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Cognitive Decline, Limited Awareness, Imperfect Agency, and Financial Well-Being[†]

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Cognitive decline may lead older Americans to make poor financial decisions. Preventing poor decisions may require timely transfer of financial control to a reliable agent. Cognitive decline, however, can develop unnoticed, creating the possibility of suboptimal timing of the transfer of control. This paper presents survey-based evidence that older Americans with significant wealth regard suboptimal timing of the transfer of control, in particular delay due to unnoticed cognitive decline, as a substantial risk to financial well-being. This paper provides a theoretical framework to model such a lack of awareness and the resulting welfare loss. (*JEL* G51, G53, H55, J14, J26, J32)

With population aging and the shift from defined-benefit to defined-contribution pensions, older Americans are becoming more responsible for managing their own finances during their retirement (Poterba 2014). As they approach the end of their lives, many have to make consequential financial decisions, such as estate planning, whether and when to sell their houses, and making costly late-in-life care arrangements. Unfortunately, cognitive decline may affect the quality of such decisions. About one-third of Americans 85 years or older (and 9 percent of those 65 years or older) have dementia (Langa et al. 2017), and cognitive decline without dementia is even more common (Plassman et al. 2008). Cognitive decline also makes older Americans vulnerable to financial fraud.[1] Setting up contingency plans can help with these challenges, but it is infeasible to plan for all potential paths of physical and

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[1] DeLiema et al. (2020) document financial fraud aimed at older Americans, and Choi, Kulick, and Mayer (2008) study financial exploitation of elders. Egan, Matvos, and Seru (2019) show that there is more misconduct by financial advisers in counties with a larger population share of retirees.

cognitive health, longevity, financial, and family dynamics. Therefore, as Agarwal et al. (2009); Santucci (2019); and Chandra, Coile, and Mommaerts (forthcoming) emphasize, it is important for economists to understand how Americans currently handle these challenges and to search for better paths forward. The prospect of cognitive decline makes the financial decision-maker's ability focal for financial well-being in late life.[2]

Given that it is not possible to set in place complete contingent plans, the second best may involve relying on a third party ("agent," hereafter), commonly a family member, to take over decisions when cognitive decline has set in (see Angrisani and Lee 2019). Ideally, this solution reduces the risk of making big mistakes. But even if there is a highly trusted agent—for example, an adult child—there is another clear challenge that may limit their role. Many who have watched loved ones age are struck by their failure to recognize their own decline. The risk of unrecognized cognitive decline and its consequences are a salient part of the aging process. These concerns are precisely what we measure and model in this paper.

We use a survey to identify how many older American wealthholders have a reliable agent and how many are concerned about the timing of their likely transfer of control. We implement this instrument in the Vanguard Research Initiative (VRI), a panel of older (55+) Vanguard clients with above-average wealth and financial literacy. VRI coverage concentrates on individuals who have wealth above the age-adjusted US population median wealth level. The tenth and fiftieth percentiles of the VRI wealth distribution correspond to the sixtieth and ninetieth percentiles of the US population distribution.

The focus of the instrument was influenced by a pilot survey that affected our prior beliefs. Somewhat to our surprise, most respondents in the pilot survey were confident of the availability and ability of a trustworthy agent to make good financial decisions on their behalf—though not quite as good as decisions respondents themselves would make in the absence of cognitive decline. In contrast, many were concerned about their own future behavior and the possibility that they may fail to transfer control at the right time. This sophisticated understanding of future control problems was striking. Our main survey was designed to quantify concerns about both the quality of an available agent and about the timing of the transfer of control.

Despite the high quality of the agent, most respondents do not want to transfer control immediately at the onset of cognitive decline, implying value in being one's own agent while still capable. At the same time, this creates uncertainty about the timing of the transfer of control. In line with the pilot survey results, many respondents worry about a delayed transfer (compared to the optimal timing) of control. For those who worry, the subjective costs that we assess using a purpose-designed strategic survey question are perceived to be high, amounting to 18 percent of their wealth (about $400,000) on average. The survey responses also allow us to calculate how much the respondents are currently willing to pay—without knowing whether they will develop significant cognitive decline or not—to guarantee the

[2] See, for example, De Nardi, French, and Jones (2010); Ameriks et al. (2011); Kopecky and Koreshkova (2014); Lockwood (2018); and Ameriks, Briggs, Caplin, Shapiro, et al. (2020) for studies that focus on the needs and desires of the older population but not changes in their ability to make financial decisions. See De Nardi, French, and Jones (2016) for a survey of this literature.

optimal timing of a transfer. Though willingness to pay (WTP) varies substantially across respondents, we identify many individuals with a high WTP: 25 percent of the sample would be willing to pay more than $50,000, and 15 percent more than $100,000, to guarantee the optimal transfer timing.

We develop a simple model of cognitive decline to capture the chance of not noticing own cognitive decline and how it limits the role of the agent. The model allows the actual timing of transfer either to be delayed by lack of awareness or to be earlier than ideal to preempt the risk of future lack of awareness. To highlight which features of the world might generate the concern evident in the survey responses, we implement an illustrative calibration exercise. The simple model is able to generate key findings from the survey: delayed transfer is likely and costly. Essential to generating these results are limited awareness of cognitive decline and a desire to maintain control of one's own finances while capable.

This paper relates to an expanding literature on late-in-life financial mistakes. This literature investigates how cognitive decline is related to mistakes in using financial products (Agarwal et al. 2009), investment mistakes (Korniotis and Kumar 2011), stock market participation (Christelis, Jappelli, and Padula 2010), wealth loss (Angrisani and Lee 2019), and seeking financial advice (Kim, Maurer, and Mitchell 2019). See also Lusardi, Mitchell, and Curto (2014) and Lusardi and Mitchell (2014), which document that financial literacy decreases with age late in life. We contribute to this literature by focusing on the role of a timely transfer of control over finances to a reliable agent in preventing late-in-life financial mistakes.

This paper also contributes to the literature on unnoticed cognitive decline. There are recent papers in the gerontology literature documenting unnoticed cognitive-decline-induced deterioration in general functioning (Farias, Mungas, and Jagust 2005; Okonkwo et al. 2009) and financial decision-making (Okonkwo et al. 2008; Nicholas et al. 2021; Sunderaraman et al. 2022). In the economics literature, Finke, Howe, and Huston (2016); Gamble et al. (2015); and Mazzonna and Peracchi (2020) document the gap between self-confidence and objective performance in memory and financial literacy among older individuals. Mazzonna and Peracchi (2020) show that this gap leads to a decline in wealth. We show that older individuals anticipate the possibility of not noticing their own decline and perceive this as a key friction in determining the timing of a transfer of control.

I. Data

This paper uses the Vanguard Research Initiative (VRI), a panel of account holders at the Vanguard Group. The VRI is composed of account holders who are at least 55 years old, have at least $10,000 in their Vanguard accounts (to guarantee their nontrivial engagement with Vanguard), and have internet access enabling them to complete online surveys. The VRI consists of seven surveys and linked Vanguard account data. The sample design of the VRI provides ample observations of older Americans with a significant amount of wealth late in life, allowing for precise inference on questions that are relevant for that group.

The VRI surveys feature strategic survey questions (SSQs) that place the respondents in hypothetical situations and elicit their preferred actions in those situations. The SSQs enable identification of the role of individual preferences and

beliefs, separately from confounding factors, in explaining observed behaviors. Multiple purpose-designed VRI surveys have been used to study late-in-life saving (Ameriks, Briggs, Caplin, Shapiro, et al. 2020), the desire to insure long-term care risk (Ameriks et al. 2018), portfolio choice (Ameriks, Kézdi, et al. 2020), and retirement decisions (Ameriks, Briggs, Caplin, Lee, et al. 2020).

This paper uses the seventh VRI survey, which focuses on late-in-life cognitive decline (Vanguard Research Initiative 2020). It was implemented over two phases. The pilot survey, implemented in December 2019, was fielded to a smaller sample (279 respondents) and focuses on the quality of the likely agents. It was followed up by online chats with respondents to learn more about their concerns related to their potential cognitive decline. The main survey, implemented in July 2020, was fielded to a larger sample (2,489 respondents) and focuses more on the timing of the transfer of control, a key concern identified in the pilot survey and the follow-up chats.[3] All the results reported in this paper are from the main survey unless noted otherwise.

Online Appendix A1 presents the key characteristics of the VRI sample. The mean age is 74 years, with 80 percent of the sample aged 64–83. The VRI sample is, by construction, wealthier, more educated, and healthier than the Health and Retirement Study (HRS) sample (Health and Retirement Study 2021; wave 2016) that is representative of older Americans. A large part of the difference comes from the VRI sampling criteria (having at least $10,000 in nontransactional accounts and internet access). Once we impose the same selection criteria on the HRS, the gap reduces significantly though not entirely. The VRI has good coverage of the above-median range of the US net worth distribution, with the tenth and fiftieth percentiles from the VRI close to the sixtieth and ninetieth percentiles from the HRS. See online Appendix A1 for more details.

Given the sample characteristics, this is arguably a group of people for whom lack of financial knowledge is not a key issue for their financial well-being. This helps us focus on their concerns about losing current financial capability due to cognitive decline. Also, wealthholders need to make particularly complex financial decisions at the end of life (such as estate planning and arranging late-in-life care out of pocket). Wealthholders also face a higher chance of being a target of financial exploitation (DeLiema et al. 2020). In addition, Mazzonna and Peracchi (2020) document that wealth decline after unnoticed cognitive decline is concentrated among wealthy individuals who hold stocks.

II. Survey Evidence

In this section, we present the key survey findings on cognitive decline and the transfer of control.

[3] For the questions that are common between the pilot and main surveys, including the subjective probability of having cognitive decline and the quality of likely agents, the response distributions are almost identical between the two surveys.

A. *Subjective Probability of Cognitive Decline*

The survey follows the HRS by defining cognitive decline as having significant difficulties with any of the following: remembering familiar things and recent changes, learning new things, following a story in a book or on TV, making decisions on everyday matters, handling financial matters, or using your intelligence to reason things through. It asks the subjective probability of having cognitive decline for at least one year and for at least five years.

The respondents overall perceive a meaningful risk of experiencing cognitive decline for at least five years. The median probability is 15 percent, and the mean is 29 percent. The average subjective probability is somewhat smaller than, but fairly close to, the 34 percent realized average chance of having cognitive decline for at least five years calculated from the realized path of cognitive decline from the HRS sample that satisfy the VRI sampling criteria (see online Appendix A2). The responses are also broadly similar to the subjective probability of dementia that Guistinelli, Manski, and Molinari (2022) estimate from an experimental module in the HRS.

B. *Quality and Availability of the Agent*

The survey then asks about the "likely agent" ("agent," henceforth)—the most likely person to make financial decisions on behalf of the respondent in case the respondent's ability to make a financial decision is severely impaired. For coupled households, the survey specifies that they outlived their spouse or partner by the time they have significant cognitive decline, so the spouse or partner cannot be the agent. The vast majority (70 percent) of the respondents say the agent is one of their children (Table 1, panel A). About 10 percent say it is one of their siblings. The remaining 20 percent report something else.

Respondents are highly confident in the capability and trustworthiness of their agents. The vast majority of respondents believe that their agents would be either excellent or very good along many key criteria (Table 1, panel B). The pilot survey also asks respondents to compare the quality of decisions made by either the agent or the self with cognitive decline to that of the self without cognitive decline. The respondents typically think the quality of decisions to be made by the agent is almost, though not exactly, as good as the self without cognitive decline.[4]

The respondents are also confident that their agent would be available, with an average subjective probability of availability when help is needed of 76 percent (Table 1, panel C).

C. *Uncertainty in the Timing of the Transfer of Control*

The evidence presented so far suggests that older American wealthholders are confident in the availability and quality of their agent. The online chats conducted after the pilot survey, however, indicated that the respondents are concerned about

[4] The question asks the amount of wealth needed to compensate for decisions to be made by the worse decision-maker. See online Appendix B1 for the implementation of this question and the details of the responses.

Table 1—Agents: Type, Quality, and Availability

	Fraction					
Panel A. Who is your likely agent?						
Child/child-in-law	69.8%					
Sibling	9.7%					
Trustee/institution	8.7%					
Grandchild	0.6%					
Other	11.1%					
	Excellent	Very good	Good	Fair	Poor	
Panel B. How good would your likely agent be at …						
Understanding your needs and desires	44%	39%	14%	3%	1%	
Understanding your financial situation	48%	33%	15%	3%	0%	
Understanding financial matters in general	48%	32%	15%	4%	0%	
Pursuing your interests instead of his/her own	57%	30%	10%	2%	1%	
	Percentile					
	10th	25th	50th	75th	90th	Mean
Panel C. Percent chance that your likely agent will be available						
	25	55	85	100	100	76

Note: Observations = 2,489.

Source: Vanguard Research Initiative (2020), as explained in text

the possibility that control over their finances may not be transferred to the agent at the right time. Based on these findings, in the main survey, we designed a battery of questions to learn more about this concern.

The battery asks respondents about a hypothetical late-in-life situation with cognitive decline. (See online Appendix B2 for the script of this battery.) Specifically, the respondents are asked to imagine that they are at the beginning of the last five years of their life and that they have mild cognitive decline. The progression of cognitive decline during the rest of the five years is left uncertain. Over the last five years of life, decisions need to be made about how to spend resources on the respondent's behalf (both routine and nonroutine spending, including medical expenditures), how to save for the future and manage investments, and how much to give to relatives, friends, and charities. Those decisions can be made by the respondent or by the agent if the respondent decides to transfer control to the agent (and if the agent agrees to it). The survey is concrete about the amount of financial resources available at the beginning of the last five years, $\$W$. It preloads an amount based on the actual net worth of the household.[5]

The battery first asks when is the optimal timing of the transfer, in terms of the progression of cognitive decline. In this question, the survey asks respondents to think only about the quality of financial decisions to be made and not to think about, for example, how much burden it will be to their agents. It presents three options, listed in panel A of Table 2. The vast majority (84 percent) say they do not want to give up control immediately at the onset of cognitive decline, implying that they value being their own agent when they are still capable, but also do not want to wait until they completely lose the ability to manage their own finances. This is

[5]The survey uses the nearest multiple of $500,000 to respondents' actual net worth. If net worth is below $250,000, it uses $500,000. See online Appendix Table B2 for the distribution of $\$W$.

Table 2—Uncertainty in the Timing of the Transfer of Control

	Fraction
Panel A. Optimal timing of transfer	
Immediately at the onset of cognitive decline	8.0%
During further decline but before completely losing the ability to manage own finances	83.9%
When completely lose the ability to manage own finances	8.1%

	Distribution of percent chance						
	Percentile						
	10th	25th	50th	75th	90th	Mean	Observations
Panel B. Transfer at the wrong time							
Delayed transfer	5	15	25	55	75	35	2,293
Early transfer	5	5	25	35	35	24	2,295
Panel C. Reasons for a delayed transfer							
Respondent not noticing own cognitive decline	15	25	45	55	75	42	2,293
Respondent not wanting to give up the control	5	25	45	65	75	44	2,293
Agent not noticing principal's cognitive decline	5	15	25	55	75	33	2,293
Agent not being available	0	5	15	35	55	23	2,293
Panel D. Reasons for an early transfer							
Agent taking control against respondent's preference	5	5	25	35	55	26	2,294

Notes: Observations = 2,489 for panel A. The numbers of observations are smaller for the other panels as the questions related to a delayed transfer are not asked to respondents who choose the last option in the optimal timing question and the questions related to an early transfer are not asked to respondents who choose the first option in the optimal timing question.

Source: Vanguard Research Initiative (2020), as explained in text

consistent with the responses from the pilot survey that the agents are slightly worse than self without cognitive decline in terms of quality of decisions to be made, while the self with cognitive decline is the worst decision-maker by a big margin.

Then the battery asks how likely it is that the actual timing of the transfer will be different from the optimal timing. The actual timing can be either too late or too early compared to the optimal timing. The average subjective probability of having a delayed transfer is 35 percent (Table 2, panel B). A delayed transfer may happen for various reasons, including those listed in panel C. The respondents are particularly worried that they might not notice their own decline and that they, once declined, might refuse to give up control. The average subjective probability of an early transfer is 24 percent (panel B), slightly less likely than a delayed transfer. One potential reason for an early transfer is the agent taking control earlier than the respondent wants, which is seen similarly likely as an early transfer (panel D).

D. *Welfare Cost of Mistimed Transfer of Control*

How damaging would it be if the transfer of control happens at the wrong time? For those who assign a positive probability for both a delayed and an early transfer, the survey first asks which is the greater concern. To keep the structure simple, the survey branches to learn more only about that event.[6] More than half of the

[6]For the respondents who assign a positive probability to only one event, the survey branches to that event. For those who assign a zero probability to both events (6 percent of the sample), this part of the survey is skipped.

Table 3—Welfare Cost of Transfer at the Wrong Time

	Percentile						
	10th	25th	50th	75th	90th	Mean	Observations
Panel A. Welfare cost of a delayed transfer							
Percent of wealth	−10.4	0	19.3	34.1	56.4	17.9	1,465
Dollars in thousands	−126	0	290	646	1,248	432	1,465
Panel B. Welfare cost of an early transfer							
Percent of wealth	−39.6	0	13.4	27.2	54.5	9.9	859
Dollars in thousands	−698	0	188	520	1,213	245	859

Note: The compensating variation in wealth is expressed as a fraction of wealth (first row) or in dollars (second row).

Source: Vanguard Research Initiative (2020), as explained in text

respondents (1,465 respondents) are more concerned about a delayed transfer, while 859 respondents are more concerned about an early transfer.

The survey asks the respondents to compare the following two scenarios. If a respondent takes the delayed-transfer branch, the scenarios are:

- Scenario 1: The transfer of control happens at the optimal timing.
- Scenario 2: The transfer of control is delayed compared to the optimal timing.

Scenario 2 does not specify the timing of the delayed transfer. Respondents are asked to imagine the most likely outcome conditional on it being delayed. (The same approach was taken for an early transfer.) To quantify the welfare cost of transferring at the wrong time compared to the optimal time, the survey asks for the amount of additional wealth needed for the respondent to be indifferent between the two scenarios. In other words, we measure the value of $\hat{x}$ that satisfies

$$\bar{\nu}(W) = \hat{\nu}\big([1 + \hat{x}]W\big), \tag{1}$$

where $\bar{\nu}$ is the utility from the last five years of life under optimal transfer timing and $\hat{\nu}$ that under wrong timing.

Table 3 shows that overall, the respondents believe that a transfer at the wrong time can be very costly. For a delayed transfer, respondents on average require a wealth compensation of 18 percent of their financial resources (or $432,000). Early transfer is less costly, but the compensation required is not small, averaging 10 percent of wealth (or $245,000).

There is strong heterogeneity across respondents in the cost of transferring at the wrong time. More than one-quarter of the sample, in both the delayed-transfer and early-transfer branches, believe that a transfer at the wrong time will not be costly at all.[7] On the other hand, more than a quarter of the sample report a

[7] Slightly more than 10 percent of the sample in the delayed-transfer branch and about 15 percent of the sample in the early-transfer branch report a negative value of compensation needed. Online Appendix C1 shows that negative welfare costs are much rarer, and the average welfare costs are much larger, among the sample who have a better understanding of the hypothetical situation according to the survey comprehension test result. Hence, the negative welfare numbers are likely to be survey response errors and the averages reported in Table 3 are likely to be attenuated due to survey response errors.

substantial amount of compensation needed—larger than 34 percent of wealth in the delayed-transfer case and larger than 27 percent in the early-transfer case.

Online Appendix C provides further evidence, including results from comprehension test questions and correlations between concerns about transferring at the wrong time and agent characteristics. This evidence suggests that the survey responses are credible.

E. *Ex Ante Willingness to Pay to Guarantee the Optimal Timing of the Transfer of Control*

The survey evidence we reported shows that *conditional on* having cognitive decline in the future, the transfer of control over finances at the wrong time is perceived to worsen financial well-being significantly. That does not imply that the respondents, who do not currently have cognitive decline, are very concerned about this issue. In this section, we quantify respondents' current concern about mistiming the transfer of financial control. We show how responses to survey questions can be combined to measure the willingness to pay (WTP) to guarantee the optimal timing of transfer. The WTP is measured using an expected utility framework but imposes no further assumptions. In Section III, we present a theoretical model that investigates which frictions can generate a costly suboptimal time of transfer.

Specifically, we consider the hypothetical scenario in which respondents are at the beginning of the last five years of their life. They do not know whether or not they will have cognitive decline.[8] We consider the hypothetical intervention that guarantees the optimal timing of the transfer (in the case cognitive decline develops) and compute the WTP for such an intervention. Let P be the WTP measured as a fraction of wealth. It satisfies

$$(2)\qquad (1-\pi_{CD})\nu(W)+\pi_{CD}(1-\pi_{WT})\bar{\nu}(W)+\pi_{CD}\pi_{WT}\hat{\nu}(W) = (1-\pi_{CD})\nu\big((1-P)W\big)+\pi_{CD}\bar{\nu}\big((1-P)W\big),$$

where ν is the utility from the last five years of life under no cognitive decline, while $\bar{\nu}$ and $\hat{\nu}$ are that under cognitive decline with the optimal and suboptimal timing of the transfer. π_{CD} is the subjective probability of having cognitive decline, and π_{WT} is the probability the transfer of control occurs at the wrong time conditional on having cognitive decline. The left-hand side is expected lifetime utility accounting for uncertainty in the timing of the transfer. The right-hand side is the expected lifetime utility after paying a fraction of wealth to guarantee the optimal timing of the transfer.

The first-order Taylor polynomial of equation (2) around $P = 0$ and $\hat{x} = 0$ (and using equation (1))[9] yields the following WTP approximation:

$$(3)\qquad P = \frac{\hat{x}\pi_{CD}\pi_{WT}\big(\bar{\nu}'(W)/\nu'(W)\big)}{(1-\pi_{CD})+\pi_{CD}\big(\bar{\nu}'(W)/\nu'(W)\big)},$$

[8] We abstract from the time they have until they reach the last five years of their life. This simplification may not be too consequential given the high average age (74) of respondents.

[9] See Figure 1 for values of P and Table 3 for values of $\hat{x}$.

where $\hat{x}$ is the conditional welfare cost from equation (1). Equation (3) shows that the WTP positively depends on four factors. While we do not have measures of all variables in equation (2), our survey measures each of these factors in equation (3) for each individual:

- The chance of having cognitive decline for at least five years (π_{CD}, reported in online Appendix Table A4).[10]
- The chance the transfer is made at the wrong time conditional on having cognitive decline (π_{WT}, reported in Table 2).
- The welfare cost of transferring at the wrong time conditional on having cognitive decline ($\hat{x}$, reported in Table 3).
- The marginal value of wealth when cognitively declined (assuming the optimal timing of the transfer) compared to that when not cognitively declined ($\bar{\nu}'(W)/\nu'(W)$). To measure this last value, the survey asks another hypothetical question where the respondent faces uncertainty about having cognitive decline based on the strategy from Ameriks, Briggs, Caplin, Shapiro, et al. (2020). The respondent allocates resources between two lockboxes where the money in one lockbox can be used only if the respondent develops cognitive decline, while the other can be used only if not. See Appendix B3 for the details of this survey question and the distribution of the responses.

Figure 1, panel A presents the distribution of the WTP (as a fraction of wealth, computed using equation (3)) across respondents.[11] There is considerable heterogeneity in the WTP. About 45 percent of the sample have zero WTP. This is not surprising because the WTP is zero as long as one of the four factors mentioned above is zero.[12] Many of those who have a positive WTP have quite a large WTP. More than a quarter of the sample are willing to pay more than 2 percent of their wealth; more than 15 percent are willing to pay more than 5 percent of their wealth. Given that the money spent to guarantee the optimal timing of the transfer is wasted unless they end up having cognitive decline, this is a fairly large WTP. In terms of dollar amount, these are large: about a quarter of the sample are willing to pay more than $50,000; more than 15 percent are willing to pay more than $100,000 (panel B).[13] This result indicates that there are large potential welfare gains from measures or policies that help address transfer timing uncertainty.

III. Model of Unnoticed Cognitive Decline and Suboptimal Transfer of Control

In this section, we present a model of cognitive decline. Instead of aiming to capture the full complexity of cognitive decline and transfer of control, we develop a very simple model that accounts for the key findings from the survey. The chief

[10] For the coupled respondents, we define this as the joint probability of having cognitive decline and outliving spouse/partner (asked in the survey), assuming independence between the two events. Assuming a sensible correlation between the two probabilities—for example, using the larger probability between the two since the two events are likely to be positively correlated—does not change the result significantly.

[11] See online Appendix Figure D1 for the WTP CDFs.

[12] Online Appendix D2 examines how each factor contributes to the WTP distribution.

[13] Note that this might be an underestimate of the WTP because in calculating the WTP, we only take into account the possibility of either a delayed transfer or an early transfer based on what most concerns them, not both.

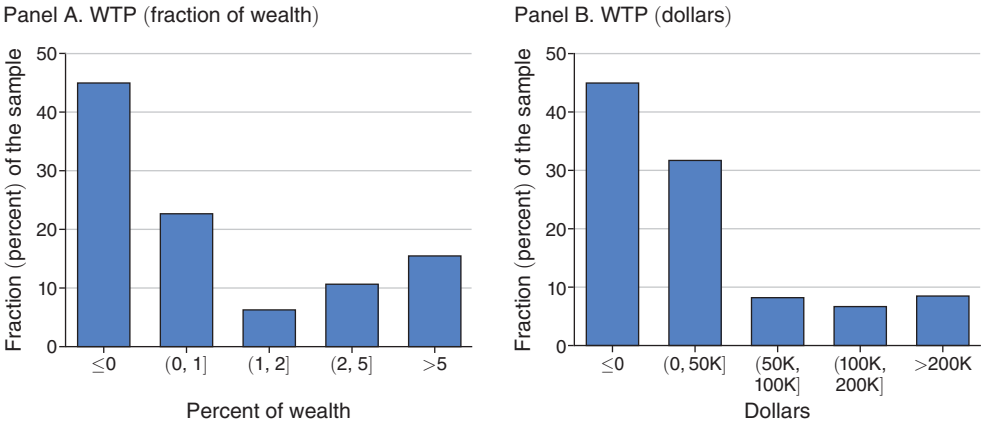

FIGURE 1. DISTRIBUTION OF THE WILLINGNESS TO PAY TO GUARANTEE THE OPTIMAL TRANSFER TIMING

Source: Vanguard Research Initiative (2020), as explained in text

novelty is that individuals may be unaware of their cognitive decline. The model shows the importance of this friction in generating suboptimal timing of transfer and welfare-reducing financial mistakes. The model also reveals the need for a large (potentially utility) cost of using an agent when not experiencing severe cognitive decline to explain why many older individuals remain exposed to these risks.[14]

We model an individual who will live for T periods. Each period, the individual may or may not learn her cognitive status. The individual not only needs to make a consumption decision out of the available choice set but also a financial decision that may affect the choice set available in the future. A bad financial decision irreversibly reduces the choice set and hence damages welfare. Cognitive decline increases the probability of a bad financial decision, such as being a victim of financial fraud. To avoid making a bad financial decision, the individual can transfer control to an agent, who would make both consumption and financial decisions for the remaining periods. The agent will not make a financial mistake, though the consumption choice made by the agent will not perfectly align with the individual's preference. Not being fully aware of her own cognitive decline may lead to suboptimal timing of the transfer of control.

To be specific, θ_t is the individual's cognitive ability in period t, which will be parameterized in terms of the odds of a bad financial decision. Higher θ_t represents higher cognitive ability (and lower chance of making a bad financial decision). θ_t takes values $\{\theta^1, \ldots, \theta^N\}$, where $\theta^1 > \theta^2 > \cdots > \theta^N$. In the first period, $\theta_1 = \theta^1$, where θ^1 represents mild cognitive decline. Modeling a fixed number of years of remaining life and starting with mild cognitive decline is consistent with the hypothetical situation in the survey. Each period, cognitive ability either stays

[14] Kim, Maurer, and Mitchell (2016) develop a life cycle model where individuals decide on financial management delegation facing a time cost of management and age-dependent decision-making abilities. Different from theirs, our model focuses on the possibility of unnoticed cognitive decline and uncertainty in the timing of the transfer of control caused by that friction.

the same or declines. It evolves according to a first-order Markov process, where $\pi(\theta^j \mid \theta^m)$ specifies the probability of having θ^j in the next period given the current ability θ^m.

The individual's consumption preference in each period is represented by $U(\cdot)$. For simplicity, we assume zero time discount rate. In each period, if no financial mistake has been made previously, there are three options available in the choice set $X = \{\bar{x}, x^A, \underline{x}\}$, where $\bar{x}$ is the first-best choice, x^A is the second-best and is chosen by the agent, and $\underline{x}$ is what the individual will be forced to choose after a financial mistake, as explained below. Preference is such that $U(\bar{x}) > U(x^A) \gg U(\underline{x})$, so the individual will always choose $\bar{x}$ if it is in the choice set.

At the end of each period, if no financial mistake has been made previously, the individual also makes a financial decision. There are good (G) and bad (B) financial decisions. If G is chosen, the choice set remains intact in the next period. If B is chosen, the choice set becomes $X_B = \{\underline{x}\}$, so the individual will be forced to choose the worst option for the remaining periods. The chance of choosing B is $1 - \theta_t$, so the more cognitively declined the individual is, the more likely she is to make a financial mistake. Thus, we focus on modeling cognitive decline's effect on financial decisions, which affects utility through restricting the choice set.

Knowing that she might make a bad financial decision, the individual contemplates handing over control based on her beliefs about her cognitive status. *The key to the model is the prior awareness of her possible lack of future awareness of this state.* Formally, $\lambda_{t,j}$ is the probability that $\theta_t = \theta^j$ and $\boldsymbol{\lambda}_t$ is the probability vector at time t. The individual may or may not learn θ_t at the beginning of each period. Learning happens with probability ζ. If learning happens, $\boldsymbol{\lambda}_t$ has probability one for the true state. If learning does not happen, Bayesian updating implies that

$$\lambda_{t,j} = \frac{\sum_{m=1}^{N} \pi(\theta^j \mid \theta^m) \chi^m \lambda_{t-1,m}}{\sum_{k=1}^{N} \sum_{m=1}^{N} \pi(\theta^k \mid \theta^m) \chi^m \lambda_{t-1,m}}, \tag{4}$$

where $\chi^m = (1 - \theta^m)$ if a financial mistake occurred in $t - 1$ and $\chi^m = \theta^m$ if no mistake was made. Given the prior $\boldsymbol{\lambda}_{t-1}$, the denominator is the probability of the realized financial outcome in $t - 1$ occurring and the numerator is the probability of that financial outcome occurring and $\theta_t = \theta^j$. Essentially, the individual updates their prior about θ_{t-1} after observing the financial outcome and then uses the transition matrix π to update from θ_{t-1} to θ_t. Thus, an individual may be unaware that she is suffering from severe cognitive decline after several periods of not learning her cognitive ability and not making a financial mistake.

Since the individual knows ex ante the risk of self-damage due to unawareness of decline, this factors into the only remaining decision, which is when to hand over control should no mistake have been made as yet. To capture imperfect agency, the agent chooses x^A, which is between the best $(\bar{x})$ and the worst $(\underline{x})$ options, if the choice set is still intact. The agent does not make financial mistakes. Therefore, the individual faces a trade-off in using the agent: the agent's choice would be worse than the first-best option, but the agent will allow the individual to avoid the worst option.

Survey responses reveal that even though the agent's decision is perceived to be high quality (i.e., $U(x^A)$ is close to $U(\bar{x})$), respondents are unlikely to transfer

control immediately at the onset of cognitive decline. Hence, they value being in control while they are still capable. To account for this, we assume a per-period utility cost of using the agent that increases as a function of perceived cognitive ability, $D(\boldsymbol{\lambda}_t)$. This cost captures disutility from being a burden or losing independence while still capable and is unrelated to the quality of the agent.[15]

The timeline of the model is as follows. The individual enters each period with beliefs $\boldsymbol{\lambda}_{t-1}$, a choice set X_t that is X or X_B, and either in control or having transferred control. Transfer of control is an absorbing state. In period t:

- The individual learns θ_t with probability ζ and updates beliefs $\boldsymbol{\lambda}_t$.
- If in control, the individual chooses whether to maintain control or transfer control.
- The person in control chooses consumption from X_t and makes a financial decision that determines X_{t+1}.

Let $V_t^A(\boldsymbol{\lambda}_t)$ be the value when the agent makes decisions in period t and $X_t = X$:

$$V_t^A(\boldsymbol{\lambda}_t) = U(x^A) - D(\boldsymbol{\lambda}_t) + E_t\left[V_{t+1}^A(\boldsymbol{\lambda}_{t+1}) \,|\, \boldsymbol{\lambda}_t\right]. \tag{5}$$

Let $V_t(\boldsymbol{\lambda}_t)$ be the value of entering period t in control when $X_t = X$, which is the larger value of either transferring or maintaining control this period:

$$V_t(\boldsymbol{\lambda}_t) = \max\Bigg\{ V_t^A(\boldsymbol{\lambda}_t), U(\bar{x}) + \sum_{j=1}^{N}\left[\lambda_{t,j}\left(1 - \theta^j\right)\right](T-t)U(\underline{x}) + \sum_{j=1}^{N}\left[\lambda_{t,j}\theta^j\right]E_t\left[V_{t+1}(\boldsymbol{\lambda}_{t+1}) \,|\, \boldsymbol{\lambda}_t\right]\Bigg\}. \tag{6}$$

The value of maintaining control has three components: utility from consuming $\bar{x}$, the perceived chance of making a financial mistake today and consuming $\underline{x}$ for periods $t+1$ to T, and the perceived chance of not making a mistake today and entering $t+1$ in control with $X_{t+1} = X$. Control is transferred if and only if $V_t^A(\boldsymbol{\lambda}_t) = V_t(\boldsymbol{\lambda}_t)$.

The optimal timing of the transfer of control is defined as the timing chosen under the counterfactual case of $\zeta = 1$—that is, under perfect information—where $\boldsymbol{\lambda}_t$ has probability one for the true state in every period. The timing determined under imperfect information can deviate from optimal, in particular when $\boldsymbol{\lambda}_t$ does not assign a large enough probability to the true state. Unawareness of ongoing cognitive decline may delay the transfer of control. If the individual becomes too preemptive anticipating this possibility, on the other hand, she will suffer a loss of utility from both the agent's selection of the second-best option and the direct utility cost from loss of control.

We implement a quantitative exercise based on an illustrative calibration to the survey evidence to show that this simple framework can generate a likely and costly

[15] For evidence on burden aversion in the context of late-in-life care provision, see Cahill et al. (2009) and Delgado-Guay, De La Cruz, and Epner (2013).

transfer at the wrong time. This exercise is illustrative in purpose, as the model abstracts from many other ways cognitive decline can affect the individual. Here we report an overview of the calibration with details presented in online Appendix E. We set x^A to be close to $\bar{x}$ to capture the perceived high quality of the agent, as reported in the survey (online Appendix B1). We set $\underline{x}$ to be very small (i.e., a financial mistake is disastrous) to match the large welfare cost of a delayed transfer. We calibrate ζ to match the subjective probability of not noticing own decline around the optimal timing of the transfer. We set parameters of the cognitive decline process to create substantial potential uncertainty about cognitive decline. Lastly, to explain the key patterns from the survey—delayed transfers are perceived to be costly, but individuals do not eliminate that risk by transferring control at the onset of cognitive decline—we set $D(\boldsymbol{\lambda}_t)$ to be large when θ is likely to be high.

Under the baseline calibration reported in online Appendix E, the model generates a 36 percent chance of delayed transfer. When delay happens, it is costly: the average welfare cost is equivalent to reducing consumption by 15 percent. These match closely the corresponding averages from the survey (35 percent and 18 percent). There is a 41 percent chance the individual does not notice her own decline around the optimal timing of the transfer, close to the 42 percent average in the survey. Though the baseline calibration does not generate a transfer that happens before the optimal timing, a small change in the calibration—reducing the utility costs of using the agent, for example—creates such a possibility.[16] Therefore, this illustrative exercise, combined with the survey responses, suggests the importance of incorporating limited awareness of cognitive decline and the desire to maintain control of one's own finances while capable into studies of late-in-life cognitive decline and financial decision-making.

IV. Conclusion

Having a reliable agent can go a long way toward protecting one from poor financial decisions induced by cognitive decline in late life. It could, however, be challenging to transfer control over finances to the agent at the right level of cognitive decline due to, among other reasons, limited awareness of the severity of cognitive decline. A desire to be one's own agent while still capable increases this risk. We provide a theoretical framework that demonstrates that this particular aspect of cognitive decline can significantly limit the helpfulness of an agent. We present evidence from the purpose-designed survey that reveals this transfer-timing issue to be a serious concern for many older American wealthholders.

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[16] An alternative way to generate early transfers would be to allow for taking back control after a transfer was made, which we do not explore here. Appendix E documents how the likelihood of delayed and early transfers varies with the utility cost of using the agent and the probability of learning own cognitive status.

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