2010) find that AD patients rate themselves significantly higher than their actual performance warrants whereas normal controls provide realistic self-assessments. Other studies confirm that those with mild cognitive impairment (Okonkwo et al., 2008) and dementia (Van Wielingen et al., 2004) are not fully aware of their deteriorating financial skills, and their proxy informants or caregivers also systematically misjudge the financial abilities of patients (Okonkwo et al., 2008). This lack of awareness can lead to increased financial vulnerability if

[5] While not all individuals with mild cognitive impairment convert to AD, cross-sectional studies have shown that individuals with mild cognitive impairment also have impaired financial abilities (Griffith et al., 2003; Okonkwo et al., 2008).

[6] Examples of financial abuse include cashing an older person's checks without permission; forging his signature or coercing him into signing a contract, will, or other document; and stealing or misusing an older person's financial resources (Teaster et al., 2006).

the impaired individual continues to make financial decisions, and suggests that a diagnosis of a memory-related disease may in itself provide the impetus for taking action.

2.3 Who Should Manage the Household's Money?

Family economics has long emphasized the gains from a family division of labor in which spouses specialize in different activities according to their comparative advantage (Becker, 1991). The gains from the division of labor are magnified by the potential of each spouse to enhance their knowledge and skills by investing in human capital through learning-by-doing, self-study, or even formal training. Managing the family finances is one such task and financial knowledge and the functional capacity to use such knowledge may be regarded as forms of human capital.

In older households with spouses in good health, it is likely that one spouse will have specialized in acquiring the knowledge and skills needed to manage the family's finances and make good decisions about the family's finances. An important implication of human capital theory is that the marginal value of improving these skills is approximately proportional to the amount of money under management, so that households with greater financial resources will also invest more in financial knowledge (Delavande, et. al., 2008). However, having more money under management also exposes the household to the risk of larger losses in the event of incompetent financial decision making. A division of labor may be efficient but only if the union is intact and if both members continue to hold the mental and physical abilities required by their responsibilities. Hsu (2011) discusses the role of widowhood in the division of labor, but what happens if one member of the couple begins to lose skills because of a dementing disease? The death of a spouse necessarily disrupts the division of labor, but cognitive decline can have consequences that are even more severe.[7] Wise financial management and decision-making become even more important given the high costs of care associated with dementia, including the complexity of identifying and paying for nursing home services and home care. Hurd et al. (2013) have recently estimated that annual monetary costs of dementia are about $56,000 per person.

Furthermore, while the onset of widowhood is instantaneous and impossible to ignore, the cognitive decline associated with dementia occurs progressively and disrupts division of labor in a more subtle way. Individuals might be physically able to continue the division of labor, but cognitive impairment makes it harder to do certain tasks well, especially if the tasks require thinking and reasoning.

[7] The analysis in Hsu (2011) focuses on women, who tend not to be the primary financial decision maker in the household (the household's "chief financial officer (CFO)") but are more likely than men to be widowed. While more women than men have dementia (Alzheimer's Association, 2011), this gap is attributable to gender differentials in mortality. Indeed, mild cognitive impairment is more prevalent among men than women (Petersen et al., 2010). The same issues regarding dementia and financial decision-making arise regardless of the gender of the household CFO.

Declines in ability lead to declines in productivity of human capital and consequently the loss of comparative advantage in tasks that require high cognitive function. Therefore, one way to mitigate the impact of Alzheimer's on a patient's family is to restructure the division of labor such that a person who is cognitively intact is responsible for cognition-intensive tasks. In the next section, we describe the extent to which older households restructure their division of labor in the face of cognitive impairment. Doing so is an example of behavior that may be elastic in the face of information about cognitive decline.

3 Descriptive analysis of cognition and financial management

3.1 Empirical approach and data

Our goal is to analyze the effect of new information about dementia risk on the financial behavior of older married couples. The new information may take the form of the observation of the "signs and symptoms" of cognitive decline by an individual or spouse, children, or friends, or it may take the form of seeking a medical diagnosis. We focus our attention on the degree to which cognitive decline influences a shift in financial responsibility between spouses.

To do so, we make use of cross-sectional and longitudinal data from the Health and Retirement Study (HRS),[8] a nationally representative longitudinal survey of Americans over the age of 50 and their spouses. Since the first wave of the HRS in 1992, follow-up surveys have been conducted approximately every two years. New cohorts are added every six years to maintain the steady-state design. In the 2008 wave, the HRS interviewed over 18,000 individuals. The survey content includes individual- and household-level information about family demographics, health status, cognition, functional limitations, assets, and debts, among others.

We define a longitudinal sample of couples and then identify the member of the couple who was designated in the baseline survey to be the "financial respondent" based on a question about which member of the couple is most knowledgeable about household finances, including family assets, debts, and retirement planning. We then examine how changes in the cognitive status of this person affect the likelihood that the HRS designates the other spouse as financial respondent in a subsequent wave.[9] The analysis sample is restricted to waves in which the cognition data was collected, waves 1998 through 2008.

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[8] The HRS (Health and Retirement Study) is sponsored by the National Institute of Aging (grant number NIA U01AG009740) and is conducted by the University of Michigan. Some variables were provided by the RAND HRS Data file. See http://hrsonline.isr.umich.edu for more information.

[9] While this measure was designed for survey management purposes, rather than as a direct measure of financial decision-making, the financial respondent measure is the best measure available in the data. Interviewers are specifically trained not to arbitrarily switch financial respondent from one spouse to another merely for convenience. Indeed, financial respondents typically do not switch back and forth repeatedly across waves.

We study HRS couples with the goal of analyzing changes in the division of labor—the choice of the household's financial decision-maker—which is one of the choices a household can make to protect against financial mismanagement in the face of cognitive impairment. We describe at what levels of cognition our sample receives memory disease diagnosesbecomes aware of difficulties in handling money, and switches the financial respondent. The use of the cognition scale as "analysis time" helps us determine whether respondents are learning or acting, and at what point on the cognition scale these changes occur.

3.2 Key measures used in the empirical analysis

Cognitive status

A 27-point cognitive test is administered to self-respondents who are 51 years old and older at each wave of the survey, resulting in multiple observations of cognition for each respondent. The scale includes a 10-word immediate and delayed recall test (0 to 20 points) that measures episodic memory, a serial 7s test that measures working memory (0 to 5 points), and a backwards-counting test that measures mental processing speed (0 to 2 points).[10] These tasks were derived from the Telephone Interview for Cognitive Status (Brandt et al., 1988), which has been validated for use as a screening instrument (Welsh et al., 1993; Plassman et al., 1994).

Crimmins et al. (2011) determined cut points of the cognitive scale that would generate the same population prevalence of dementia and 'cognitive impairment, not demented' (CIND) among the HRS sample as that found in a national study focused on dementia. Scores between 12 and 27 points are considered normal, 7 to 11 points as CIND, and 0 to 6 points correspond to dementia. Those who have proxy interviews are scored based on proxy assessments of memory, proxy assessment of instrumental activities limitations, and interviewer assessments of cognitive impairment. These three assessments combine for a 9-point scale (prior to 2000) and an 11-point scale (2000 onward), which can be mapped to the same categories of the above full 27-point scale. For the pre-2000 (2000 onward) scale, normal scores are 0 to 2 (0 to 2) points, CIND scores are 3 to 4 (3 to 5) points, and demented scores are 5 to 9 (6 to 11).[11] Proxy interviews are generally triggered by low scores on a more basic cognition test.

The use of the 27-point cognition scores and the cutoffs for CIND and dementia on an individual level can be validated using the Aging, Demographics, and Memory Study (ADAMS), a national population-based study of dementia whose participants are drawn from the HRS (Langa et al., 2005). A

[10] Scores from waves from 2006 and earlier include imputations for missing data (Fisher et al., 2009), while those from 2008 are raw scores and do not include imputations.

[11] This classification of cognitive function was developed by Mohammed Kabeto and David Weir. In our sample, 21 percent of proxy respondents are classified as demented, 21 percent as CIND, and the remaining as normal. Alternatively, coding proxy interviews as having cognition scores of zero does not influence the empirical results.

sample of 856 HRS respondents over the age of 70 participated in an extensive in-home cognitive assessment and received a diagnosis of normal, CIND, or dementia based on the judgments of an expert panel of neuropsychologists and neurologists. Follow-up assessments were conducted for those diagnosed with CIND, or whose diagnoses were unclear at baseline. These diagnoses can be linked to the same participants' HRS cognition data to verify the validity of the 27-point cognition scores we use in this paper.

Figure 1 displays a box plot of cognition scores for ADAMS respondents who were found to be normal, CIND, or demented as of the most recent wave available of the ADAMS. The scores reported were the most recent scores from the core HRS interview available at the time of the ADAMS diagnosis. Because cognition tends to decline with age, the scores may be slightly higher than what the respondents would have achieved if measurement of the tests occurred at the same time as the ADAMS assessment. As seen in Figure 1, over 80 percent of ADAMS respondents with a normal outcome have cognition scores in the normal range (greater than 12, or above the topmost red horizontal line). The interquartile range of CIND respondents is mostly in the CIND cognition score range, though the median is at 11 points, the upper cutoff of the range. Those with a dementia diagnosis have scores that span both the CIND and the dementia score ranges, and again the median at the dementia/CIND threshold. The cognition scores and the cutoffs proposed by Crimmins et al. (2011) are largely consistent with the diagnostic conclusions from ADAMS, which validates the use of these 27-point scores alone for all respondents.

In addition to providing an objective measure of cognitive status, the 27-point scale also captures factors that make individuals themselves aware of the risk of future dementia. Specifically, in 2006 and 2008, the HRS asked respondents: "Assuming that you are still living at X, what are the chances [on a 0 to 100 scale] that you will be free of serious problems in thinking, reasoning or remembering things that would interfere with your ability to manage your own affairs?" where "X" is an age between 11 and 15 years ahead. Figure 2 shows that the subjective probability that an individual will be free of serious cognitive problems 10-15 years in the future declines linearly over the full range of the 27-point scale from 80 percent for persons at the top end of the scale to about 40 percent for those at the bottom. This suggests that even people with little current cognitive impairment believe that they face a significant risk of future impairment. Conversely, the fact that persons whose cognitive test scores fall within the CIND and dementia range claim a 40 percent chance of being free of problems with thinking and reasoning in the future is consistent with the lack of self-awareness of cognitive deficiencies by those who are currently impaired, as discussed earlier.

Information: memory disease diagnoses

Beginning in 1998, the HRS has asked each respondent at each interview, "Has a doctor ever told you that you have a memory-related disease?" This question is our primary source of information about the medical assessment of cognitive decline. We also include a variable on insurance coverage, which takes a value of 1 if the respondent is covered by a current or previous employer plan, by a spouse's current or previous employer plan, or a government-administered plan like Medicare or Medicaid, given that those without insurance will face much greater barriers and costs to receiving a diagnosis.

Awareness of financial capacity: difficulties handling money

The HRS asks respondents about their ability to perform both activities of daily living and instrumental activities of daily living and IADLs. One such question asks the respondent, "Because of a health or memory problem, do you have any difficulty with managing your money—such as paying your bills and keeping track of expenses?" If a respondent answers "yes," "don't do," or "can't do," he is coded as having difficulties handling money. This variable can thus be used as an indicator for having problems handling money. This variable is also an indicator of self-awareness of one's own financial capacity, or a source of information. Because the question includes health as a source of such problems, in all multivariate analysis we also include controls for self-rated health.

Behavioral outcome: switching financial respondents

A measure of financial responsibility in the household in the HRS is the "financial respondent," who answers all survey questions related to household finances and wealth. This person is selected when the couple enters the study, in accordance with the question about the person most knowledgeable about household finances, including family assets, debts, and retirement planning. During the introductory section of each wave's interview, the interviewer determines whether or not the financial respondent assignment needs to be changed. A new financial respondent can be seen as a strong signal that the previous financial respondent is no longer the most knowledgeable about household finances. The financial respondent in a couple tends to have higher financial literacy than the spouse, and in most cases is the husband (Hsu, 2011). The financial respondent also tends to either independently or jointly make the major financial decisions for the household.[12]

[12] In the appendix, we describe sensitivity analyses that show that our results are not sensitive to small artificial changes in the timing of the switch, and falsification tests that show that our results are not an artifact of arbitrary switching at a certain age, level of cognition, or other criteria.

3.3 Descriptive analysis

All analysis in this paper is conducted at the household level from the perspective of the member who was the financial respondent when the couple entered the HRS. Because there can only be one financial respondent in the couple, each couple only has one observation per wave. Table 1 reports summary statistics of the couple's initial financial respondent from the first year a couple appears in the analysis sample. Most financial respondents at baseline are male. Likewise, they are older than their spouses and are more educated than their spouses.

The bottom of Table 1 summarizes the cognition of baseline financial respondents and their spouses, measured during the first year the couple appears in the analysis sample. Most respondents have cognition scores in the normal range. About 11 percent of initial financial respondents and 14 percent of spouses have scores in the CIND range, and 3 percent and 5 percent in the dementia range, respectively. In about 90 percent of couples, the baseline financial respondent has a cognition score in the same or better range than his spouse (see Table 2). Few respondents (less than 2 percent) report having been diagnosed with a memory disease. About 5 percent of initial financial respondents and 10 percent of spouses report having problems handling money.

Patterns over the 27-point cognition scale

Do baseline financial respondents turn over responsibility for finances at the same level of cognition that they report having difficulties managing money or when they receive a diagnosis of a memory-related disease? In other words, do respondents undertake changes in behavior before or after the emergence of signs and symptoms? To investigate such changes, we restrict the analysis to the baseline financial respondent in couples, as all uncoupled individuals are necessarily financial respondents and cannot turn over responsibility to a spouse. Figure 3 displays smoothed plots[13] for coupled baseline financial respondents the following:

- the proportion of respondents who are financial respondents,
- the proportion of respondents who do not report problems handling money, and
- the proportion of respondents who do not report receiving a diagnosis,

over the 27-point cognition scale.

In our initial descriptive analysis, we pool together the multiple observations for each person without exploiting the person identifier. We arrange each observation in order of the respondent's

[13] These smoothed plots, based on locally smoothed regressions of each outcome on the 27-point scale, are generated using Stata's *lowess* command, With the exception of the financial respondent plot, these plots all look very similar if the full HRS sample is used (for example, by including singletons and spouses who were not financial respondents at baseline).

cognition score, so the data in these graphs are displayed as if they comprised a series of 27 cross-sections, one for each possible score on the cognition scale.

As seen in the thin dashed line in figure 3, virtually all respondents report not having any difficulty handling money until cognition scores reach the CIND range, at which point there is a linear decline to about 20 to 60 percent reporting no difficulties in the dementia range of scores. While this finding suggests that people have some awareness of their cognitive difficulties, it also seems likely that many of the cognitively impaired respondents are either not aware of problems they have in managing money or are not willing to tell an interviewer about their problems.

The incidence of self-reported memory-disease diagnoses increases as the cognition score declines. The thick solid line in figure 3 shows that almost no respondents report having received a diagnosis of a memory problem if their cognitive score falls within the normal range of 11 to 27, and only about 5 percent report a diagnosis within the CIND range of 7 to 11. Even among those with scores within the dementia range of 0 to 6, only 25 percent of respondents with dementia-range cognition scores report a memory disease diagnosis. One possible explanation is that some of the remaining 75 percent do indeed have such a disease but never received a diagnosis from a doctor, perhaps due to lack of insurance. Alternatively, these may be false negatives in the sense that the respondents were once diagnosed but either are unaware of the diagnosis or have forgotten. Thus, unless there is severe underreporting of diagnoses, it appears that relatively few people have received (or perhaps even sought) a medical diagnosis for memory problems and that those who did probably have quite severe cognitive impairment.[14]

The lower the cognition score, the less likely an individual is to be a financial respondent, which indicates that the spouse is now the financial respondent (thick dashed line in figure 3). However, even in demented ranges, over 80 percent of these baseline financial respondents *still remain* financial respondents. Given the much lower proportions of respondents reporting being free of problems handling money or being free of a memory disease diagnosis, it must be that in many couples, the financial respondent continues to be responsible for the finances in spite of information indicating difficulties with the task. A possible reason for this discrepancy—that a person remains the financial respondent in spite of having problems handling money or a diagnosis—is that the spouse may be even worse off. In this case, the baseline financial respondent may retain his comparative advantage even in light of his difficulties handling money. The regression analyses will address this issue.

[14] To our knowledge, no studies have examined the reasons for the low rates of self-reported memory disease diagnoses, but studies about rates of undiagnosed dementia find results ranging between 35 and more than 90 percent (Olafsdottir et al., 2000).

To summarize, declining cognitive ability is associated with reporting difficulties handling money, couples switching financial respondent to the cognitively intact spouse, and reporting memory disease diagnoses. Second, difficulties handling money are more common than memory disease diagnoses, which, in turn, are more common than changing the financial respondent. A majority of respondents in the demented range of cognition do not report a memory disease diagnosis. This result could be due to underdiagnosis or misreporting. Third, respondents frequently claim to have difficulty handling money before a memory disease diagnosis, consistent with the medical studies described earlier, and both before switching financial respondent. Finally, respondents who report memory disease diagnoses often remain the financial respondent.

3.4 An explanation: variation in the value of a diagnosis

These descriptive results are consistent with heterogeneity in household responses to a diagnosis of a memory-related disease like dementia. Such variation across individuals can be seen in the debate on the value of early detection of AD. In an article about advances in the early diagnosis of Alzheimer's, the author asks: "Does it help to know you are likely to get a disease if there is nothing you can do?" (Kolata, 2010b). Readers who thought that early detection held little value emphasized the idea that there is nothing one can do with such information.[15] Early detection is seen as merely delivering "devastating knowledge" (Winer, 2010), given the inevitability of decline with AD. The question above hinges on the idea that one may not be able do anything with this information—with no cure, a diagnosis provides only emotional costs and no benefits. The role of psychological costs, including anxiety and fear, have been emphasized in research about HIV testing (see Thornton, 2008) and behavioral research on decision-making, including health decisions (for example Caplin and Leahy, 2001; Koszegi, 2003; Frank, 2004), both of which have parallels to the case of AD diagnoses.

Others, in spite of the incurability and irreversibility of Alzheimer's, see value in this information, precisely because they would take action as a result of a memory disease diagnosis. One reader states: "I most definitely do want to know if [AD] is in store for me so that I can begin to plan the rest of my life while I am still 'in charge.' Most important, I would invest my savings in a supportive,

[15] Some examples: "…what good does that knowledge do? There is no drug that cures the disease, only ones that mitigate the symptoms at an early stage. My wife died four years ago from Alzheimer's at age 69. She and her family suffered with the disease for seven years after the initial diagnosis. Had we known earlier, everyone would have suffered even longer." (Eisen, 2010) A doctor's perspective, in an Op-Ed: "Until we have a more definite idea about what causes Alzheimer's, early detection tests may do patients more harm than good." (Pimplikar, 2010). However, in experimental Module 3 in HRS-2010, a majority of respondents agreed with the statement "You would like to know your chances of someday getting Alzheimer's."

long-term living arrangement, one that I would choose, on my own terms. And I would decide myself what to do with all my 'stuff'—my books, collections, clothing, and furniture" (Bloom, 2010).[16]

Armed with foreknowledge about one's cognitive decline, a planner can begin preparation for a state of cognitive impairment. One retirement planning magazine suggests gathering a group of experts in a number of areas: financial, legal, and medical or day-to-day care, among others (Garland, 2010). While the suggestion may not be feasible for all households dealing with dementia, it highlights that one can take actions. In this paper, we will focus on the first of these areas.

Sharing financial responsibilities with a cognitively intact spouse or loved one (and eventually delegating responsibilities completely to that person) can be a key form of preparation. Problems understanding or remembering to pay bills are frequently cited in anecdotal accounts and academic studies of dementia and AD (Kolata, 2010b; Loewenstein et al., 2001; Okonkwo et al., 2006; Martin et al., 2008; Okonkwo et al., 2008; Griffith et al., 2003), so for some, altering financial planning may also be as basic as ensuring that bills are paid correctly and on time.[17]

Households who manage their own investments tend to have more assets to protect, which makes turning over financial responsibilities even more important. One *New York Times* reader comments: "By the time [my father's] dementia became manifest, I was forced to learn the entire universe of money-management without benefit of his experience and expertise...Please, if you have assets to protect, make sure your family understands the details before it's too late."[18] These households will also be more vulnerable to financial abuse, as they have assets that can be exploited.

The value of information—in this case information with a large negative emotional cost—is determined largely by what individuals can do with such information. There is no cure that can be applied after this information is revealed, so the utility value of information is derived from changes in one's own behavior and planning. Behavior that can be changed to increase utility in light of information

[16] A geriatric psychiatrist agrees: "…if the Alzheimer's disease is diagnosed early (providers can do this today with a skillful history and clinical exam), [people with memory loss] can actively plan for their future. The real emotional trauma comes when patients and families are confronted with incomprehensible personality changes, memory lapses and difficulty functioning that are unrecognized by their medical providers." (Czapiewski, 2010)

[17] Households may also want to alter their financial plans well before functional capacities are lost. Expenditures on goods and leisure activities might be re-allocated to earlier ages when a person still has normal cognition and functioning, or cancelled outright in favor of saving for expensive care in old age. Dementias like AD are progressive and expensive to manage, so the most direct financial implication of foreknowledge is to ensure access to care. Additionally, if a spouse is present, one may want to ensure that the spouse's financial needs are taken care of during the period of cognitive impairment. Furthermore, a spouse is also commonly the caretaker and may be in a position to monitor behavior, such as how the patient handles money, as cognition declines. A financially involved spouse may notice the danger signs and know when it is optimal to assume responsibility of finances.

[18] Susan, Chester County, PA, October 31, 2010, 10:24 a.m., Comments to Kolata (2010b), http://community.nytimes.com/comments/www.nytimes.com/2010/10/31/health/healthspecial/31finances.html?sort=oldest&offset=2

can be considered *information elastic* (Boozer and Philipson, 2000). A number of actions involving long-term consumption decisions, financial planning, and financial management are likely to be quite information elastic. In this paper, we focus on adjustments to financial decision-making that might reduce the financial costs of Alzheimer's.

4 Empirical analysis of variation in information elasticity

The consequences of incompetent financial decision-making or financial abuse will vary across households. The extent of a household's vulnerability to either risk depends on the volatility and exposure of their assets and any future potential income. If a household's retirement income comes primarily from wealth that is individually managed, then the household will be exposed to the risk of poor investment decisions. In such a case, it would be possible to quickly squander wealth that was meant to last months or even years.[19]

Others may have fewer assets under their direct control. Those who depend primarily on regular streams of income that are not actively managed may be less likely to incur severe losses as a result of incompetent decision-making. Active decisions are generally not required to receive streams of income like defined benefit pensions or Social Security income. Furthermore, individuals whose income is limited to such streams do not have direct access to future income that could be spent unwisely or exploited in scams. The problems these individuals face are likely to be limited to cash flow issues—leaving enough money each month for necessities, refraining from buying items they would not otherwise buy if they were cognitively intact, knowing how to access the money, or remembering to pay the bills.

Variation in the benefits of preparation: individually managed wealth

Our data allows us to determine if households have retirement wealth that is individually managed. The HRS asks of those who report participating in defined contribution pension or retirement plans: "Are you able to choose how the money in your account is invested?" We create an indicator that takes the value of one for the first wave at which the couple reports holding at least one account that allows the holder to choose how the money is invested, and each wave thereafter.[20] In doing so, our measure is not contaminated by moving assets out of individually controlled accounts as a form of

[19] For example, an older doctor somehow became the director of several clinics; one used his name to engage in fraudulent billing, and another took out mortgages without his knowledge. By the time his son noticed, the doctor's savings had been completely emptied out by a scammer, and all that was left was his Social Security income (Kolata, 2010a).

[20] Using the nature of retirement wealth at baseline enables us to avoid any re-allocation of assets in response to cognitive decline that could potentially contaminate our analysis.

preparation. As seen in Table 1, approximately 1/3 of couples have retirement accounts for which they can choose their investments. About 63 percent of households do not hold any wealth in stock.

Using non-parametric smoothed plots, we investigate graphically whether those who manage their own retirement wealth are more responsive to a diagnosis or the emergence of problems handling money. We then proceed with regression models—probit and survival models—to analyze how the choice of financial respondent relates to cognitive decline over time, the emergence of problems handling money, and most importantly the diagnosis of a memory-related disease. Because these are analyses of couples, we consider characteristics of both members of each couple. The reasoning in our framework predicts that the financial respondent switch should occur more quickly for households whose wealth is individually managed. Because the speed of cognitive decline varies across individuals, we use cognition as analysis time in survival analysis to examine how low cognition falls before a failure occurrence.

4.1 Descriptive analysis by nature of retirement wealth

4.1.1 Difficulties handling money and financial responsibility

Figure 4 displays smoothed plots of being the financial respondent as well as plots of the absence of money difficulties plotted on the 27-point cognition scale, plotted separately by nature of investments. Like the preceding smoothed plots, both of these graphs only include individuals in couples who were the financial respondent at the baseline, and they pool the different waves of the survey together into a single cross-section. The solid lines are for those who do not control investments, while dashed lines correspond to those who do control their investments.

For both groups, the lines for being the financial respondent are higher than the lines for being free of difficulties with money. Although the proportion of respondents without money problems begins to decline at the lower end of the normal cognition range and drops sharply in the CIND and dementia ranges, the proportion of individuals who are financial respondents remains quite stable until the CIND-dementia threshold. For those in the dementia range, a larger proportion of individuals are financial respondents than report no difficulties handling money. This finding suggests that some of these financial respondents may make financial decisions in spite of reporting difficulties handling money. Furthermore, the slope for being free of problems is steeper than that of financial respondents, showing that the financial respondent switch is much less responsive to cognitive decline than functional capacity.

However, the gap between the two dashed lines is much narrower, and slopes much closer, than between the two solid lines, which means that for those who can choose investments fewer households are exposed to the risk of bad financial decisions. This finding also provides some suggestive evidence that the decision to switch the financial respondent is different for the two groups.

4.1.2 Information elastic behavior: memory disease diagnoses and financial responsibility

Receiving a diagnosis of a memory-related disease is a strong indication from a medical professional that one's cognition is declining. Being able to recall and report this diagnosis to an interviewer demonstrates self-awareness of cognitive decline. How do rates of being financial respondents and of memory disease diagnoses change as cognition declines? We know that memory disease diagnoses rise (learning) and financial respondents fall (acting) in the dementia range of cognition scores, but do these changes track each other?

Figure 5 displays smoothed plots of being the financial respondent and not having a memory disease diagnosis, plotted against the cognition score. Like the previous figure, respondents with retirement accounts that are individually managed have dashed lines, and the solid lines include only those who do not have such accounts. In both cases, when respondents are in the normal cognition range, the two lines are parallel. Regardless of the nature of retirement accounts, some individuals with a memory disease diagnosis serve as financial respondents, and this proportion is fairly constant throughout the range.

The pictures diverge for those in the dementia range. Because both financial respondent lines are above the diagnosis lines, the gap between the two represents the financial respondents who remain so in spite of reporting a diagnosis. Even more so than in the previous graph, the two dashed lines for those who control their investments are much closer together than the two solid lines for those who do not.

Among those without individually managed retirement accounts, the proportion of individuals who are financial respondents is much higher than the proportion of respondents without a memory disease diagnosis, particularly in the dementia range. For those who do control their investments, the gap is much smaller, suggesting that fewer couples retain financial respondents who report a diagnosis. This finding suggests that how the financial respondent decision relates to a memory disease diagnosis depends on the nature of financial decisions being made—namely, whether or not retirement wealth needs to be individually managed—and reflects variation in the potential benefits to changing behavior.

In summary, cognition scores negatively correlate with having a memory-related disease diagnosis and having problems handling money in the expected manner. In particular, the lower the cognition score, the higher the likelihood of reporting a diagnosis and problems handling money. The emergence of financial incapacity with low cognition is consistent with medical research on AD. Couples do switch financial respondents when the original respondent's cognition declines, but many log-cognition respondents remain the financial respondent for their households. In general, among those with cognition in the CIND or dementia range, the proportion who are financial respondents exceeds the proportion who retain their financial capacity. Therefore, some low-cognition individuals are financial respondents even while they report having problems handling money. However, the gap between rates of

problems handling money and being the financial respondent is much smaller for those who have individually controlled retirement accounts. Within the dementia range, the rate of being a financial respondent is higher for persons with a memory disease diagnosis than for those without a diagnosis if retirement wealth is *not* individually controlled. This finding implies that some demented individuals are serving as the financial respondent in spite of suffering from a memory-related disease. The proportion of couples who do have individually controlled investments in this situation is much smaller. Because the descriptive graphical analyses are univariate and do not exploit the fact that we have multiple observations for each person, we now turn to regression analyses that explicitly analyze person-specific cognitive decline over time to further understand these patterns.

4.2 Regression analysis

We analyze how the financial outcomes, financial capacity and financial responsibility (a choice of financial decision maker that may be information elastic) are affected by cognition (a sign and symptom) and learning about a memory disease diagnosis. As before, the unit of analysis is a couple, and each observation will contain attributes of both the first financial respondent and his or her spouse. The reference point of the observation is the person who was designated as the most financially knowledgeable when the couple first entered the survey, and our regression analysis employs each observation of the same couple. Where we refer to "own education" or "own cognition," we mean the characteristics of the financial respondent at baseline; we refer to the other member of the couple as "the spouse."

The regression analysis employs the following variables (see Section 3.2 for more details):

- Individual-level cognition: cognition scores, indicators for having a cognition score in the CIND or dementia range, self-reported diagnoses of memory-related diseases, and self-reported difficulties handling money of both members of the couple, and
- Household financial characteristics: tercile of household assets held in stock (zero if the household owns no stock), and natural log of total assets,[21]
- Additional control variables (coefficients not reported here): age, education, and self-rated health status of each member of the couple. We also control for the gender and health insurance status of the initial financial respondent.[22]

[21] These two variables are based on wealth calculations drawn from RAND HRS Data (2010). First, we use the natural log of total wealth (including the net value of primary housing, but subtracting trusts and second home less debt). Those with negative values are coded as zero. Second, we use the tercile of share of those assets held in stock; those who do not own any stocks are coded as zero.

Summary statistics of all variables used in the regression are presented in table 3. Here, statistics are presented for the full analysis sample—multiple observations over time of the 7,730 couples described at baseline in table 1.

4.2.1 Survival analysis: competing risks regressions

Our discussion suggests that couples may want to respond to declines in cognitive function. We use survival models to analyze factors that influence the hazard of changing the financial respondent. In survival analysis, the hazard function *h* describes the instantaneous risk of an event occurring (in our case, a change in the financial respondent, or the emergence of problems handling money) and denoted as follows

$$h(t) = \lim_{\delta \to 0} \frac{P(t \le T < t + \delta \mid T \ge t)}{\delta}$$

where T is the value of t at which the event occurs, and t is analysis time.

The transition event occurs when an HRS interviewer recognizes that the original financial respondent is unable to provide accurate information about household income and wealth, most often because of cognitive impairment that the interviewer observes directly or from information provided by the spouse. Since the triggering event for this transition is a change in the cognitive status of the original financial respondent, we have chosen to use the individual's score on the 27-point cognition score as our measure of analysis time rather than calendar time, as is common in many applications of hazard analysis to phenomena such as unemployment spells in the labor economics literature (for example, Meyer, 1990; Kiefer, 1988)[23]. In our case, calendar time is not suitable because the pace of dementing disease is highly variable across individuals. According to WebMD, while 3-9 years is the typical range, some patients experience very rapid decline to disablement and death, and others decline gradually for as long as 20 years. Therefore, instead of measuring analysis time as the length of time that has elapsed, we define duration as the units of cognition that have declined when a failure event occurs.[24] This measurement allows us to analyze how much cognition deteriorates before the occurrence of the two events—developing problems handling money, and switching the financial respondent. Therefore, this

[22] The "problems handling money" question queries about problems arising from both health and cognitive issues, so we control for self-rated health. Furthermore, because the costliness of acquiring a memory disease diagnosis depends on access to health insurance, we also include a control for insurance coverage.
[23] Results using calendar age as analysis time are similar and are reported in the sensitivity checks in the appendix.
[24] In their survey, Lee and Whitmore (2006) discuss the rationale for monotone transformations of clock time—called operational time or running time—in various applications of survival analysis. The transformation may be either deterministic or stochastic. Because of variation in the rate of cognitive decline across individuals there is unmeasured heterogeneity in the calendar time "clocks" governing the transition process. By using the cognitive test score as analysis time, we endeavor to create a clock that ticks at a more uniform rate across individuals.

strategy allows us to analyze the hazard of individual events occurring over the course of individual-specific cognitive decline, rather than simply comparing events at different levels of cognition.

We estimate Cox Proportional Hazard models and competing risks regressions, which both assume that covariates cause a proportional shift around a baseline hazard function which is an arbitrary function of *t*, as follows:

$$h(t \mid x_j) = h_0(t)exp(x_j\beta_x),$$

where x_j is the *j*th covariate, h_0 is the baseline hazard, and β is estimated in the regression. The coefficients are hazard ratios that measure the proportional effect of a covariate in raising or lowering the risk of a transition around the baseline hazard associated with a given cognitive score. The baseline hazard itself is of arbitrary shape because, given the proportionality assumption, it factors out of the likelihood function.

The use of cognition scores as units of analysis time requires that cognition declines monotonically over time. In the appendix we show that in our data the scores are indeed negatively monotonic for the most part (particularly after a respondent has moved out of the normal range). Some individuals receive the same cognition score in multiple waves, so we perturb scores in order to deal with the fact that survival analysis cannot deal with multiple observations at the same point in analysis time *t*.[25]

The data contain a few sources of censoring. Couples may exit the sample when one spouse dies, or the couple otherwise dissolves. Another source of right-censoring comes from couples who are still intact, with no reports of money difficulties or switching of the financial respondent during the most recent wave of the HRS in our analysis. Couples who have not yet switched their financial respondents may still do so in the future, potentially generating right censoring.[26] Survival analysis combines data from both non-censored and censored observations, and it accounts for such censoring, albeit under the assumption that the distribution of durations is independent of censoring, conditional on covariates (Wooldridge, 2002). Survival models explicitly analyze durations (measured in terms of units of cognition lost) so we can compare how if reporting problems handling money occurs at higher or lower levels of cognitive decline than changing financial respondents.

[25] If an individual receives the same cognition score in two waves, we subtract 0.01 from the more recent score. If an individual receives the same cognition score in three waves, we add 0.01 to the first measurement and subtract 0.01 from the most recent measurement. For four waves with the same cognition score, we subtract 0.01 from the oldest score and 0.03 from the second score, and we add 0.03 to the third and 0.01 to the fourth to achieve four equidistant scores. Alternatively, dropping duplicate scores yields similar results.

[26] If some couples switched financial decision-makers prior to the onset of the survey, or if they passed on responsibility to an adult child, our analysis will not capture these events. Right censoring can also emerge if a spouse dies, or if the marriage otherwise dissolves. Our sample is also subject to left censoring; because of the design of the HRS, members of different cohorts entered the study at different ages. Therefore, some couples are younger during the first wave of analysis, while others are older.

Another source of censoring (in addition to the lack of failure during the most recent measurement) is reaching the lowest cognition score. Cognition scores are on a 27-point scale and cannot take values outside this range, so in the survival analysis framework, censoring occurs when a person has reached a score of zero, or has been replaced with a proxy respondent in the survey. Therefore a more appropriate model would be a competing risks survival model. Here, we estimate competing risks regressions where the failure object of interest is the switching of financial respondents within a couple or the emergence of problems handling money, and the competing risk is the attainment of the lowest cognition score. Table 4 reports results from the competing risks regressions. Estimates of a Cox Proportional Hazard model that does not account for the competing risk yield similar results, reported in the appendix.

The preceding descriptive analysis shows that people develop difficulties handling money before they turn over being the financial respondent to the spouse. If the financial respondent switch occurs at the same time as the original respondent reports difficulty handling money, then the hazard ratios for a particular covariate should be the same for both equations.

The effect of a memory disease diagnosis has a strong impact on the financial respondent switch for those who are most vulnerable to financial mismanagement. The interaction effect of a diagnosis and controlling one's investments is large and statistically significant; if one has accounts that are individually invested, being diagnosed with a memory disease more than doubles the hazard of switching the financial respondent (hazard ratio of 2.7), even though this interaction term has no effect on problems handling money. This result is consistent with the idea that those with much to gain from preparing for cognitive decline—those with assets that are at risk of being mismanaged by the original financial respondent—prepare by switching the financial respondent more quickly.

Holding a greater share of wealth in stock and log wealth constant has very little effect on the hazard of switching the financial respondent. While this lack of effect is inconsistent with the intuition that wealthier individuals have more to lose from poor financial decision-making, it confirms the most important factor is whether or not assets are individually controlled. Therefore, the indicator for holding retirement wealth that is individually controlled is not merely a proxy for portfolio allocation or wealth. These results are confirmed in estimates of alternative survival model specifications, and these are reported in the appendix.

Education is an important component of human capital. While own education does not have a statistically significant effect on either the emergence of difficulties handling money or on switching the financial respondent, an additional year of schooling for the spouse increases the hazard function of switching the respondent by about 16 percent, and is precisely measured. In other words, the higher the spouse's level of formal human capital, the more willing the household is to switch the financial

respondent, similar to the patterns we see with spousal cognition and functional status. A possible interpretation of this finding is more education may help offset the spouse's likely lack of experience with financial management because education enhances the spouse's ability to learn management skills, thereby allowing him or her to substitute for the original financial respondent whose cognitive human capital is depreciating.

The effects of spousal cognition and functional status also support the idea that greater abilities of the spouse increase the likelihood of switching the respondent.. Having a spouse who has cognition in the CIND or dementia range reduces the hazard of switching the financial respondent to 64 percent and 27 percent, respectively. The hazard responds similarly to the spouse reporting difficulties handling money.

It may be the case that those who have health insurance are more likely to be in a position of receiving a doctor's diagnosis. Insurance coverage (which includes coverage through Medicare, Medicaid, and other government-administered plans) is high, and whether we control for it as we do here, or restrict the analysis to those with insurance coverage, the results remain the same.

Those who see a doctor may also already have exhibited other signs of cognitive impairment, and all of our regressions do control for cognitive status. In addition, in our data, conditional on having a low cognition score, receiving a diagnosis is not correlated with nature of one's retirement wealth, and therefore should not impact our interpretation of the results.

4.2.2 Bivariate probit regression

The fact that the two financial responsibility outcomes—difficulties handling money, and no longer being the financial respondent—should be correlated suggests the use of bivariate probit analysis. Unlike survival models, however, the bivariate probit model, does not address censoring. Furthermore, while our discussion has been about cognitive decline, the bivariate probit uses the current cognitive status of respondents. Therefore, the coefficients on cognition are more accurately interpreted as the effect of low levels of cognition versus higher levels of cognition, rather than cognitive change per se. Consequently, we use the bivariate probit to provide additional evidence on how diagnoses and the nature of retirement wealth influence the financial respondent switch, relative to the emergence of problems handling money.

If a particular coefficient is larger in the equation estimating difficulties handling money, then the decision to switch financial respondents is less responsive. Table 5 presents coefficients from a bivariate probit regression of two financial outcomes: difficulties handling money for the initial financial respondent in column (1), and switching the financial respondent in column (2). Standard errors are clustered at the household level. The reference point is the member of the couple who was the financial

respondent at baseline. Column (3) reports χ^2 tests for the difference in coefficients for each covariate across the two equations.

Having a memory disease diagnosis is strongly associated with difficulties with money, but the effect of a diagnosis on switching the financial respondent is much smaller in magnitude and statistically indistinguishable from zero. However, the interaction effect of the memory disease diagnosis and an indicator of retirement wealth that can be individually managed is positive and statistically significant for the financial respondent switch. This interaction effect has a negative, statistically insignificant effect on the probability of having problems managing money. This finding is consistent with the competing risks regression results; those who control their investments are much more responsive to a diagnosis than those who do not.

The probability of switching the financial respondent is less responsive to the respondent being CIND than is the probability of reporting having problems handling money. For both the CIND and dementia indicators, the coefficients for equation for difficulties handling money are larger in magnitude than those of the switching financial respondent outcome, and for CIND the difference is statistically significant. This finding provides additional evidence that some individuals who have difficulties handling money have not yet been replaced as the financial decision-maker. Note that these indicators are separate from a memory disease diagnosis or reported problems handling money; these self-reported measures represent awareness, while the CIND and dementia indicators represent the objective state of cognition. Therefore, the marginal effect of a diagnosis controlling for these indicators represents the impact of awareness and information, holding cognition constant. Likewise, the coefficients on CIND and dementia indicators give us the marginal effect of being cognitively impaired, holding awareness constant.

The effects of education are similar to those found in the competing risks regression. Own education, again controlling for cognition, has a negative but statistically insignificant effect on the probability of problems handling money, or switching the financial respondent. However, spouse's education has positive and precisely measured effect on switching. Again, this is consistent with the idea that, controlling for spousal cognition, higher education makes the spouse a more attractive candidate for taking over household finances.

5 Conclusion

How one prepares for cognitive decline and how responsive one is to a diagnosis of a memory-related disease depends on how much one has to gain through such preparation. For example, poor financial decisions may have a smaller impact for someone who is living on predictable streams of

income than for those with retirement wealth that needs to be individually managed. Therefore, some households would experience greater adverse effects of cognitive decline and human capital related to the management of finances than others. We expect variation in responses to diagnoses of memory-related diseases like Alzheimer's disease. In this paper, we analyze how the person in the couple serving as the financial respondent changes as cognition declines to impaired and demented levels.

We find that households tend to wait until cognition has fallen quite low to make the switch. In particular, this switch often occurs well after the original financial respondent has reported having difficulties handling money. Over one-third of coupled respondents with cognition in the dementia range are financial respondents, and their cognitive impairment may prevent them being able to provide accurate data on financial holdings.

To analyze how this financial respondent switching behavior varies according to the nature of their retirement wealth, we use a number of econometric methods which all yield the same story. In our main analysis using survival models, we treat the progression of cognition as our time scale to analyze effects as cognition declines. We find variation in how quickly financial respondents switch in response to cognitive decline, memory disease diagnoses, and even the emergence of problems handling money. After controlling for wealth, those with individually managed retirement accounts switch financial respondents more responsively to memory disease diagnoses—the hazard ratio is well over two. They also switch at higher levels of cognition, before suffering too much decline, and sooner after reporting problems handling money.

Such heterogeneity is consistent with an economic model of the value of information about current and future states. If information about future cognition enables re-optimization and preparation by have someone else manage retirement wealth, then learning such information is useful and leads to beneficial action. If one does not have the ability to prepare, for instance, if one holds no individually managed retirement wealth that can be handed over to a spouse, then the information is not helpful. Our results do not merely reflect an effect of higher wealth, which has a small, positive but imprecisely estimated effect on the financial respondent switch in all specifications. While Oster et al. (2011) emphasize the role of emotional costs (anticipated utility in their framework), we analyze the variation in potential *benefits* of acting on information that arise from different types of retirement wealth.

Spousal characteristics, particularly in human capital (both in terms of education and cognition) are also important and influence the decision to switch financial respondents in the expected direction. The decision depends not only on how poor one's cognition is, but how poor is the cognition of the spouse to whom one might potentially turning over the finances. This distinction provides evidence that the most important factor is one of comparative advantage relative to one's spouse.

Our finding that spousal education increases the hazard of switching the financial respondent is consistent with results in Poterba, Venti, and Wise (2013). The authors show that human capital can operate like an efficiency parameter which raises financial asset growth, and such a relationship is one example of why spousal education would increase her ability to manage finances relative to a spouse with depreciating cognition.

Another option we cannot observe in our data is passing on responsibility of finances to an adult child. Having adult children nearby may enhance monitoring; these children may more easily notice poor decision-making. On the other hand, frequent contact with children may make it more difficult to notice changes in cognition in the parent. If children only see their parents during major holidays, the time distance between visits makes cognitive decline more noticeable. Indeed, including child proximity measures in the regressions does not influence the effect explanatory variables of interest, cognition, and memory disease diagnoses; furthermore, the sign of their coefficients is extremely sensitive to the specification and is never statistically significant, and therefore were dropped from our analysis. Future research will enable us to examine in greater detail the nature of the division of labor within older couples as well as the role of their adult children.

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7 Appendix: Robustness checks using alternative regression specifications

7.1 Monotonicity of the progression of cognition

Table A1 tabulates the wave-to-wave changes in cognitive status among HRS respondents. About 83 percent of wave-to-wave changes in cognition remain within the same cognitive status—for example, back-to-back scores in the normal range. Most of these within-status changes are small, and, on average, they are declines in scores. Approximately 10 percent are transitions into worse cognitive states: from normal to CIND or dementia, and CIND to dementia. The average change in cognition scores is a 6.5 point decline. Only 6 percent of wave-to-wave changes are improvements from one cognition category to another. Of these, the vast majority are CIND to normal transitions.

7.2 Survival analysis using age as analysis time: Cox Proportional Hazards models

Here, durations are measured in calendar time, using the baseline financial respondent's age at each wave of observation. Table A2 reports results from Cox proportional hazards models; column (1) treats reporting difficulties handling money as the failure, and column (2) treats switching the financial respondent as the failure. Like the competing risks regressions and the bivariate probit results in the paper, the interaction of a memory disease diagnosis with choosing one's own retirement investments has a large positive impact on switching, which doubles the hazard, and a much smaller impact on having problems managing money. This finding is consistent with the idea that those with more to lose—those with individually managed retirement accounts—do indeed respond more elastically to a memory disease diagnosis above and beyond those who do not choose their own investments.

This analysis assumes the two "failures"—money difficulties and the financial respondent switch—are independent. Column (3) of table 7 reports the results of a Cox proportional hazards model that restricts the analysis to those who have reported difficulties handling money, and treats the financial respondent switch as the failure. Note that this sample size is quite small (1,718 couple-wave observations) so estimates are not precise, but qualitatively the results are the same: the interaction of choosing investments and memory disease diagnosis has a large positive effect on the hazard of switching the financial respondent.

7.3 Survival analysis using cognition as analysis time: Cox Proportional Hazards models

Table A3 reports the results of the estimation of Cox proportional hazards models, one for each failure: problems managing money, and the financial respondent switch. Like our other estimates, the interaction of a diagnosis and controlling investments has no effect on the hazard of difficulties handling money but increases the hazard of switching the financial respondent to a statistically significant 248 percent of the baseline hazard.

7.4 Sensitivity analysis and falsification checks on the financial respondent outcome

The dependent variable—a switch in the financial respondent—may be measured with error, for example, if the interviewer decides to switch respondents for convenience rather than because of any true change in financial knowledge or responsibility. Skinner and Humphreys (1999) show that measurement error in timing of a "failure" in survival analysis generally results in estimated coefficients in parametric survival regressions (specifically Weibull regressions) that remain unbiased, as long as the measurement error is uncorrelated with covariates. As a sensitivity check, we introduce error into the timing of switches in the data by randomizing the timing of the switch from the wave prior to the actual switch and all subsequent waves with probability 0.25, as well as randomly assigning some nonswitchers to switch (probability 0.005 for each wave), to see if the results still hold. These probability cutoffs produce a similar number of failures as in the actual data. The resulting estimates from a bivariate probit and the Cox proportional hazards survival model are very similar; the interaction between controlling investments and a diagnosis has a positive coefficient of 0.56 for the financial respondent outcome in the bivariate probit (statistically different than the same coefficient on the problems handling money equation) and a hazard ratio of 2.3 for the Cox proportional hazards model, both statistically significant, which are comparable to the estimates of the actual data. Therefore, we conclude that our results are not likely to be sensitive to such error.

We also perform several falsification tests to see if failures based on some other rules also generate similar patterns, particularly on the interaction effect. If, for example, the interviewer tends to switch respondents based on some sort of decision rule based on length of time in the study, cognition, age, or health of the respondent, and the interviewer does so differentially by whether or not the respondents control their investments, then our main results may be attributable to reasons unrelated to our discussion. We create false failures under the following situations, with failures occurring:

- on a particular ordered wave a household is in the analysis sample (second; third)
- on the first wave that cognition drops below a certain score (17, the modal cognition score; 12, the cutoff for CIND; and each individual score between 5 and 8)
- when the original financial respondent turns 65
- when the original financial respondent first reports poor health
- randomly for 1 percent of the sample in each wave

Like with the sensitivity test, we also re-estimate the bivariate probit and the Cox proportional hazards models using each of these falsified versions of the dependent variable. In the bivariate probit, none of these methods produce interaction effects on memory disease diagnoses and controlling investments that are statistically distinguishable from the coefficient on the second outcome (problems handling money). Likewise, for the Cox proportional hazards model, none of these falsification tests produce estimated hazard ratios on the interaction effect that are larger than one and statistically

significant. Therefore, we conclude that the effects we find with the actual financial respondent switch is inconsistent with some sort of alternate decision rule based on observables, such as those in the falsification tests.

8 Figures and Tables

Figure 1: Cognition score of ADAMS respondents, by eventual outcome

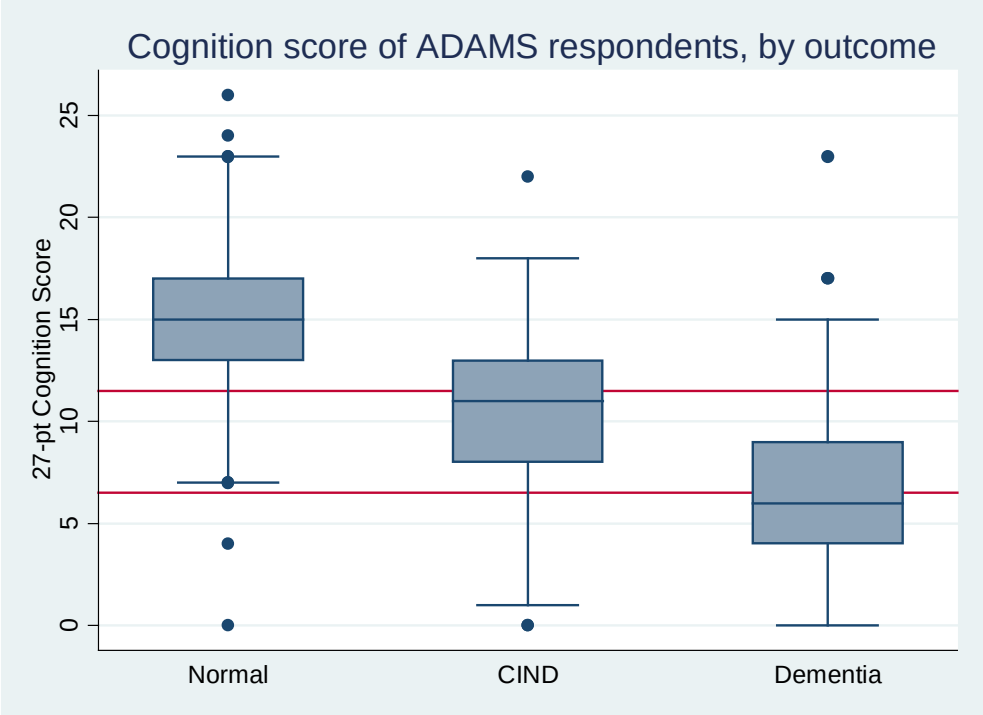

Figure 2: Subjective expectation of thinking and reasoning in 10 years, by cognition score

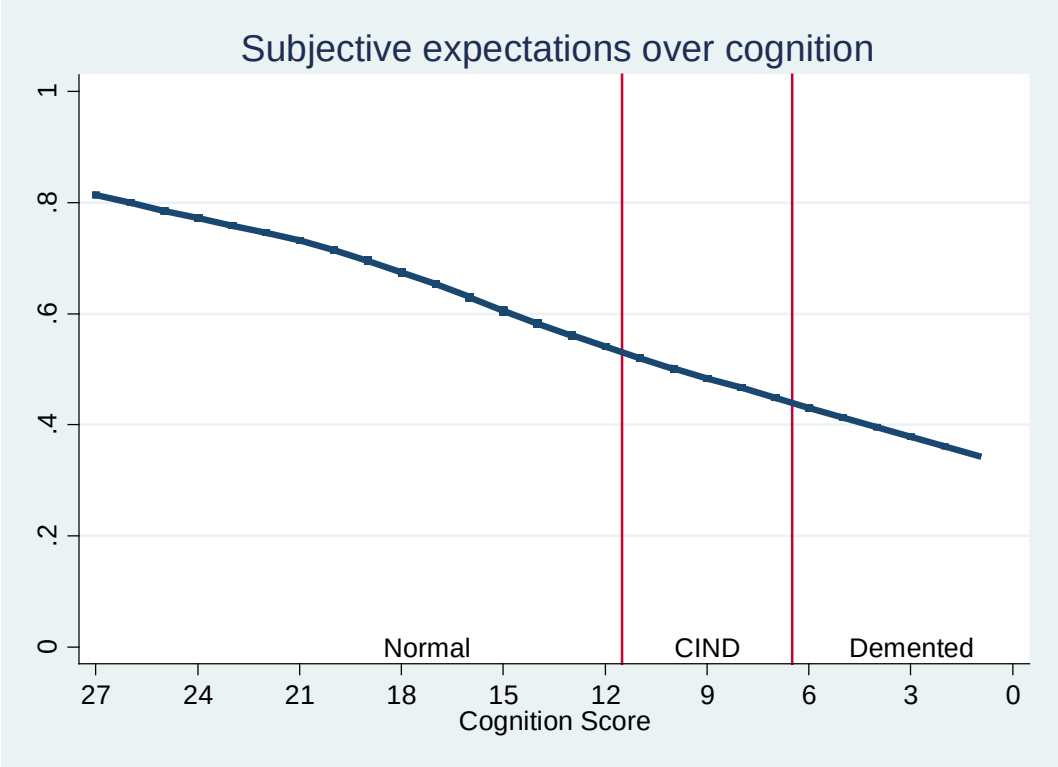

Figure 3: Financial respondents, self-reported problems handling money, and memory disease diagnoses, by cognition score (coupled respondents who were initial financial respondents)

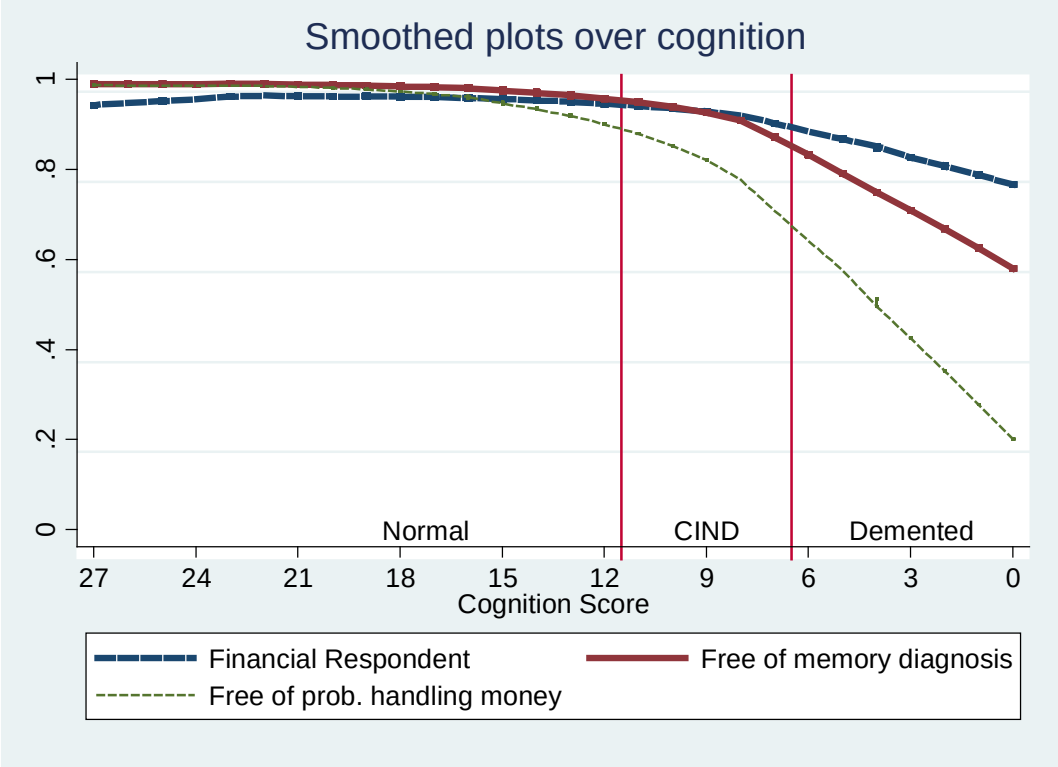

Figure 4: Smoothed plots of financial respondents and the absence of difficulties handling money by cognition score, separated by nature of retirement wealth

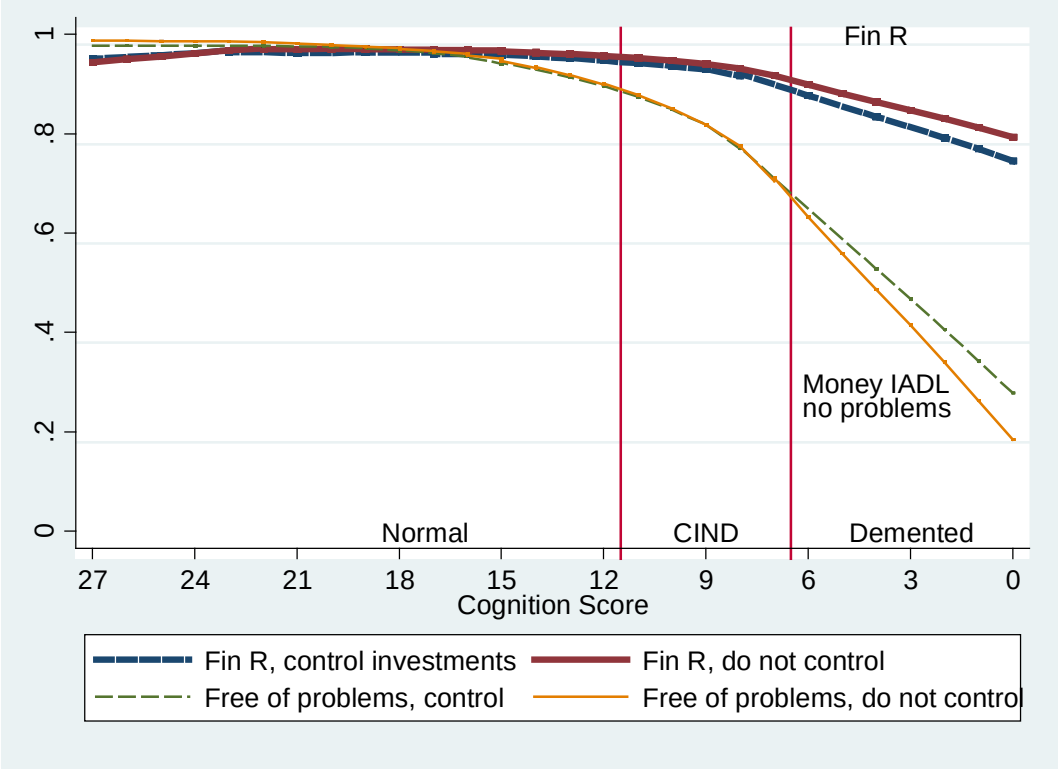

Figure includes all respondents in couples who were financial respondents during the baseline wave.

Figure 5: Smoothed plots of financial respondents and memory diagnoses over cognition scores, separated by nature of retirement wealth

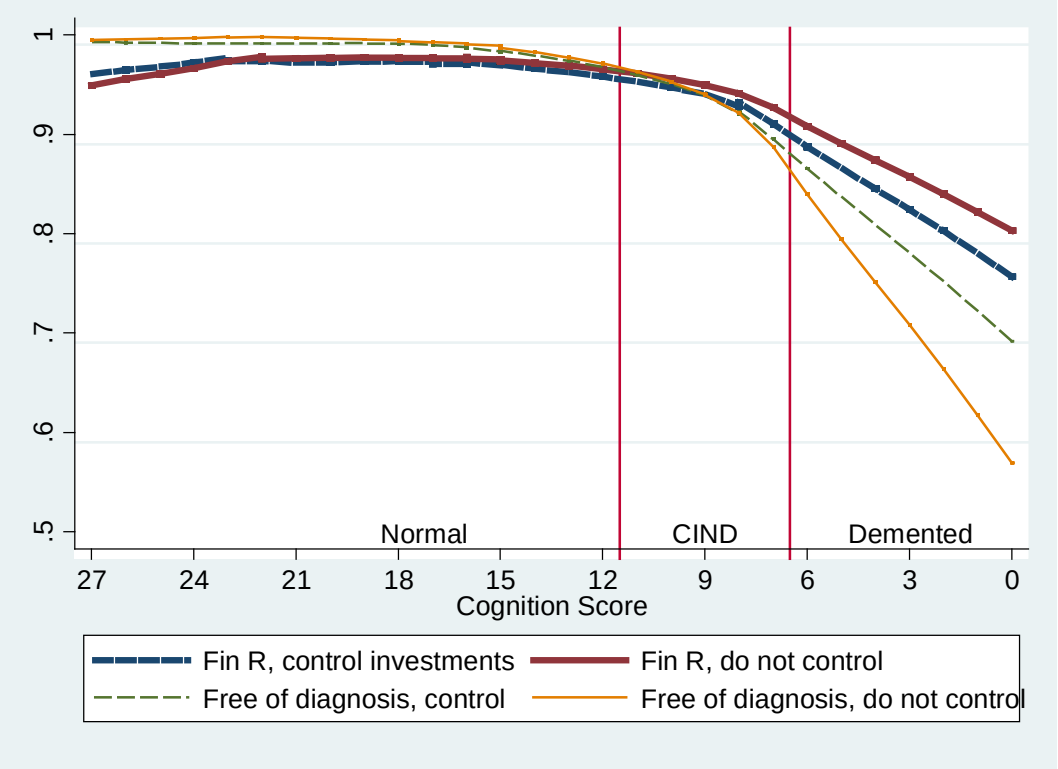

Figure includes all respondents in couples who were financial respondents during the baseline wave.

Table 1: Summary statistics for baseline wave only

Variable	mean	sd	min	max	N (households)
Financial Respondent	1	0	1	1	7730
Female	0.3777	0.4849	0	1	7730
Age	62.4752	10.0583	31	96	7730
Spouse's Age	61.8966	10.6326	25	98	7730
Own education	12.6697	3.2362	0	17	7730
Spouse's education	12.1102	3.2573	0	17	7730
Self-rated health	3.2405	1.1498	1	5	7730
Spouse's self-rated health	3.2019	1.1549	1	5	7730
Stock share tercile	0.7250	1.0770	0	3	7730
Log wealth	11.4850	2.7609	0	18.2723	7730
Health insurance	0.8809	0.3240	0	1	7730
Control investments	0.3138	0.4641	0	1	7730
Own cognition in normal range	0.8671	0.3394	0	1	7730
Own cognition in CIND range	0.1058	0.3076	0	1	7730
Own cognition in Dementia range	0.0270	0.1622	0	1	7730
Own problems handling money	0.0451	0.2076	0	1	7730
Own memory disease diagnosis	0.0127	0.1119	0	1	7730
Spouse's cognition in normal range	0.8094	0.3928	0	1	7730
Spouse's cognition in CIND range	0.1370	0.3439	0	1	7730
Spouse's cognition in Dementia range	0.0536	0.2252	0	1	7730

Table 2: Cross-tabulation of cognition of respondent and spouse

		Spouse's cognition		
	Normal	**CIND**	**Demented**	**Total**
Own cognition				
Normal	72.96	10.21	3.46	86.63
CIND	6.63	2.49	1.46	10.58
Demented	1.44	0.89	0.46	2.8
Total	81.03	13.59	5.38	100

Table 3: Summary statistics of regression variables for the full analysis sample

Variable	mean	sd	min	max	N (obs)
Financial Respondent	0.988366	0.107232	0	1	30773
Female	0.36519	0.481491	0	1	30773
Age	65.76739	9.604771	31	102	30773
Spouse's Age	65.09248	10.09812	25	100	30773
Own education	12.81688	3.16557	0	17	30773
Spouse's education	12.23969	3.200948	0	17	30773
Self-rated health	3.250089	1.106674	1	5	30773
Spouse's self-rated health	3.232249	1.10761	1	5	30773
Stock share tercile	0.718292	1.072639	0	3	30773
Log total assets	11.80698	2.644913	0	18.42855	30773
Health insurance	0.921425	0.269079	0	1	30773
Control investments	0.35073	0.477206	0	1	30773
Own cognition in normal range	0.85562	0.35148	0	1	30773
Own cognition in CIND range	0.116141	0.320399	0	1	30773
Own cognition in Dementia range	0.028239	0.165658	0	1	30773
Own problems handling money	0.053911	0.225846	0	1	30773
Own memory disease diagnosis	0.015826	0.124802	0	1	30773
Spouse's cognition in normal range	0.799272	0.400551	0	1	30773
Spouse's cognition in CIND range	0.149904	0.356983	0	1	30773

The analysis sample consists of 7,730 couples measured in multiple waves.

Table 4: Competing risks regressions using cognition as analysis time

	(1)	(2)
Failure:	Problems Handling Money	Not Financial Respondent
Memory disease diagnosis	0.842	0.627
	(0.102)	(0.162)
Control investments	0.885	1.182
	(0.072)	(0.198)
Control X Diagnosis	1.311	2.713*
	(0.302)	(1.062)
Stock share tercile	1.016	0.973
	(0.036)	(0.070)
Log wealth	0.984	1.002
	(0.011)	(0.031)
Own education	1.022	0.972
	(0.012)	(0.025)
Spouse's education	1.004	1.157***
	(0.012)	(0.035)
Spouse's cognition: CIND	0.739***	0.637*
	(0.061)	(0.129)
Spouse's cognition: dementia	0.745*	0.268*
	(0.096)	(0.152)
Spouse diagnosis	1.091	0.349
	(0.185)	(0.382)
Spouse's problems handling money	1.083	0.358**
	(0.109)	(0.128)
Additional controls	Yes	Yes
N couples	7730	7730
N failures	1001	230
N competing risk	5	17

Hazard ratios reported. Additional controls for respondent gender and health insurance status, as well as respondent's and spouse's age, education, and self-rated health are included. Standard errors clustered at the household level.

Table 5: Bivariate probit regressions with outcomes "Difficulties handling money" and "no longer financial respondent"

	(1)	(2)	(3)
Failure:	Problems Handling Money	Not Financial Respondent	Chi-squared test (p-value)
Memory disease diagnosis	0.916***	0.193	24.12
	(0.097)	(0.126)	(0.0000)
Control investments	-0.069	0.050	1.77
	(0.047)	(0.077)	(0.1837)
Control X Diagnosis	0.021	0.649**	6.31
	(0.197)	(0.224)	(0.0120)
Stock share tercile	0.010	-0.013	0.44
	(0.021)	(0.029)	(0.5077)
Log wealth	-0.032***	-0.012	1.26
	(0.007)	(0.016)	(0.2612)
Own education	-0.010	-02021	0.41
	(0.008)	(0.014)	(0.5223)
Spouse's education	-0.002	0.060***	15.53
	(0.009)	(0.014)	(0.0001)
Own cognition: CIND	0.466***	0.230**	6.58
	(0.049)	(0.085)	(0.0103)
Own cognition: dementia	1.291***	0.844***	13.62
	(0.078)	(0.119)	(0.0002)
Spouse's cognition: CIND	-0.160**	-0.177*	0.03
	(0.052)	(0.085)	(0.8607)
Spouse's cognition: dementia	-0.027	-0.529**	5.85
	(0.097)	(0.187)	(0.0156)
Spouse diagnosis	0.052	-0.222	1.02
	(0.116)	(0.246)	(0.3118)
Spouse's problems handling money	-0.096	-0.478***	9.56
	(0.062)	(0.109)	(0.0020)
cons	-1.012***	-4.063***	43.32
	(0.207)	(0.413)	(0.0000)
Additional controls	Yes	Yes	Yes
athrho			
cons	0.265***		
	(0.055)		
N couples	7730		

Coefficients reported. Additional controls for respondent gender and health insurance status, as well as respondent's and spouse's age, education, and self-rated health are included. Estimation uses HRS household level weights, with standard errors clustered at the household level.

Table A1: Changes in cognition over time

	Mean	SD	Pct
Normal to Normal	-0.224	3.243	69.56
Normal to CIND	-5.008	2.747	8.27
Normal to Dementia	-10.566	3.927	1.01
CIND to Normal	4.670	2.602	6.01
CIND to CIND	-0.136	1.783	6.85
CIND to Dementia	-4.327	2.124	2.23
Dementia to Normal	8.864	2.668	0.37
Dementia to CIND	3.697	1.842	1.29
Dementia to Dementia	-0.209	1.440	4.41
Total	-0.431	3.772	100.00
N			103426

All HRS respondents included, regardless of coupleness status, to validate that cognition tends to decline with age for all individuals.

Table A2: Cox Proportional Hazards models using age as analysis time

	(1)	(2)	(3)
	Problems Handling Money	Not Financial Respondent	Not fin R Conditional on Problems handling money
Memory disease diagnosis	2.156***	2.307**	1.131
	(0.257)	(0.591)	(0.410)
Control investments	1.112	1.514*	1.171
	(0.100)	(0.266)	(0.494)
Control X Diagnosis	1.201	1.910	1.967
	(0.264)	(0.771)	(1.117)
Stock share tercile	0.918*	0.905	0.861
	(0.032)	(0.062)	(0.104)
Log wealth	0.961***	0.975	1.062
	(0.011)	(0.029)	(0.057)
Own cognition: CIND	1.904***	1.266	1.583
	(0.155)	(0.236)	(0.700)
Own cognition: dementia	3.352***	3.356***	5.303***
	(0.354)	(0.714)	(1.801)
Own education	1.014	0.994	1.024
	(0.014)	(0.030)	(0.051)
Spouse's education	0.995	1.126***	1.069
	(0.013)	(0.035)	(0.065)
Spouse's cognition: CIND	0.740***	0.661*	0.729
	(0.059)	(0.124)	(0.244)
Spouse's cognition: dementia	0.836	0.241**	0.247
	(0.111)	(0.116)	(0.189)
Spouse diagnosis	1.041	0.455	0.000
	(0.153)	(0.324)	(.)
Spouse's problems handling money	1.004	0.408**	1.132
	(0.099)	(0.132)	(0.510)
Additional controls	Yes	Yes	Yes
N couples	7730	7730	725
N failures	1654	325	73

Hazard ratios reported. Additional controls for respondent gender, health insurance status, and spouse's age, as well as respondent's and spouse's education and self-rated health are included. Standard errors clustered at the household level.

Table A3: Cox proportional hazards using cognition as analysis time

	(1)	(2)
	Problems Handling Money	Not Financial Respondent
Memory disease diagnosis	0.869	0.658
	(0.086)	(0.163)
Control investments	1.034	1.351
	(0.084)	(0.234)
Control X Diagnosis	1.206	2.475*
	(0.222)	(0.916)
Stock share tercile	0.997	0.935
	(0.033)	(0.066)
Log total assets	0.985	1.003
	(0.010)	(0.030)
Own education	1.012	0.982
	(0.012)	(0.029)
Spouse's education	1.000	1.143***
	(0.012)	(0.037)
Spouse's cognition: CIND	0.704***	0.616*
	(0.051)	(0.116)
Spouse's cognition: dementia	0.754*	0.221**
	(0.083)	(0.108)
Spouse diagnosis	0.961	0.491
	(0.134)	(0.359)
Spouse's problems handling money	1.050	0.392**
	(0.095)	(0.129)
Additional controls	Yes	Yes
N couples	7730	7730

Hazard ratios reported. Additional controls for respondent gender and health insurance status, as well as respondent's and spouse's age, education, and self-rated health are included. Standard errors clustered at the household level.