The Implications of Alzheimer's Risk for Household Financial Decision-Making

Joanne W. Hsu
Federal Reserve Board
joanne.w.hsu@frb.gov

Robert Willis
University of Michigan
rjwillis@isr.umich.edu

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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. This poses enormous financial risk to the household due to the high costs of care and the potential of financial mismanagement by an impaired decision-maker. These risks highlight the potential benefit of advance preparation for the loss of functional capacities. In this paper we analyze the impact of information about cognitive decline—self-reported difficulties handling money and memory disease diagnoses—on the choice of household financial decision-maker. Using longitudinal data on older married couples, 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% for couples who control their retirement accounts (like 401ks) relative to those who passively receive retirement income. This 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 finances is a form of human capital (Delevande, Rohwedder and Willis, 2008; Lusardi, Michaud and Mitchell, 2011; Ehrlich, Shin and Yin, 2011, Kézdi and Willis (2011) and McArdle and Willis, forthcoming). While people accumulate financial knowledge and skills over their lifetime, at older ages they confront a serious risk of losing these capacities if they acquire Alzheimer's disease (or another type of dementia) that causes progressive declines in cognition and eventual complete loss of functional capacities. This may pose an enormous financial risk to all members of a household. First, Alzheimer's 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 question: how do households respond to early signs of cognitive impairment and official diagnoses of Alzheimer's or dementia? In this paper we focus on the impacts of self-reported difficulties with money and memory disease diagnoses on the household division of labor for financial decision-making tasks.

A series of articles about Alzheimer's disease in the *New York Times* describe the difficulties some older individuals have handling money, for example, forgetting to pay bills, participating in fraudulent schemes, and signing contracts they don't understand. 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 dementias like Alzheimer's.

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 suggests that a cognitively impaired individual often continues to make financial decisions even after he is aware of his difficulties handling money.

To understand the variation in the timing of this switch, 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 detection of Alzheimer's. On one hand, given the irreversibility of Alzheimer's and the current absence of effective treatment, 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. Our model highlights both the emotional cost of new information and the financial benefits of using that information to re-optimize for the future. Based on the model, we hypothesize that, holding emotional costs constant, one source of variation in the net benefit from re-optimization is the level of individual oversight needed to manage a household's existing financial assets.

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.

In fact, 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 of switching the financial respondent by a factor of 2.2 for couples who control their retirement accounts relative to those who passively receive retirement income. These results hold even after controlling for wife's cognition, education, wealth, and stock ownership. This 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.

2 Background

In this section, we will provide some background on the issues at hand. We will begin with a description of Alzheimer's disease and its impact on the division of labor. In particular, we focus on the management of finances and the financial vulnerability of older persons. Lastly, we discuss the value of a diagnosis of Alzheimer's, a form of information about cognitive decline.

2.1 Aging, dementia, and Alzheimer's Disease

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.[1] 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).

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. Under typical aging, a person may complain about memory loss but can generally recount in detail these bouts forgetfulness, whereas a demented person would generally be unable to recall these incidents ({American Medical Association}, n.d.).

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). The prevalence of Alzheimer's has been estimated at 13 percent of those over 65 and 43 percent of those over 85 ({Alzheimer's Association}, 2011). The defining abnormalities of Alzheimer's disease are amyloid plaques and neurofibrillary tangles in the brain, though these features cannot be definitively identified until the brain is examined in an autopsy.

Individuals with dementias like Alzheimer's suffer progressive declines in cognition that worsen continuously over a period of years. Other common forms of progressive dementia include vascular dementia, dementia with Lewey bodies, Parkinson's disease, or some combination thereof. 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.

For all causes of 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

[1] 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.

State Examination (MMSE), which covers a number of cognitive functions in about ten minutes (Holsinger et al., 2007).

While all forms of dementia are associated with memory impairment, the defining feature is the loss of functional capacity (Marson, 2001). 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 ADLs include walking, bathing, toileting and other requirements of personal care and hygiene. Instrumental ADLs (IADLs) 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 IADLs than those who do not develop dementia.

At this time, Alzheimer's and most other forms of dementia have no cure.[2] Current treatments include drugs that can help manage the cognitive symptoms of Alzheimer's for a limited period of time.[3] While research on the prevention, treatment, and early detection of Alzheimer's is underway, reactions to the value of early detection are quite varied.

2.2 Human capital and cognitive decline: the case of financial management

Many couples have a division of labor that results in each member specializing in particular tasks. For instance, one member (often the wife) may be primarily responsible for health care for the family, while the other (frequently the husband) may be the household "Chief Financial Officer" (CFO) responsible for household finances. Individuals will typically invest in the human capital relevant to their specialty early on in order to reap the benefits of their knowledge over the course of their adult lives.

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 due to a dementing disease such as Alzheimer's? The death of a spouse necessarily disrupts the division of labor, but cognitive decline can have consequences that are even more severe.[4] Wise financial management and decision-making become even more important given the high costs of care associated

[2] Dementias with certain causes, like infection, nutritional deficiencies, or drug interactions, may be reversible. A meta-analysis of dementia studies showed that less than ten percent of cases were potentially reversible; in articles that provided follow-up information, only 0.6 percent of cases reversed at least partially (Clarfield, 2003).
[3] http://www.alz.org/alzheimers_disease_standard_prescriptions.asp
[4] The analysis in Hsu (2011) focuses on women, who tend not to be CFOs but are more likely than men to become widows. While more women than men have dementia ({Alzheimer's Association}, 2011), this gap is attributable to gender differentials in mortality. Indeed, mild cognitive impairment (MCI) 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 financial CFO.

with Alzheimer's, including the complexity of identifying and paying for nursing home services and home care.

Furthermore, while the onset of widowhood is instantaneous and impossible to ignore, the cognitive decline associated with dementias like Alzheimer's 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. 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.

Financial management is one such task that can be very complex and requires high cognitive function. As discussed by Hsu (2011), 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 both before and after retirement. 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 cases of Alzheimer's have significantly impaired financial abilities, particularly with respect to complex tasks (Marson et al., 2000), even though their basic calculation skills may still be intact (Martin et al., 2003). The impairment in financial abilities is even more severe among those with moderate Alzheimer's (Marson et al., 2000). Studies have also found particularly rapid declines in financial skills among Alzheimer's subjects, particularly in their susceptibility to simple fraud (Martin et al., 2008).

While it may be unsurprising that researchers have identified reduced financial abilities among individuals who already have Alzheimer's, the worsening of financial abilities can be found prior to the onset of dementia and Alzheimer's. (Triebel et al., 2009) detect declining financial skills in patients with mild cognitive impairment (MCI) in the year before developing Alzheimer's. While not all individuals with mild cognitive impairment convert to Alzheimer's, cross-sectional studies have shown that individuals with MCI also have impaired financial abilities (Griffith et al., 2003; Okonkwo et al., 2008).

Ideally, individuals would be aware of their own declining cognitive capacity early in the process and change their own behavior accordingly in order to mitigate the effects of such declines on their households. Alarmingly, however, individuals with mild cognitive impairment (Okonkwo et al., 2008) and dementia (Van Wielingen et al., 2004) are not fully aware of their deteriorating financial skills. This suggests that self-reported measures of cognitive functioning may actually overestimate the financial skills of the cognitively impaired. Furthermore, their proxy informants or caregivers also systematically misjudge the financial abilities of patients (Okonkwo et al., 2008), as well as their general cognitive and other functional abilities (Loewenstein et al., 2001). This lack of awareness on the parts of both the impaired and their caregivers will lead to increased financial vulnerability if the impaired individual continues to make financial decisions.

2.3 The 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 and exploitation. At the same time, the financial tasks facing the elderly can be quite complex. These tasks include budgeting and decumulation, leaving enough money for essentials, 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. Financial exploitation is defined as the "unjust, improper, and/or illegal use of [an older person's] resources, property, and/or assets" ({National Research Council}, 2003). Examples of financial abuse include cashing an older person's checks without permission; forging an older person's signature or coercing him into signing a contract, will or other document; stealing or misusing an older person's financial resources; and so forth (Teaster et al., 2006).

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). Financial exploitation cases outnumbered cases of physical abuse as well as emotional and psychological abuse. A survey of older Americans and their adult children found that half of the older respondents exhibited at least one of the "warning signs of current financial victimization." These warning signs include being asked for money,

to play lotteries, or participate in other schemes; not feeling comfortable making major financial decisions alone; or not understanding financial decisions being made on their behalf (Infogroup/ORC, 2010).[5]

However, 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 and easily squander wealth that was meant to last months or even years. 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).

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 monthly 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.

2.4 \subsection{The value of information: costs and benefits} \label{sec:prepare}

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.[6] Early detection is seen as merely delivering "devastating knowledge" (Winer, 2010), given the inevitability of decline with Alzheimer's. 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

[5] This survey also found that 40 percent of adults with parents over 65 are worried that their parents "will become less able to handle personal finances over time"; 36 percent of the parents over 65 have the same worry about themselves (page 23).

[6] Some examples: "Even assuming that the new diagnostic test for Alzheimer's is 100 percent accurate, 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: "The doctor's most basic tenet is that of primum non nocere---first, do no harm. Until we have a more definite idea about what causes Alzheimer's, early-detection tests may do patients more harm than good." (Pimplikar, 2010)

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 Alzheimer's 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 early detection. One reader states: "I most definitely do want to know if [Alzheimer's] 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, 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)[7]

A positive diagnosis would allow an individual who knows that s/he will suffer cognitive decline to prepare for that impairment. In this respect, preparation is as much about protecting the rest of their household from the externalities of future poor decision-making as it is about preparing themselves individually for such impairment. This reflects the logic of the two-selves model (Thaler and Shefrin, 1981). In this model, a single agent is represented as two players: a "planner," whose utility is derived as the present value of future gains, and a "doer," who receives the utility from prior planning in a present period. In the context of dementia, preparation is needed to protect the planning-self---who will no longer exist after dementia exacts a sufficient toll---from a future "doer" who has no ability to plan or to act altruistically toward other members of the household. For instance, a cognitively intact person may believe that if he developed Alzheimer's he would not have the awareness to derive utility from high-quality nursing care. In spite of this, he may still want to plan for such nursing care in order to increase the utility of his spouse or loved ones, who may suffer disutility if he suffered bedsores due to insufficient care, for example.

Armed with foreknowledge about one's cognitive decline, the "planner" can begin preparation for a state of cognitive impairment. One retirement planning magazine suggests gathering a group of experts: a financial advisor to plan for incapacity and paying for costs of care, an attorney to establish trusts and use

[7] A geriatric psychiatrist agrees: "Scientists' understanding of Alzheimer's disease may not be clear enough to develop tools for diagnosis and treatment. But Sanjay W. Pimplikar falls into the trap into which many of us physicians find ourselves: thinking that without a medical treatment, `many individuals would simply prefer to be spared the emotional trauma of a diagnosis.' This runs contrary to the spoken wishes of many people with memory loss. They are grateful to hear that their disorienting and frightening experiences have a name. And if the Alzheimer's disease is diagnosed early (providers can do this today with a skillful history and clinical exam), they 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 is unrecognized by their medical providers." (Czapiewski, 2010)

other legal vehicles to protect financial assets and medical planning, and a geriatric-care manager to help with finding caregivers (Garland, 2010). While the suggestion may not be feasible for all households dealing with dementia, it highlights that one can take actions in a number of areas: financial, legal, and medical or day-to-day care, among others. In this paper, we will focus on the first of these areas.

Households may want to alter their financial plans well before cognition and 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. Alternatively, such expenditures may be delayed or cancelled outright in favor of saving for expensive care in old age. Dementias like Alzheimer's 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 of a dementia patient, so this spouse may be in a position to monitor behavior and actions, such as how the patient handles money, as cognition declines. A financially competent, or involved, spouse may notice the danger signs and know when it is optimal to assume responsibility of finances.

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 Alzheimer's (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.

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."[8] These households will also be more vulnerable to financial abuse, since they have assets that can be exploited.

Knowing preparation is necessary requires some awareness of one's current or future cognitive status. Because of the gradual nature of cognitive decline, mild impairment may not be easily detected. While cognitive impairment is more easily concealed than physical impairment, loved ones, particularly spouses

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

or children, are likely to notice and can persuade an individual to see a doctor. Financial advisors, lawyers, doctors, and others who work with the elderly may also be in a position to notice cognitive decline. However, due to privacy obligations, lawyers and doctors may not inform family members or loved ones. Even those without privacy obligations will not find it easy to deal with these situations. Recent articles in the *Journal of the American Medical Association* aim to help clarify the role of physicians who might be in a position to notice financial decision-making problems in their patients (Sabatino, 2011; Widera et al., 2011).

In summary, 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. In this paper, we focus on adjustments to financial decision-making that might reduce the financial costs of Alzheimer's.

3 Theoretical framework

Early detection of Alzheimer's, before the onset of symptoms, is a source of information about the trajectory of one's cognition and functional capacity. To formalize the variation in beliefs about the value of this information, consider a model first proposed by Boozer & Philipson (2000) to analyze the demand for HIV tests. An individual is one of two types, each with its own utility function. In our context, one type undergoes normal aging U^N; the other type develops Alzheimer's disease U^A. Let y be a vector of behaviors over time that is a function of p, the subjective belief of one's own probability of developing Alzheimer's.

Therefore, the expected utility gained from a particular type of behavior is

$$V(y,p) = pU^A(y) + (1-p)U^N(y) + \mathbb{I}(pE_A + (1-p)E_N) \tag{1.1}$$

where $\mathbb{I}$ is one if the individual takes a medical test that reveals his type.

The prior belief is denoted by p_0. If an individual is tested for Alzheimer's, p_A is the posterior belief after a positive test, and p_N is the posterior belief after a negative test. If the test perfectly predicts whether or not one will eventually develop Alzheimer's, p_A equals one and p_N equals zero. Otherwise, p_A and p_N reflect updated beliefs based on new information from the doctor. For simplicity, we assume that the test is administered while a person still has normal cognition.

The emotional impact of receiving a diagnosis (positive or negative) is E, with the emotional impact of remaining in ignorance normalized to zero. The "emotional trauma of a diagnosis" (Pimplikar, 2010) of Alzheimer's is $E_A < 0$. The benefit of knowing you will retain your cognition is denoted by $E_N > 0$.

Behavior y is chosen optimally given a person's underlying beliefs. If one tests positive for Alzheimer's, a person re-optimizes his behavior based on his posterior beliefs, formed with the new information about his type, y_A. If a person learns he will not develop diagnosis and will undergo normal aging, his new optimal behavior bundle is y_N. A person who does not take the test will act in accordance with his prior subjective beliefs and continues his behavior y_0.

Utility is then

$$V(y,p) = \begin{cases} V(y_A, p_A) = U^A(y_A) + E_A & \text{if one receives a positive test} \\ V(y_N, p_N) = U^N(y_N) + E_N & \text{if one tests normal} \\ V(y_0, p_0) = p_0 U^A(y_0) + (1-p_0)U^N(y_0) & \text{if one does not take the test.} \end{cases}$$

The value of information is "equal to the expected utility with the information (under the assumption of optimal reaction) minus the expected utility without" (Birchler and Bütler, 2007). If c denotes the pecuniary cost in units of utility of acquiring a diagnosis, the value of information is positive if

$$p_0 V(y_A, p_A) + (1-p_0)V(y_N, p_N) - c > V(y_0, p_0) \tag{1.2}$$

where the left-hand side is the net utility gained from the information, and the right-hand side is the utility gained if a person behaved in accordance with his prior.

Plugging in for V and rearranging shows that one would take the test if:

$$p_0 \overbrace{\left[U^A(y_A) - U^A(y_0)\right]}^{\text{Benefit from preparation}} + (1-p_0) \overbrace{\left[U^N(y_N) - U^N(y_0)\right]}^{\text{Benefit of freedom from fear}} > \overbrace{-\left[p_0 E_A + (1-p_0)E_N\right] + c.}^{\text{Emotional and pecuniary cost of test}} \tag{1.3}$$

The two expressions on the left hand side represent the increased utility derived from behavior that is changed with new information, or behavior that is *information elastic* (Boozer and Philipson, 2000). If re-optimization after a new Alzheimer's diagnosis does not generate changes in behavior (and therefore utility), then information about Alzheimer's has little value. More specifically, information is only valuable if the utility gain from the information exceeds the emotional (and pecuniary) cost of the information.

We can think of y as a stream of behaviors from now until death. In our context, behaviors might include the intertemporal allocation of consumption, saving, portfolio allocation and the management of finances, and leisure activities. Other behaviors may involve other preparation for old age by turning over the management of finances to a loved one, designating a power of attorney, writing medical directives, undertaking estate planning, and so forth. There is currently little conclusive evidence about behavior that specifically lowers the risk of Alzheimer's disease, so we assume that the objective probability of developing Alzheimer's is exogenous.

An individual may choose to preemptively prepare for the prospect of Alzheimer's even without a definitive diagnosis. If a person has a very high prior belief about getting Alzheimer's (p_0 close to one), he may have mechanisms in place for someone else to take over finances, choose to invest in safer assets, or save sufficiently for long-term nursing care. In this case, a positive diagnosis does not effect substantial changes in behavior, and therefore behavior is information *inelastic*; y_0 is already quite close to y_A. Indeed, Boozer & Philipson (2000) show that the greatest gains from test results are reaped by those who would be surprised by those results. Figure 1 plots the costs and benefits of information by p. If emotional costs of a positive diagnosis are low, then most individuals would derive benefit from a diagnosis. Only those with p_0 very close to 0 or 1 would not expect to gain utility from a diagnosis. This is because their behavior y_0 is already very close to y_N or y_A, respectively, and therefore the benefits of preparation or freedom from fear are very low. If emotional (or pecuniary) costs are high, very few individuals would find it worthwhile to have information; only those with values of p_0 close to 0.5 would seek a diagnosis.

If we interpret p as the probability of developing Alzheimer's within a specific time horizon, say five years, the model also generates predictions of how the value of information depends on the timing in which it is revealed. Consider, for example, beliefs p that represent the probability of developing Alzheimer's within five years. A person at age 20 has a close to zero probability of developing Alzheimer's in such a short time frame; furthermore, the potential benefits of changing behavior, such as turning over finances to a loved one, will not be reaped until old age. Therefore, such information holds little value for such a young person who is far, in terms of age and cognition, from developing Alzheimer's.

As a person progresses into old age, the risk of Alzheimer's increases dramatically. Researchers have found that starting at age 65, the probability of developing Alzheimer's doubles every five years

(Khachaturian, 2000), and almost 50 percent of those 85 and older have Alzheimer's. One's p increases accordingly as one ages, and as can be seen in Figure 1, the value of information also increases to a point. When one is very old and Alzheimer's is very likely, information no longer carries much value because the posterior p generally will not be much different than the prior belief at such an advanced age or low cognition. Consequently, information like a diagnosis generates few changes in behavior if it is revealed when a person is very young and has a very low p, or when a person is very old and has suffered much cognitive decline already, and has a very high p.

We have implicitly assumed so far that the subjective prior is formed rationally and is at least partially based on current medical knowledge. In reality, one may have a poor understanding of the risk factors of Alzheimer's and may have irrationally low or high prior beliefs, when the objective probability of developing Alzheimer's may be very different. Medical professionals therefore are in a position to update the beliefs of patients, perhaps by through an educational role that increases a patient's awareness of actual risk factors. These patients with unrealistically high or low priors would gain greatly from such information, even if the information is not in the form of an accurate test.

Re-optimizing and choosing a new y bundle after a positive diagnosis of Alzheimer's yields *benefits from preparation*, formalized in the first term of Equation (1.3). Given a person is the type who will eventually develop Alzheimer's, this term describes the utility that would be gained if a person changed his behavior from y_0, based on his prior subjective belief, to y_A, the optimal bundle chosen under the new information from a diagnosis. The greater the differences between y_A and y_0, and therefore the utility derived from each bundle, the greater the value of information.

One key dimension of re-optimization and changing y is through financial preparation. Individuals can become especially financially vulnerable in old age, and the potential losses of wealth are even more severe if one is trying to make financial decisions under cognitive impairment. Therefore, those who would retain control of their finances under y_0 would be subject to a substantial reduction in their budget when they suffer cognitive decline. These individuals will necessarily see a reduction in their subsequent consumption and lower levels of utility $U^A(y_0)$. If such a person were to instead learn that he would eventually develop Alzheimer's, his behavior would change---for him, y_A chosen after a diagnosis is very different than y_0 chosen optimally in the absence of a diagnosis. The more his behavior changes, the greater the benefits from preparation.

Behavior may be more information elastic if a person's finances are particularly vulnerable to losses due to poor decision-making. This theoretical framework therefore predicts that households with more to lose---for example, those with investments that must be individually managed---will respond more actively to signs of cognitive decline and memory disease diagnoses than those with less to lose under cognitively impaired decision-making. These individuals would choose y_A that is very different than their default y_0, particularly if their prior belief on p_0 was very low.

Conceptually U^A and U^N are the same with respect to consumption and other behaviors engaged during periods of normal cognition. However, the utility gained from behavior changes after the onset of Alzheimer's, perhaps by the separation of the "doer" from the "planner." While preferences under normal cognition are assumed to be well-behaved, a person with such severe Alzheimer's that he has no awareness of his surroundings may have little to no marginal utility of consumption. A forward-looking person may therefore re-allocate his consumption earlier to periods of low cognition and place less emphasis on high-quality nursing care.

Even if a person's own marginal utility of consumption is low under Alzheimer's, though, a spouse or loved one may derive great disutility from seeing him experience poor nursing care. If a person cares about the spouse's utility, he may want to reduce current consumption and increase precautionary saving in order to afford more expensive nursing home care. In this case, his forward-looking altruistic marginal utility of consumption would drive re-allocating consumption later in the life-cycle. We can think of the utility function here as representative of however couples make decisions and abstract away from any cooperative or non-cooperative decision-making processes. Consequently, individuals with and without spouses may have different preferences before and after the onset of Alzheimer's, with differing optimal paths of consumption.

Re-optimizing with a new behavior path after a test reveals a person to be of normal type yields *benefits of freedom from fear*, the second term of Equation (1.3). Certainty that a person will not develop Alzheimer's may enable a person to reduce precautionary savings intended to pay for long term nursing care, and he would no longer need contingency plans based on cognitive decline. He might re-allocate consumption with the knowledge he will retain his ability to think and reason.

The right hand side of Equation (1.3) represents the utility cost of paying for the test, and the expected emotional impact of the diagnosis. This emotional impact may be the emotional relief associated with a normal diagnosis, or the trauma from a diagnosis of dementia. In sum, individual variation in the value of

an Alzheimer's diagnosis can be traced to the degree to which behavior is information elastic, differences in prior beliefs, and the expected emotional cost of the test.

4 Empirical approach and data

In this paper, we focus on the decision to change the household's financial decision-maker within the household and therefore restrict our analysis to couples. As discussed in Section 3, the value of information and its associated changes in behavior depends in part on its timing. Behavior changed too early---when a person is young, has normal cognition, and has low subjective and objective prior probabilities of developing Alzheimer's---is of little value. Likewise, attempts to change behavior at a very advanced age or when cognition is already impaired may be too late to result in any increases in utility relative to the counterfactual. We analyze the impact of new information---a diagnosis of a memory-related disease---on the timing of this change. Because our empirical analysis focuses on older Americans, the possibility of learning or changing behavior too early has probably passed, but we can observe how behavior changes at various points of aging or cognitive decline.

We begin with descriptive analysis of two-way relationships between the choice of financial decision-maker, cognition, functional capacity, and memory disease diagnoses. 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 theoretical model 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 also use cognition as analysis time in survival analysis to examine how low cognition falls before a failure occurrence.

The empirical analysis uses several waves of the Health and Retirement Study (HRS),[9] a nationally representative longitudinal survey of Americans over the age of 50 and their spouses. Since its first wave 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. The survey content includes individual- and household-level information about family demographics, health status, cognition, functional limitations, assets, debts, and others. In the 2008 wave, the HRS interviewed over 18,000 individuals.

[9] 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 \citep{rand_hrs_data__2010}. See http://hrsonline.isr.umich.edu for more information.

The HRS is supplemented by the Aging, Demographics, and Memory Study (ADAMS), a national population-based study of dementia (Langa et al., 2005). A sample of 856 HRS respondents over the age of 70 participated in an extensive in-home cognitive assessment and received a diagnosis of normal, `cognitive impairment, not demented' (CIND), or dementia. Follow-up assessments were conducted for those diagnosed with CIND, or whose diagnoses were unclear at baseline. Each ADAMS respondent also participated in the HRS, so the diagnoses can be linked to HRS cognition data to verify the validity of HRS measures.

4.1 Measures used in the empirical analysis

Cognitive decline

A 27-point cognitive scale is administered to self-respondents who are 51 and older. The scale includes a ten-word immediate and delayed recall test (0-20 points) that measures episodic memory, a serial 7s test that measures working memory (0-5 points), and a backwards counting test that measures mental processing speed (0-2 points). These tasks were derived from the Mini-Mental State Examination commonly used by physicians and other well-validated scales, and they display "satisfactory psychometric properties" (Herzog and Wallace, 1997; Herzog and Rodgers, 1999).

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. (Crimmins et al., 2011) determined cut points of the 27-point 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 the Aging, Demographics, and Memory Study (ADAMS). Scores between 12 and 27 points are considered normal, 7-11 points CIND, and 0-6 points correspond to dementia. Those who have proxy respondents are coded with scores of zero, in the dementia range. Proxy interviews are generally triggered by low scores on a more basic cognition test.

Information: memory disease diagnoses

Beginning in 1998, the HRS has asked each respondent, "Has a doctor ever told you that you have a memory-related disease?" This question is re-asked at each interview and is our primary variable of information about cognitive decline.

Awareness of financial capacity: Money IADL

The HRS asks respondents about their ability to perform both ADLs and Instrumental Activities of Daily Living (IADLs). One such IADL 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 money IADL variable can thus be used as an indicator for having problems handling money. This variable can be used both as an intermediate outcome---financial capacity---as well as an indicator of self-awareness, or a source of information.

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. The wording of the question varies slightly across waves:

- Which of you is most knowledgeable about your family's assets, debts and retirement planning? (husband, wife, or partner) (1992)
- I will be asking some questions about your financial situation and health care costs. Which of you would know more about this, you or your (husband/wife/partner)? (1993)
- I would like to interview both you and your [husband/wife/partner]. I will be asking some questions about family assets, debts and retirement planning. Which of you is the most knowledgeable about this, you or your [husband/wife/partner]? (1998)

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. 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. As seen in Hsu (2011), the financial respondent in a couple tends to have higher financial literacy than the spouse, and in most cases is the husband. The financial respondent also tends to either singly or jointly make the major financial decisions for the household.

The choice of financial respondent is our measure of behavior y; in our empirical analysis, we look for changes in the financial respondent within couples in response to cognitive decline.

Household wealth

We use two variables related to household wealth. First, we use the natural log of total wealth (net value of total wealth, not including secondary home), with households with negative wealth coded as zero. Second, we use the tercile of share of wealth held in stock; those who do not own any stocks are coded as

zero. Both of these variables are based on wealth calculations drawn from RAND HRS Data (2010). We also construct an indicator for owning retirement accounts with investments that are personally managed.

Variation in the benefits of preparation: individually managed wealth

Impaired financial decision-making exposes households to more severe consequences if they hold wealth that requires personal management. 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. In doing so, our measure is not contaminated by moving assets out of individually controlled accounts as a form of preparation.

4.2 Descriptive statistics

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. The analysis sample is restricted to waves in which the cognition score was collected, waves 1998 through 2008. Table 1 reports summary statistics from of the couple's initial financial respondent 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. 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.

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 13 percent of spouses have scores in the CIND range, and 4 percent and 8 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.

It should be noted that our sample is subject to left censoring. Due to the design of the HRS, members of different cohorts entered the study at different ages. Therefore, some couples are young during the first wave of analysis, while others are older. 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.

5 Descriptive analysis

5.1 Validation of cognition measures

5.1.1 27-point cognition scores and actual diagnoses of dementia or CIND

The use of the 27-point cognition scores and the cutoffs for CIND and dementia can be validated using the ADAMS. ADAMS respondents were administered the same cognitive tests as all other HRS respondents in addition to additional assessments, resulting in a determination of whether the respondent is normal, CIND, or demented. Figure 2 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. Therefore, the scores may be slightly higher than what the respondents would have achieved if measurement of the 27-point tests occurred at the same time as the ADAMS assessment, given that cognition tends to decline with age. As seen in Figure 2, 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.

5.1.2 Comparison of objective and subjective (self-reported) measures

During each interview, All respondents underwent a cognitive assessment using the objective 27-point scale, and were also asked whether they have received a memory disease diagnosis. In Figure 3, we pool all respondents (regardless of coupleness status) and all waves to compare the objective cognition measure and the self-reported memory disease diagnosis.

The incidence of self-reported memory disease diagnoses increases as the cognition score declines. However, only 15 percent of respondents with dementia-range cognition scores report a memory disease diagnosis (see Table 3). One possible explanation is that some of the remaining 85 percent do indeed have such a disease, but never received a diagnosis from a doctor. 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. 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 percent and more than 90 percent (Olafsdottir et al., 2000).

5.2 Cognition and financial skills / responsibility

5.2.1 Cognition and financial capacity: problems handling money

Financial capacity can be ascertained from an IADL question asked by the HRS: "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?" Figure 4 graphs the proportions of all respondents that answer yes, don't do, can't do, and no, split by the cognition score. As the cognition score declines, the proportion reporting "no difficulty" declines as well. While very few of those with cognition scores in the normal range report having difficulties handling money, more than one third of those in the dementia range report difficulties (see Figure 5).

5.2.2 Cognition and financial responsibility: the financial respondent

Figure 6 displays a bar graph of the proportion of respondents who are the financial respondent in their households, by their cognition score. Because all uncoupled individuals are necessarily financial respondents, the analysis only includes those in couples. All waves are included. The lower the cognition score, the less likely an individual is to be a financial respondent, but 37 percent of coupled respondents serve as financial respondents. Figure 7 groups the cognition scores into the normal, CIND, and dementia ranges; the pairwise differences in proportions of respondents who are financial respondents are statistically significant across the three groups.

5.2.3 Changes in wealth and changes in cognition

Do declines in cognition generate reductions in wealth? In Figure 8, we present a lowess curve of wave to wave changes in total wealth (in thousands of dollars) plotted against changes in cognition on the 27-point scale. Large declines in cognition are associated with large declines wealth, which is consistent with anecdotal evidence presented above. This graph should only be taken as suggestive evidence, however, for a number of reasons. First, declines in wealth may reflect transfers to children in order to qualify for Medicaid and avoid private financing of nursing home care. Secondly, large swings in cognition can only occur for those who started with relatively high cognition. For example, a person who is borderline CIND-normal can decline by a maximum of 11 points on the scale, which according to this graph is associated with zero change in wealth. Lastly, if wealth is calculated using responses from a cognitively impaired financial respondent, those values may not reliably reflect wave-to-wave changes. Indeed, Venti (2010) finds that longitudinal estimates of IRA values in the HRS are made difficult by inaccuracies in respondent reports.

5.3 Lowess estimates over the 27-point cognition score

5.3.1 Financial capacity and financial responsibility

Do baseline financial respondents turn over responsibility for finances at the same level of cognition that they report having difficulties managing money? Figure 9 displays two graphs; both include a lowess curve of being the financial respondent as well as a lowess of the absence of money difficulties plotted on the 27-point cognition scale. Both of these graphs only include individuals in couples who were the financial respondent at the baseline. The first graph includes those who do not have retirement investments that are individually chosen, while the second graph includes respondents who do. In both cases, 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 suggests that some of these financial respondents may make financial decisions in spite of reporting difficulties handling money. However, the gap between the two lines is much narrower for those who can choose how their retirement wealth is invested, so fewer households are exposed to the risk of bad financial decisions. This also provides some suggestive evidence that the decision to switch the financial respondent is different for the two groups.

These graphs imply that for many individuals, reporting difficulties managing money precedes switching the financial respondent. Table 4 cross-tabulates couple-wave observations and shows that for 87 percent of observations in which initial financial respondents report having trouble handling money, they are still the financial respondent. Table 5 tabulates the order of the two events: reporting problems handling money on the part of the initial financial respondent, and switching the financial respondent. Note that one or more of these events occur for 1575 couples; neither event occurs for the remaining couples. Among the couples that have experienced at least one event, nearly three quarters of them reported difficulties handling money first. For most of these, the financial respondent switch has not yet occurred. An additional 5 percent had both events occurring in the same wave. About 20 percent switched the financial respondent before the baseline financial respondent reported difficulties managing money.

A possible reason for this discrepancy---that a person remains the financial respondent in spite of having problems handling money---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 analysis will address this issue.

5.3.2 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 and financial respondents fall in the dementia range of cognition scores, but do these changes track each other?

Figure 10 displays lowess estimates of being the financial respondent and not having a memory disease diagnosis, plotted against the cognition score. The upper graph includes respondents who have retirement accounts that are individually managed, and the lower graph includes 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. 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, and the gap increases the lower the cognition score. However, the opposite is the case for respondents with retirement investments that are individually chosen. Among those in the dementia range, a much smaller proportion of individuals are financial respondents than have not had memory disease diagnoses. This provides suggestive evidence 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.

Kaplan-Meier estimation

Kaplan-Meier survival estimates (Figure 11) show that those with accounts that are individually managed have a greater hazard of switching the financial respondent than those who do not; a log-rank test rejects the null that these hazard functions are equal (log rank test: $\chi^2(1) = 26.83$; $Pr > \chi^2 = 0.0000$). However, having individually managed retirement accounts does not increase the hazard of reporting problems handling money (log rank test: $\chi^2(1) = 1.57$; $Pr > \chi^2 = 0.2109$). Individuals tend to report difficulties with money at the same levels of cognition, regardless of the nature of their retirement wealth.

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 Alzheimer's. 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. At dementia ranges of cognition, rates of being the financial respondent exceed of having no memory disease diagnosis if retirement wealth is \emph{not} individually controlled. This implies that some demented individuals are serving as the financial respondent in spite of suffering from a memory-related disease. The reverse is true for couples who do have individually controlled investments. The next section uses regression techniques to further understand these patterns.

6 Regression analysis

Here, we analyze how the financial outcomes, financial capacity (measured by respondent self-reports of difficulties handling money) and financial responsibility (measured by identifying the financial respondent in the couple) are affected by cognition and 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 the most financially knowledgeable when the couple first entered the survey. 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." Because there can only be one financial respondent in the couple, each couple only has one observation per wave.

Couples exit the sample when one spouse dies, or the couple otherwise dissolves---this is a source of censoring, which can be addressed using survival analysis. 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 2008 wave of the HRS.

The regression analysis employs the following variables (see Section 4.1for more details):

- Individual-level demographic characteristics of both members of the couple: gender, age, and education,

- Individual-level cognition: 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), natural log of total wealth.

6.1 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. The descriptive analysis above 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 coefficients should be the same for both equations. If a particular coefficient is larger in the equation estimating difficulties handling money, then the decision to switch financial respondents is less responsive.

Table 6 presents results of 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). The reference point is the member of the couple who was the financial respondent at baseline. Having a memory disease diagnosis is strongly associated with difficulties with money, but the effect of a diagnosis on switching the financial respondent much smaller in magnitude and not statistically distinguishable 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 means that while a memory disease diagnosis is associated with switching the financial respondent (though the coefficient is indistinguishable from zero), the effect is even larger for households in which investments in retirement wealth can be individually controlled. It is precisely those couples that are more potentially more exposed to poor financial decisions that are more responsive to memory disease diagnoses in terms of switching the financial respondent.

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. Column (3) reports χ^2 tests for the difference in each coefficient across the two equations. For both the CIND and dementia indicators, the coefficients for the money problem outcome are larger in magnitude than those of the switching financial respondent outcome, and for CIND the difference is statistically significant. This provides additional

evidence that some individuals who have difficulties handling money have not yet been replaced as the financial decision-maker.

6.2 Survival analysis

6.2.1 Survival analysis using age as analysis time

While a bivariate probit model explicitly assumes the two financial outcomes are correlated, the model does not address right censoring caused by the dissolution of couples due to divorce or widowhood. Furthermore, couples who have not switched their financial respondents may still do so in the future, creating another source of right censoring. Survival models treating the two outcomes as "failures" account for such censoring and explicitly model durations so we can compare how time to reporting problems handling money relates to the time to changing financial respondents. Although the bivariate probit model shows that the two equations are correlated, standard survival models assume the two are independent. Here, durations are measured in calendar time, using the baseline financial respondent's age at each wave of observation.

Table 7 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. The main effect of a memory disease diagnosis is much larger for reporting difficulties managing money than for the financial respondent switch, increasing the hazard by a factor of 3.3 and 1.5, respectively. However, the interaction of a memory disease diagnosis with choosing one's own retirement investments has a large, statistically significant positive impact on switching, doubling the hazard, and virtually no impact on having problems managing money. This is consistent with the idea that those with more to lose---those with individually managed retirement accounts---do indeed respond to a memory disease diagnosis above and beyond those who do not choose their own investments.

Having a cognition score in the CIND range more than doubles the hazard of problems handling money relative to being in the normal cognition range. However, a CIND score only increases the hazard of switching the financial respondent by less than a factor of 1.5. This suggests that the hazard of switching of the financial respondent is less responsive to declines in cognition to CIND than the hazard of difficulties handling money, as shown in the descriptive analysis. Given that the evidence in medical research shows that financial capabilities suffer when cognitive declines are still mild, the lack of responsiveness to being in the CIND range can pose problems to the household. That said, dementia increases the hazard of difficulties handling money to 435 percent, and the hazard of switching the financial respondent responds similarly (483 percent), so when declines are severe, families do adjust accordingly.

Having a spouse in the CIND or dementia range reduces the hazard function of money difficulties, to 72 percent and 77 percent of the hazard associated with having normal cognition spouse. Again, the switching of financial respondents is much more responsive to being in the spouse being in the dementia range than in CIND. If the baseline financial respondent is female, the hazard of having problems handling money only increases by a factor of 1.2, while the hazard of switching the financial respondent to the spouse triples. Therefore, the characteristics of both members of the couple are important.

Unlike the bivariate probit regression, 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 (1739 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.

6.2.2 Survival analysis using cognition scores as analysis time

While the previous analysis measures durations in terms of calendar time, we can also treat the 27-point cognition score itself as the "time scale." This would allow us to how much cognition deteriorates before the occurrence of the two failures-developing problems handling money, and switching the financial respondent. Using cognition scores as analysis time in a survival framework is a transformation similar to operational time (Lee and Whitmore, 2006).

To use these scores as analysis "time," cognition scores should decline monotonically with age. Table 8 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. These changes have an average of a 6.5 point decline in cognition scores. Only six percent of wave-to-wave changes are improvements from one cognition category to another. Of these, the vast majority are CIND to normal transitions.

Cognition scores are negatively monotonic for the most part (particularly after a respondent has moved out of the normal range), so they can be treated as analysis time. Some individuals receive the same cognition score in multiple waves; we can either drop the duplicate waves or perturb scores in order to deal with the fact that survival analysis cannot deal with multiple observations at the same point in "time." 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. The two methods have similar results, so we report the analysis using the full sample with perturbed scores.

The first two columns of Table 9 report the results of the estimation of Cox proportional hazards models, one for each failure---problems managing money, and the financial respondent switch. While the main effect of a memory disease diagnosis increases the hazard of having problems managing money by a precisely-measured factor of 1.87, it does not increase the hazard of switching the financial respondent. However, 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 157 percent of the baseline hazard, with a p-value of 0.09.

In using cognition scores as analysis time, there is another source of censoring (in addition to the lack of failure during the most recent measurement): reaching the lowest cognition score. Cognition scores are on a 27-point scale and cannot take values outside this range, so in this 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.

While the Cox estimates in the first two columns of Table 9 do not account for the competing risk of reaching a zero cognition score, the third and fourth columns report results from the analogous competing risks models. The results of the Cox proportional hazards model and the competing risks model are quite similar, but accounting for the competing risk strengthens the estimates of the effects of a memory disease diagnosis and its interaction with controlling investments. Surprisingly, the main effect of having a memory disease diagnosis, while doubling the hazard of difficulties handling money, decreases the hazard of switching the financial respondent, though it is not statistically significant. However, its interaction effect with 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 2.1), 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.

Given that problems handling money tend to precede the financial respondent switch, we also estimate models of this switch with problems handling money as an explanatory variable. Results from the estimation of a Cox proportional hazards model and a competing risks model are reported in Table 10. Even controlling for these problems managing money, the two models again confirm the large, significant effect of a memory disease diagnosis on switching the financial respondent *for those who control investments in their retirement accounts*. In fact, for the competing risks regression in column (2), the hazard ratio of the interaction effect is a statistically significant 2.2.

Reporting having trouble handling money has a strong (and statistically significant, for the Cox model) effect on the hazard. If the initial financial respondent reports no problems, the hazard is reduced; if the spouse reports no problem, the hazard is increased. In all specifications, other spousal characteristics also matter in the expected way; in some cases they matter more than the initial financial respondent's characteristics. The older, more educated, and more cognitively intact a spouse is, the greater the hazard of switching financial respondents. The effect of the spouse's age is not statistically significant in the competing risk regression, which is not surprising given that the regression already controls for spouse's cognition. Own age and education do not have a statistically significant effect on the hazard.

Holding a greater share of wealth in stock and log wealth have very little effect on the hazard of switching the financial respondent. While this is inconsistent with the intuition of the theoretical model 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.

7 Conclusion

How one prepares for cognitive decline depends on how much one has to lose by failing to prepare. 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, 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 a 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. The same story arises in all of the regression analyses---bivariate probit models, survival analysis using calendar age, and survival analysis using cognition as analysis time. There is 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. They also switch at higher levels of cognition---in other words, before suffering too much decline---and sooner after reporting problems handling money.

This is consistent with an economic model of the value of information about future states. If information about future cognition enables re-optimization and preparation by have someone else manage retirement wealth, then the information is useful. 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. This is not just an effect of higher wealth, which has a small, positive but imprecisely estimated effect on the financial respondent switch in all specifications. Spousal characteristics 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 provides evidence that the most important factor is one of comparative advantage relative to one's spouse.

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 there 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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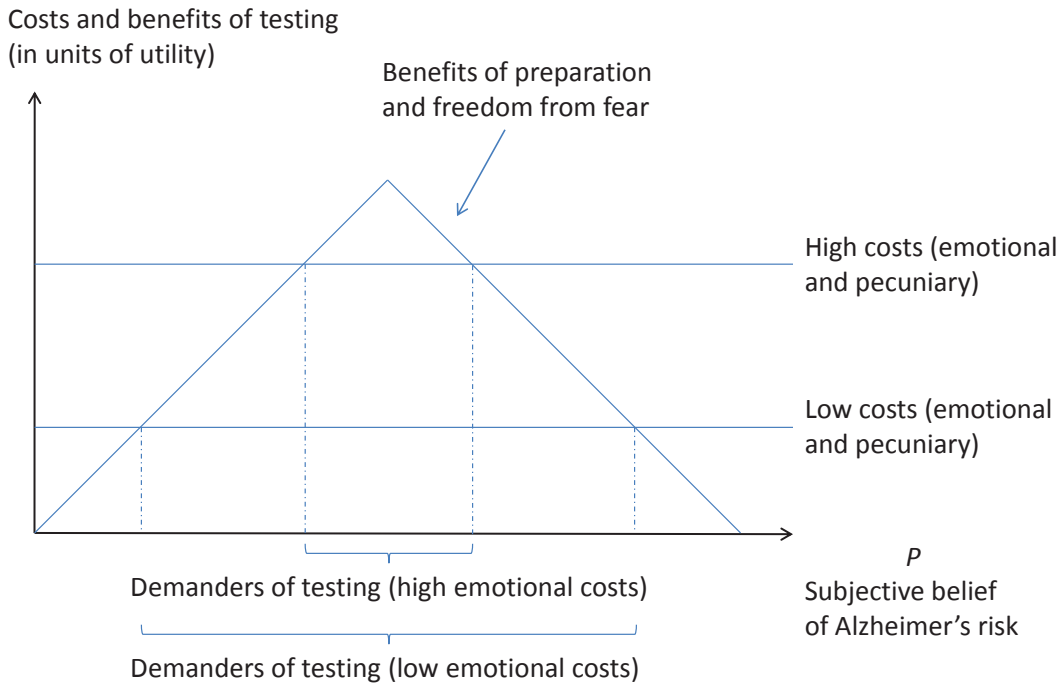
A Figures and Tables

Figure 1: Value of information as a function of subjective risk of Alzheimer's



Graph adapted from Figure 1 of Boozer and Philipson (2000).

Figure 2: Cognition score of ADAMS respondents, by eventual outcome

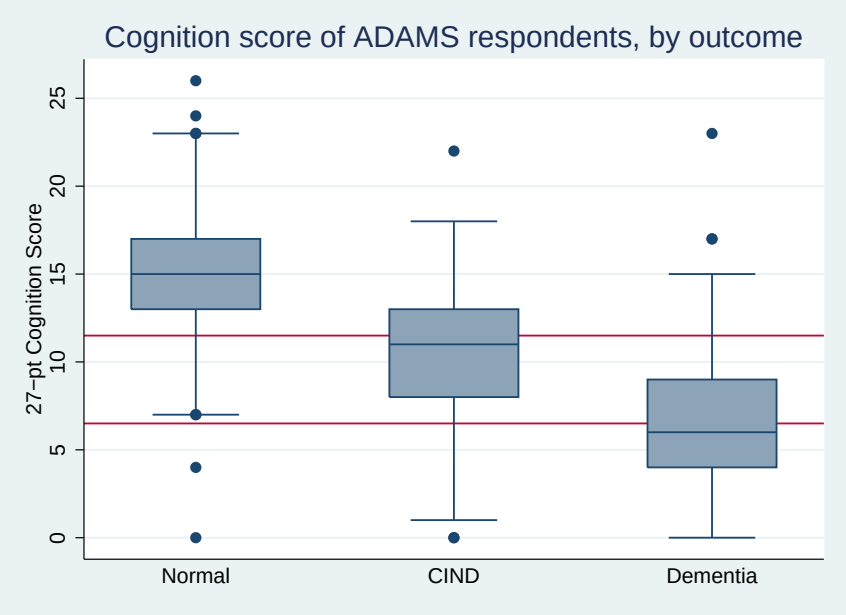


Figure 3: Self reported memory disease diagnoses, by cognition score

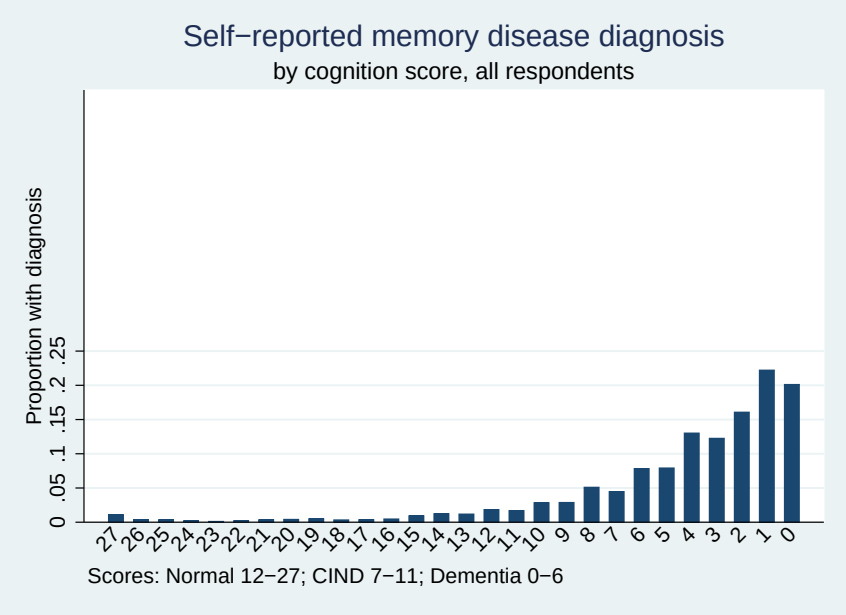


Figure includes all respondents.

Figure 4: Self-reported difficulties handling money, by cognition score

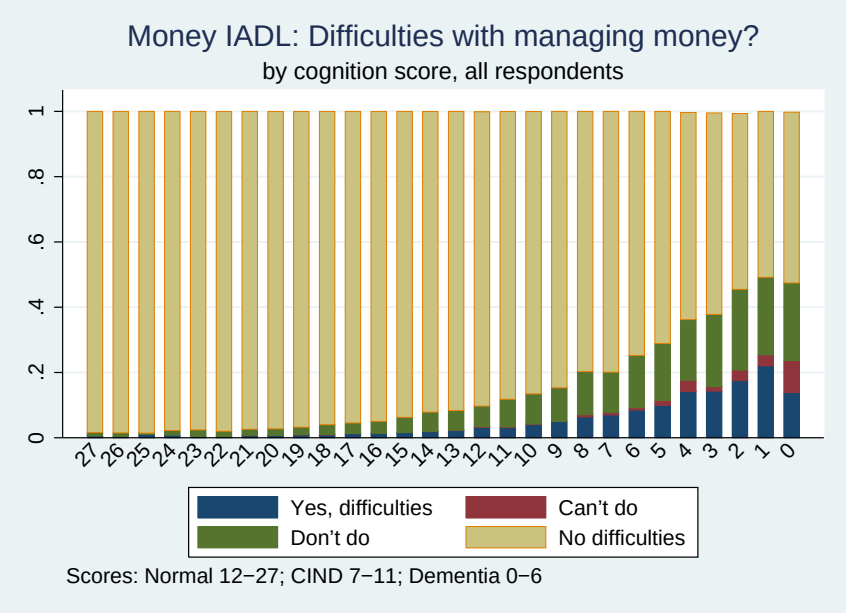


Figure includes all respondents.

Figure 5: Self-reported difficulties handling money, by cognition score range

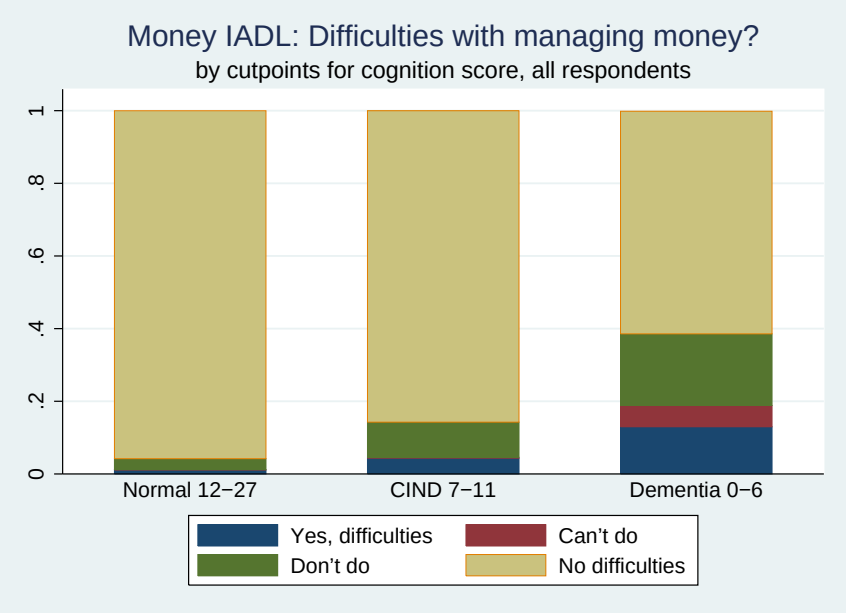


Figure includes all respondents.

Figure 6: Proportion of individuals who are financial respondents, by cognition score

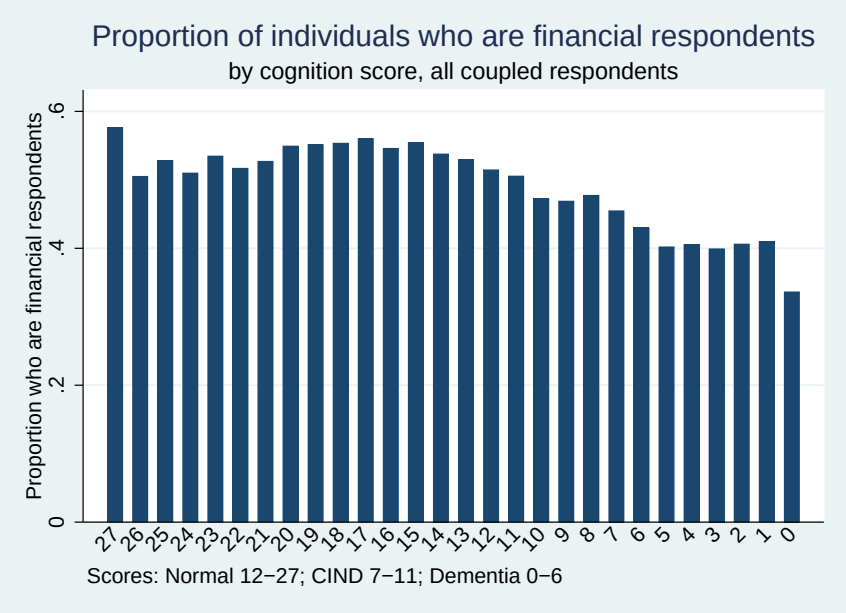


Figure includes all respondents in couples.

Figure 7: Proportion of individuals who are financial respondents, by cognition score range

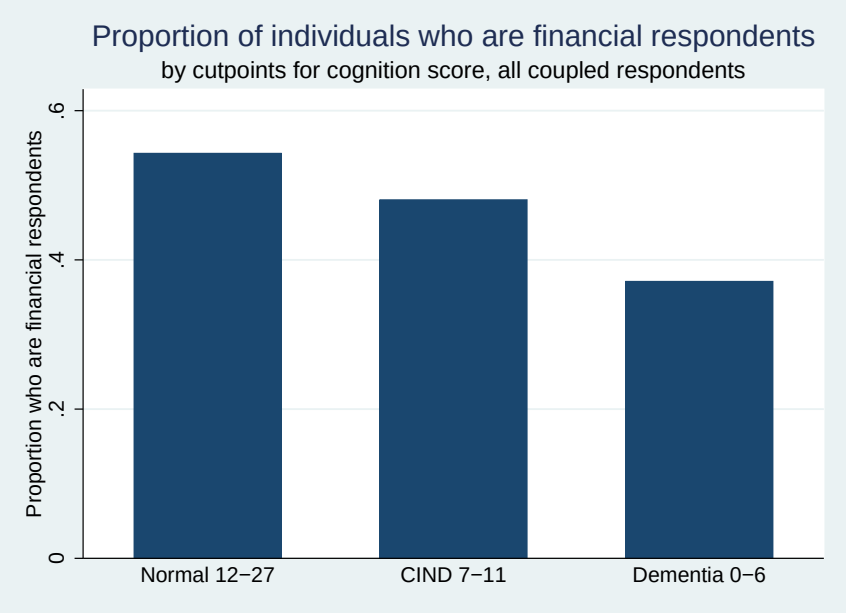


Figure includes all respondents in couples.

Figure 8: Lowess estimates of change in wealth (in thousands of dollars) and change in cognition

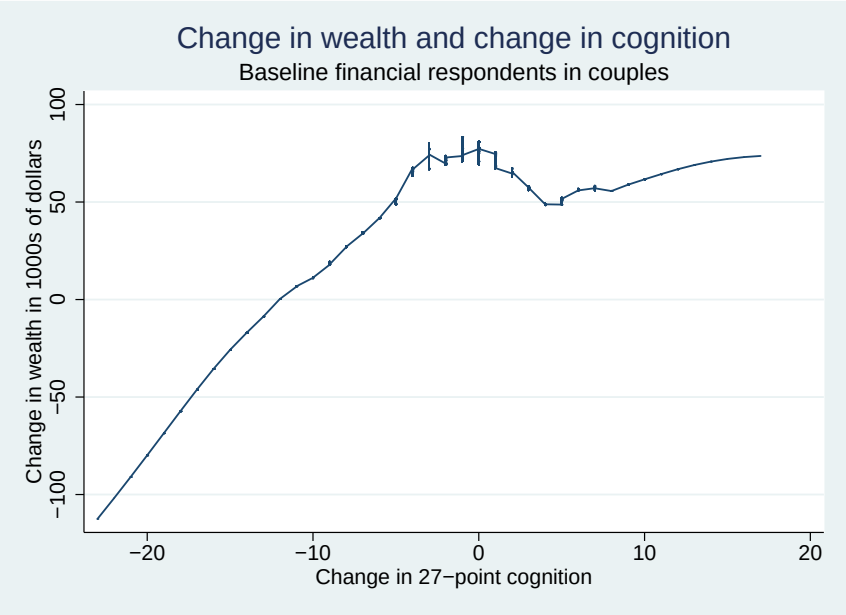


Figure 9: Financial respondents and the absence of difficulties handling money by cognition score, separated by nature of retirement wealth

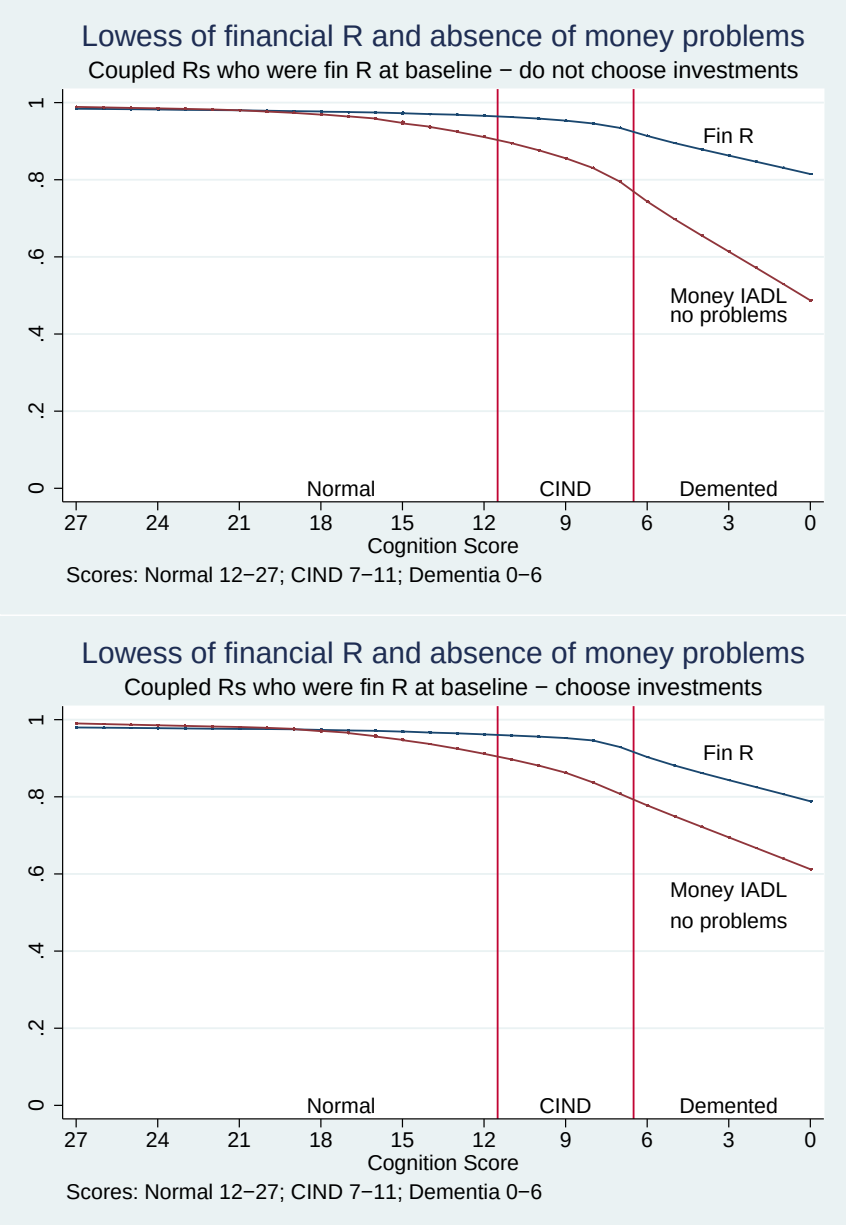


Figure includes all respondents in couples who were financial respondents during the baseline wave.

Figure 10: Financial respondents and memory diagnoses over cognition scores, separated by nature of retirement wealth

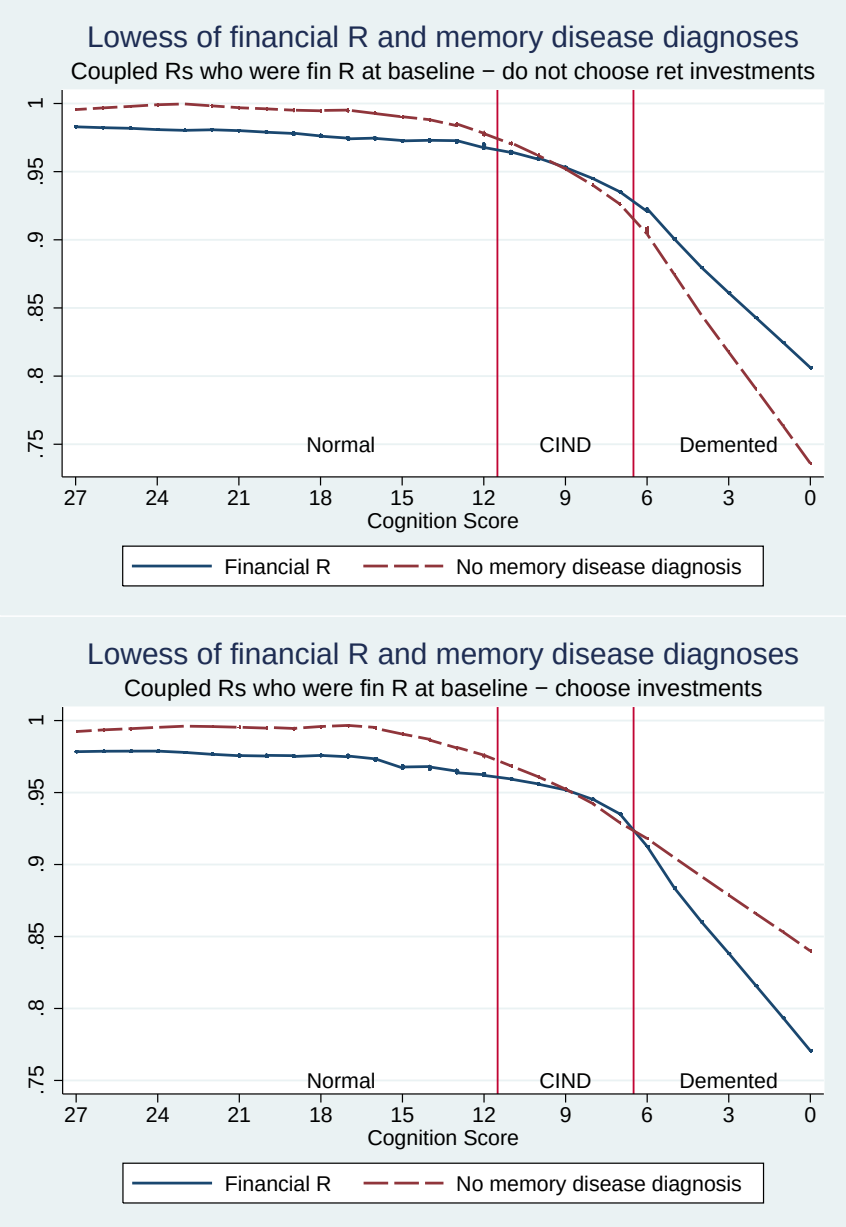


Figure includes all respondents in couples who were financial respondents during the baseline wave.

Figure 11: Kaplan-Meier survival estimates of problems handling money and being the financial respondent, separated by nature of retirement wealth

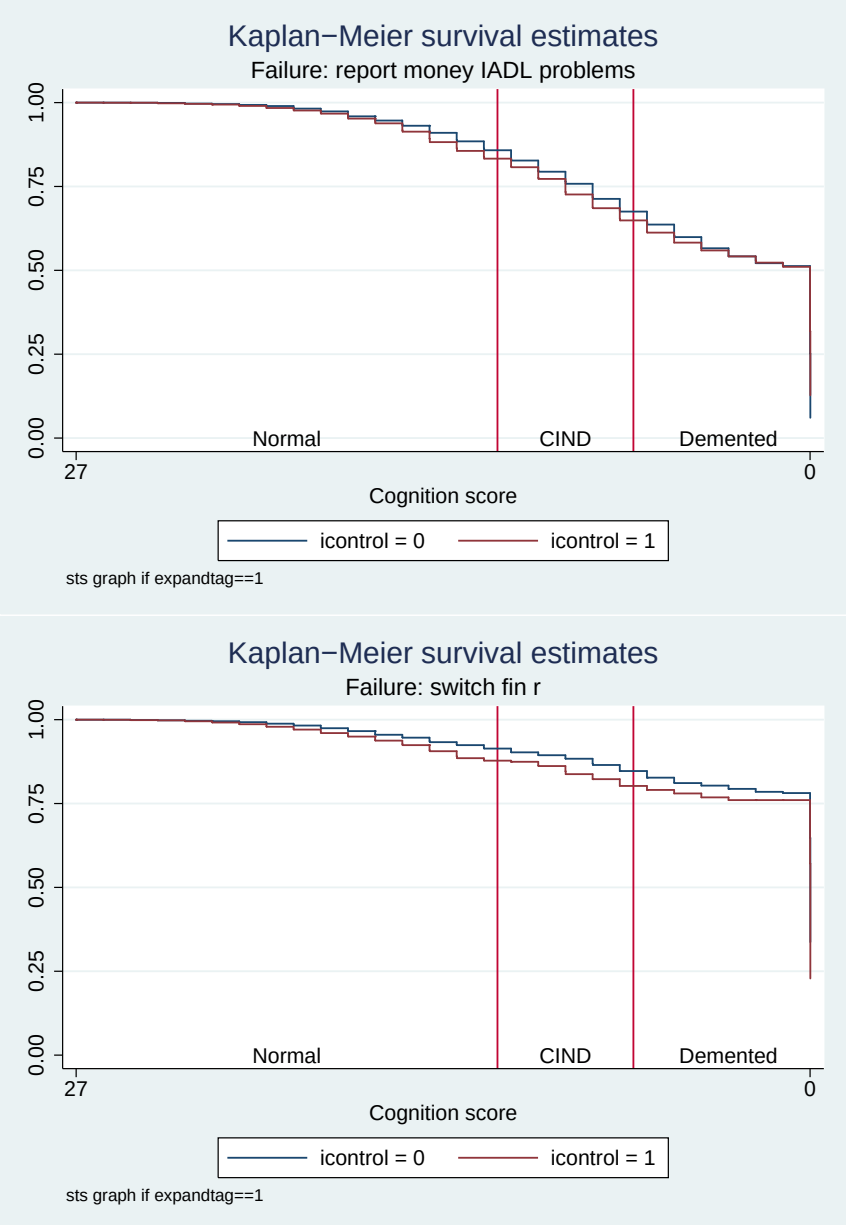


Figure includes all respondents in couples who were financial respondents during the baseline wave.

Table 1: Summary statistics of financial respondents during the first wave analysis

Variable	Mean	Std. Dev.	N
Female	0.362	0.481	7103
Own age	63.817	9.6	7103
Spouse's age	63.18	10.201	7103
Years of school	12.793	3.146	7103
Spouse's years of school	12.245	3.133	7103
Tercile of stock share if stock> 0, otherwise 0	0.744	1.084	7103
Log total household assets	11.999	1.594	7103
Choose investments for retirement accounts	0.318	0.466	7103
Own cognition in normal range	0.845	0.362	7103
Own cognition in CIND range	0.108	0.31	7103
Own cognition in Dementia range	0.048	0.213	7103
Own problems handling money	0.045	0.207	7103
Own memory disease diagnosis	0.015	0.12	7103
Spouse's cognition in normal range	0.791	0.406	7103
Spouse's cognition in CIND range	0.131	0.337	7103
Spouse's cognition in Dementia range	0.078	0.268	7103
Spouse's problems handling money	0.092	0.289	7103
Spouse's memory disease diagnosis	0.018	0.135	7103

Table 2: Cognition of baseline financial respondent and spouse

	Own cognition			
Spouse's cognition	Normal	CIND	Dementia	Total
Normal	4,941	666	392	5,999
CIND	466	188	112	766
Dementia	215	75	48	338
Total	5,622	929	552	7,103

Table 3: Proportion of respondents with memory disease diagnoses, by cognition score range

Cognition score	Proportion with Memory disease diagnosis	Std. Dev.	Freq.
Normal	.007	.082	57332
CIND	.0301	.171	8856
Dementia	.156	.363	4029
Total	.018	.134	70217

Table reports results for all respondents, person-wave observations.

Table 4: Financial respondents and difficulties handling money

Problems	1 if financial respondent		
Handling money	Mean	Std. Dev.	Freq.
No	.968	.176	23701
Yes	.864	.343	1371
Total	.962	.190	25072

Table reports results for observations in the analysis sample only; person-wave observations.

Table 5: Onset of money problems and switching the financial respondent

Events				Years between events	
Problems handling money	Switch financial respondent	Freq	%	Mean	SD
1st event	n/a	1089	0.69	3.21	3.56
1st event	2nd event	76	0.05	4.72	3.17
Events happened same wave		73	0.05	0.00	0.00
2nd event	1st event	48	0.03	-4.44	2.62
n/a	1st event	289	0.18	3.12	3.55
TOTAL		1575	100.00	2.89	3.74

Table 6: Bivariate probit regressions with outcomes "Difficulties handling money" and "no longer financial respondent"

	(1) Difficulties Handling money	(2) Not Financial Respondent	(3) χ^2 test (P-value)
Female	-0.02	0.43***	27.8
	(0.05)	(0.07)	(0.00)
Age	0.02***	0.00	5.10
	(0.01)	(0.01)	(0.02)
Spouse's Age	-0.01	0.02***	13.53
	(0.00)	(0.01)	(0.00)
Own education	-0.01	-0.01	0.20
	(0.01)	(0.01)	(0.66)
Spouse's education	-0.02*	0.03	7.48
	(0.01)	(0.01)	(0.01)
Own cognition: CIND	0.49***	0.23***	11.1
	(0.05)	(0.07)	(0.00)
Own cognition: dementia	1.00***	0.99***	0.02
	(0.07)	(0.09)	(0.90)
Spouse's cognition: CIND	-0.24***	-0.28***	0.35
	(0.06)	(0.07)	(0.55)
Spouse's cognition: dementia	-0.18*	-0.65***	14.7
	(0.09)	(0.10)	(0.00)
Control investments	0.01	0.09	1.01
	(0.05)	(0.06)	(0.31)
Memory disease diagnosis	1.22***	0.13	54.8
	(0.09)	(0.13)	(0.00)
Control X Diagnosis	-0.01	0.49*	3.87
	(0.19)	(0.22)	(0.05)
Spouse diagnosis	0.04	-0.13	0.99
	(0.12)	(0.14)	(0.32)
Spouse's problems handling money	-0.12	-0.26***	2.02
	(0.07)	(0.08)	(0.16)
Stock share tercile	0.00	-0.03	1.54
	(0.02)	(0.02)	(0.21)
Log total assets	-0.09***	-0.00	10.46
	(0.02)	(0.02)	(0.00)
Const.	-1.39***	-4.01***	36.98
	(0.28)	(0.34)	(0.00)
ρ	0.27***		
	(0.04)		
N	25072		

* significant at 5%; ** significant at 1%; *** significant at 0.1%

Coefficients reported. Estimation uses HRS household level weights (unweighted results are very similar). For regression results, robust standard errors in parentheses (couple-level clusters). For χ^2 tests, p-values in parentheses.

Table 7: Cox proportional hazards models with age as analysis time

	(1)	(2)	(3)
Regression type	Cox PH	Cox PH	Cox PH
Analysis time	Age	Age	Age
Failure	Money IADL	Not fin R	Not fin R conditional on money IADL
	b/se	b/se	b/se
Female	1.014	2.748***	2.065***
	(0.07)	(0.21)	(0.38)
Spouse's Age	0.981***	1.011	0.991
	(0.00)	(0.01)	(0.01)
Own education	0.975*	0.991	0.987
	(0.01)	(0.01)	(0.03)
Spouse's education	0.983	1.074***	1.055
	(0.01)	(0.02)	(0.03)
Own cognition: CIND	2.306***	1.429***	1.071
	(0.17)	(0.15)	(0.23)
Own cognition: dementia	4.352***	4.832***	2.654***
	(0.35)	(0.47)	(0.52)
Spouse's cognition: CIND	0.692***	0.577***	0.684
	(0.06)	(0.06)	(0.15)
Spouse's cognition: dementia	0.750**	0.342***	0.321**
	(0.08)	(0.06)	(0.12)
Control investments	1.190**	1.163*	0.960
	(0.08)	(0.09)	(0.17)
Memory disease diagnosis	3.294***	1.469*	1.211
	(0.32)	(0.24)	(0.32)
Control X Diagnosis	1.160	1.950**	2.001
	(0.20)	(0.50)	(0.78)
Spouse diagnosis	1.062	0.866	0.818
	(0.19)	(0.25)	(0.46)
Spouse's problems handling money	0.852	0.619***	0.936
	(0.08)	(0.08)	(0.28)
Stock share tercile	1.002	0.932*	0.820*
	(0.03)	(0.03)	(0.07)
Log total assets	0.886***	0.993	1.139*
	(0.02)	(0.03)	(0.06)
N	25072	25072	1739

* significant at 5%; ** significant at 1%; *** significant at 0.1%

Hazard ratios reported.

Table 8: Changes in cognition scores over time

Change in cognitive status	Change in cognition score		Freq.	Percent
	Mean	SD		
Normal to Normal	-0.22	3.20	45,738	76.4
Normal to CIND	-5.09	2.77	4,111	6.87
Normal to Dementia	-13.52	4.58	925	1.55
CIND to Normal	4.71	2.64	3,032	5.06
CIND to CIND	-0.13	1.78	2,836	4.74
CIND to Dementia	-5.78	2.91	1,029	1.72
Dementia to Normal	8.90	2.77	142	0.24
Dementia to CIND	3.69	1.82	474	0.79
Dementia to Dementia	-0.65	1.86	1,580	2.64
Total	-0.56	3.97	59,867	100.00

All respondents included.

Table 9: Cox proportional hazards and Competing Risks Regression models using cognition as analysis time, two failures estimated separately

	(1)	(2)	(3)	(4)
Regression type	Cox PH		Competing Risks	
Analysis time	Cognition Score		Cognition Score	
Failure	Money IADL	Not fin R	Money IADL	Not fin R
Female	0.971	2.725***	0.775**	2.230***
	(0.07)	(0.21)	(0.07)	(0.28)
Age	1.013*	0.997	1.004	1.010
	(0.01)	(0.01)	(0.01)	(0.01)
Spouse's Age	1.004	1.034***	1.012*	1.013
	(0.01)	(0.01)	(0.01)	(0.01)
Own education	0.990	1.001	1.013	1.015
	(0.01)	(0.01)	(0.01)	(0.02)
Spouse's education	0.974*	1.076***	0.964**	1.053*
	(0.01)	(0.02)	(0.01)	(0.03)
Spouse's cognition: CIND	0.740***	0.567***	0.731***	0.575**
	(0.06)	(0.06)	(0.07)	(0.10)
Spouse's cognition: dementia	0.742**	0.335***	0.591***	0.347***
	(0.08)	(0.06)	(0.08)	(0.11)
Control investments	1.259***	1.396***	1.000	1.146
	(0.08)	(0.11)	(0.09)	(0.15)
Memory disease diagnosis	1.946***	0.872	1.786***	0.909
	(0.17)	(0.14)	(0.18)	(0.20)
Control X Diagnosis	0.952	1.605	0.892	2.115*
	(0.16)	(0.42)	(0.18)	(0.72)
Spouse diagnosis	0.986	0.759	0.881	0.555
	(0.16)	(0.22)	(0.18)	(0.35)
Spouse's problems handling money	0.950	0.674**	1.034	0.522*
	(0.09)	(0.09)	(0.12)	(0.13)
Stock share tercile	1.071*	0.971	1.076*	0.992
	(0.03)	(0.03)	(0.04)	(0.06)
Log total assets	0.920***	1.053*	0.940**	1.002
	(0.02)	(0.03)	(0.02)	(0.05)
N	26913	26913	25401	26335
N couples	7087	7087	7063	7063
N failures	1421	923	849	348
N competing risk			137	261

* significant at 5%; ** significant at 1%; *** significant at 0.1%

Hazard ratios reported.

Table 10: Survival analysis using cognition as analysis time: problems managing money as an explanatory variable

	(1)	(2)
Regression type	Cox PH	Competing risks
Analysis time	Cognition score	Cognition score
Failure	Not fin R	Not fin R
Female	2.660***	2.202***
	(0.21)	(0.28)
Age	0.988	1.002
	(0.01)	(0.01)
Spouse's Age	1.032***	1.010
	(0.01)	(0.01)
Own education	1.000	1.014
	(0.01)	(0.02)
Spouse's education	1.078***	1.054*
	(0.02)	(0.03)
Spouse's cognition: CIND	0.554***	0.566**
	(0.06)	(0.10)
Spouse's cognition: dementia	0.349***	0.352***
	(0.07)	(0.11)
Control investments	1.275**	1.031
	(0.10)	(0.14)
Memory disease diagnosis	0.745	0.814
	(0.12)	(0.20)
Control X Diagnosis	1.658	2.205*
	(0.44)	(0.76)
Spouse diagnosis	0.794	0.587
	(0.24)	(0.37)
Own problems handling money	1.503***	1.276
	(0.15)	(0.22)
Spouse's problems handling money	0.688**	0.528*
	(0.10)	(0.14)
Stock share tercile	0.980	0.999
	(0.03)	(0.06)
Log total assets	1.059*	1.008
	(0.03)	(0.05)
N	24334	23783

* significant at 5%; ** significant at 1%; *** significant at 0.1%

Hazard ratios reported.