Dementia and Long-run Trajectories in Household Finances

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(Very Preliminary Draft—Do Not Circulate)

Abstract

We use two decades of the U.S. Health and Retirement Study data to compare long-run trajectories in household finances between individuals who eventually developed dementia and those who did not. In prior work, we find large and steady divergence in household wealth that starts 6-8 years prior to dementia onset. In the current paper, we investigate several possible hypotheses for these changes. By examining detailed categories of household income and spending, we find that long-run divergence in wealth between dementia and non-dementia groups are not explained by higher out-of-pocket healthcare expenses or intentional "spend-down" to qualify for Medicare coverage of nursing home residence. Rather, our findings suggest that they are driven by earlier exit from the labor force and potentially suboptimal investment decisions, which negatively affect long-term income in multiple areas among the dementia cohort relative to their counterparts. We also find that these patterns are more prominent among individuals with higher socioeconomic status.

JEL classification: D14, E21, G51, G53
Keywords: dementia, cognition, decision-making, wealth, income

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1. Introduction

Dementia is one of the most expensive and prevalent medical conditions afflicting older adults and their families (Hurd et al. 2013; Alzheimer's Association 2022). The process of cognitive decline may start years before the onset of the condition, potentially affecting decision-making in many areas, especially financial decision-making (Ameriks et al. 2022; Angrisani and Lee 2019; Nicholas et al. 2021). The accumulation of these decisions could have long-term consequences that profoundly impact well-being at older age. Most existing literature on dementia and financial decision-making either examines decisions at a single point in time (Peterson et al. 2014; Sudo and Laks 2017), or examine them in a few limited domains (Angrisani and Lee 2019; Hsu and Willis 2013). In this study, we use two decades of nationally representative data from Heath and Retirement Study to examine the extent to which dementia-related cognitive decline changes long-run trajectories of multiple measures of household finances. They reflect decisions in various domains, including labor market participation, investment, consumption, and planning for long-term care.

In prior work (Li et al. 2023), we compared the long-term trajectories in overall household wealth between matched older adults who eventually developed dementia versus those who did not. We find that household wealth started to diverge between individuals with and without dementia as early as eight years prior to dementia onset, with a difference in median net worth as large as $100,000 at the time of dementia onset. In the current paper, we seek to test several hypotheses to explain the divergence in wealth well before household members might be diagnosed as having dementia. While we focus here on a cohort of individuals who ultimately become at high risk of dementia, we believe that our results can also cast light on heterogeneity in wealth accumulation caused by differences in cognitive skills.

There are several reasons why cognitive decline may be related to financial decision-making in the household. First, cognitive decline may directly affect individual earnings by affecting their participation in the labor force, for instance due to difficulty in carrying out certain job duties, and may also affect subsequent income from pension and social security (possibly due to earlier withdrawal or benefit claim). Second, cognitive decline could be associated with a decline in judgment in financial decision-making, leading to suboptimal investment decisions and hence less income or higher loss on financial assets (Angrisani and Lee 2019; Christelis, Jappelli, and Padula 2010). Third, cognitive decline itself or associated comorbidities could prompt higher out-of-pocket medical spending if the individual sought treatments (Hudomiet, Hurd, and Rohwedder 2019; Kelley et al. 2015), which could lead to a depletion of wealth. Fourth, cognitively impaired individuals and their families could be aware of their risk of developing dementia and the likelihood of needing long-term care, which prompted them to dissave intentionally, possibly in order to qualify for Medicaid coverage of nursing home residence ("spend-down") as Medicare has no coverage for long-term care (Wiener et al. 2013).[2] Finally, the empirical pattern may be the result of endogeneity such thatdownturns in wealth lead to a decline in cognition. These hypotheses yield distinct empirical predictions in income (the first two), spending (the second two), and the timing of cognitive change, each of which we explore.

We find evidence that both the first (lower labor force participation) and second (suboptimal investment decisions) mechanisms likely explain the long-run wealth divergence between the dementia and non-dementia groups. Dementia cohort experience a more rapid decline in household income during the years leading up to dementia, driven by faster exit from

[2] An additional hypothesis is that people who later develop dementia exhibit lower rates of wealth accumulation all through life. However, this hypotheses was rejected by Li et al. (2023), described below.

the labor force (resulting in reduced or no individual earnings), a decline in pension/annuity income (compared to mostly stable pension/annuity income among non-dementia group), mostly flat social security income (compared to an increase in such income among non-dementia group), and large decline in household capital income (mostly explained by lower income from financial market investments).[3] We do not find evidence that dementia individuals and their households increase spending, including out-of-pocket healthcare spending during this period. Neither do they seem to be aware of their risk of needing long-term care. Nor is there evidence of reverse causation.

The relative decline in wealth and income among the dementia cohort relative to their non-dementia counterparts is more prominent among individuals with college education, likely because of higher baseline wealth and the requirements for more complex financial decision-making in wealth management. We also show that these patterns are plausibly unique to dementia by conducting parallel analyses comparing individuals with and without cancer and finding little divergence in wealth.

Our study contributes to the growing literature on cognitive function and financial decision-making by providing a more complete picture of the long-run trajectories of household finance among individuals who eventually develop dementia symptoms, a group most susceptible to faulty decision-making in financial matters. A particular contribution of our study is the timing and nature of the likely impact of cognitive impairment on financial decision-making. While the impact on employment and earnings may be difficult to reverse, the early involvement of financial consultants and family members in managing assets, potentially as soon

[3] A reverse-causation explanation, in which early retirement causes cognition decline, does not appear plausible given the size of this reverse effect that would be necessary to drive such a mechanism.

as when any issues with memory emerge, could mitigate the losses in wealth due to suboptimal investment decisions.

2. Methods

2.1 Data and Sample

We use the nationally representative and longitudinal Health and Retirement Study (HRS) from 1998-2016. HRS is a biennial survey of U.S. older adults aged 50 and above. We construct a cohort of respondents with incident dementia (cases) using an established dementia ascertainment algorithm developed using HRS data (Hurd et al. 2013). The algorithm classifies a respondent in a given wave as having probable dementia if they have a predicted dementia probability of at least 0.5 based on age, education, sex, number of activities of daily living (ADL) limitations, number of instrumental ADL (IADL) limitations, and scores on the Telephone Interview for Cognitive Status (TICS). We construct a control cohort who was never classified as having probable dementia in HRS, never had a spouse with dementia, and were never a spouse to an individual with dementia. For both cases and controls, we impose the following inclusion restrictions (and their waves included in the study): 1) aged between 65 and 100, 2) continuously enrolled in Medicare, 3) having at least two consecutive waves (cases were required to have at least one "clean" wave before dementia wave to qualify as having incident dementia).

In addition to cognitive health and functional status, HRS collect rich information on household wealth and assets in different categories, labor force participation and physical health. It also collects information on healthcare use and out-of-pocket costs. For general household consumption and spending, we use data from the Consumption and Activities Mail Surveys

(CAMS), an ongoing supplement of HRS and a series of biennial surveys conducted on a random subsample of about half of all households participating in HRS and administered in the off-years of HRS core surveys. CAMS collect information on household spending over the previous 12 months.

Our final analysis sample includes 2,583 cases (16,774 person-years) and 5,525 controls (27,229 person-years). Table 1 shows summary statistics among cases and controls two years prior to actual dementia onset among cases or randomly assigned dementia onset year for controls. Column 1 and 3 show that they are different along several dimensions in terms of key demographics, in that cases tend to be older, less likely to be female, and lower educated.

2.2. Inverse Probability Weighting

In order to account for differences in basic demographics, for each year we observe in the data relative to dementia onset among cases (e.g. t = -10, -8,, -6, -4, -2, 0, 2, 4, 6), we apply inverse probability weighting to all person-year observations among controls so they were observably similar to cases on distributions of age, gender, education and marital status. We then compare long-term trends between cases and re-weighted controls along measures of wealth, income and spending.

After re-weighting, cases and controls look observably similar in terms of age, fraction female, education and marital status (Panel A, Column 1 and 2, Table 1). As expected, they are more different along covariates not used to estimate the propensity score: even after re-weighting, cases have a higher fraction of racial and ethnic minorities and higher fraction of certain comorbidities, including stroke, diabetes, and psychiatric condition, and much higher index of ADLs and IADLs.

2.3. Event study and difference-in-differences

To ensure the robustness of our comparisons, we further employ an event study and difference-in-differences approach to use only within-individual variation overtime to examine differential changes in wealth, income and spending measures between cases and controls. We estimate the following standard event study specification:

$$Y_{it} = \alpha + \sum_{r=-6}^{6} 1[R_{it} = r]\beta_k + X_{it}'\gamma + \delta_t + \eta_i + \varepsilon_{it} \qquad (1)$$

where Y_{it} is a measure of financial outcome of interest for individual *i* in calendar year *t*. We apply inverse hyperbolic sine transformation to all dependent variables measured in dollar values as many of them are highly skewed. $1[R_{it} = r]$ is an indicator function if a given observation for the individual corresponds to a specific year relative to dementia $r \in$ (-6, -4, -2, 0, 2, 4, 6). The omitted year relative to dementia is -8. For controls, all the indicator functions evaluate to 0. X_{it} is a vector of time-varying individual specific characteristics, including marital status and comorbidities. δ_t and η_i represent calendar and individual fixed effects. The standard errors are clustered at the individual level, though clustering them at the household level yield almost identical results.

For the difference-in-differences specification, we focus on the long-run change in financial outcomes during the period leading up to dementia onset. There are several reasons for this. First, almost half of the cases in the sample dropped out of HRS as soon as they develop dementia, therefore we do not have information for any changes in finances after dementia onset for these individuals. Second, the period leading up to dementia onset is the period where cognitive impairment symptoms may start to develop, and to the extent that the individuals and

households are not yet fully aware of the risk, they may be more vulnerable to deficits in financial decision-making. Our DD specification is as follows:

$$Y_{it} = \alpha + 1[-6 < R_{it} \leq 0]\beta + X_{it}'\gamma + \delta_t + \eta_i + \varepsilon_{it} \qquad (2)$$

In estimating this equation, we use only person-year observations among cases up to dementia onset ($R_{it} \leq 0$), and all person-year observations among controls.

To test the hypothesis of reverse causation, we require exogenous changes in wealth in (say) the great recession, and test whether such exogenous changes, which differ across individuals depending on their initial wealth holdings, predict declines in cognition in subsequent years. [To be developed.]

2.4. Cancer as falsification test

In order to investigate whether any patterns we find are specific to dementia and cognitive impairment instead of serious illnesses in general, we construct an alternative sample with (self-reported) cancer as the condition of interest instead of dementia. We apply similar inclusion and exclusion criteria to the cancer group and control group as we do in the main analysis sample, and we define the year of cancer onset as the first year in which the HRS respondent reported having cancer of any type except skin cancer (if at all). We conduct analogous event study analysis examining any differential trajectories in household finances between those who eventually developed cancer and the non-cancer control group.

2.5. Heterogeneity

Finally, we examine any heterogeneity in dementia related differential trajectories in household finances by baseline respondent characteristics. We conduct stratified DD analyses by gender (female vs. male), race (White vs. Non-White) and education (no high school degree vs. high school degree and above). Prior literature has documented gender differences in risk-taking behavior, labor force participation and financial responsibilities within the household, and these differences could affect the manifestation of cognitive impairment in financial decision-making. Individuals who are racial ethnic minorities may have worse access to capital, and so are individuals with lower education. On the other hand, individuals with higher education likely have higher level of baseline wealth and engage in more sophisticated financial decisions, which are more susceptible to the impact of dementia.

3. Results

We first review relevant results from our prior work that motivates the current paper. Appendix Figure A1 from Li et al. (2023) shows that both median household net worth and financial wealth, while largely similar at 8 to 10 years prior to dementia onset between the two groups, start to diverge afterwards, with a difference of over $100,000 in net worth and about $25,000 in financial wealth at and after dementia onset (Panel A and B in Figure A1). As another key measure of wealth, home ownership does not appear to exhibit the same pattern (Panel C). These patterns are confirmed using event study analyses (Panels A-C in Figure 3).

3.1. Individual and household income

In order to explain the patterns described above on overall household wealth, we begin by examining the first two hypothesized mechanisms in Section 1 related to income: 1) lower labor

force participation, and 2) suboptimal investment decisions. The results for trends analyses are shown in Figure 1. We show trends in median for any income category with median above $0 in at least one of the two groups, and show proportion with any income in that category otherwise. First, we observe that the gap in total annual household income more than doubled during the 8 years prior to dementia onset, from less than $2,500 to over $5,000, though cases were already at a lower point 10 years prior to dementia onset (Panel A). This divergence is partially explained by accelerated decline in the proportion of having any individual earnings among the cases relative to the controls during the same period (Panel B). The graph for labor force participation has almost identical trends to Panel B (not shown).

As two other major components of individual income among older adults, pension/annuity (Panel C) and social security retirement income (Panel D) both diverged widely between the two groups. The gap in social security retirement income represents the largest difference among categories of median income between cases and controls, growing from less than $500 to about $1500 during the 10 years prior to dementia onset. This is potentially explained by a combination of higher prior earnings and later benefit start time among controls relative to cases.

While both pension/annuity and social security retirement income are related to historical earnings and length of time in the labor force, income from pension/annuity could also reflect investment decisions (unless the individual has a defined benefit plan). We further examine changes in household capital income (Panel E) which also reflect investment decisions: during the 10 years prior to dementia onset, median household capital income dropped sharply from about $650 to $0 among the cases, while it remained steady at about $400 among controls. Among subcategories of capital income (most of which had $0 median), this pattern was only

mimicked by income from financial markets, e.g. income from checking, stock or mutual funds dividend, bonds and CDs (Panel E).

Event study results in Figure 3 (Panels D-H) again confirm these findings. Relative to the control group, total household income among the dementia group declines by over 10% during the eight years leading up to dementia onset, with most of the decline occurring already by two years prior to dementia onset. While individual earnings also decline by approximately 10% during the same period, the other major income categories—pension/annuity, social security, and household capital income all experience large relative decline of at least 40%. Pension/annuity income in particular has a relative decline of close to 75%.

Taken together, these results appear to be consistent with both earlier exit from the labor market and suboptimal investment decisions among cases compared to controls. However, it is still possible that individuals with cognitive decline and their families intentionally decumulate assets in order to qualify for Medicaid coverage of nursing homes, if they are conscious of the risk of needing long-term care.

3.2. Household spending and nursing home status

To examine the last two hypothesized mechanism (higher out-of-pocket healthcare spending and spending down to qualify for Medicaid coverage), we show household spending patterns in Figure 2. We find no evidence that case households spend more than controls during the 8-10 years leading up to dementia onset, either overall (Panel A) or in terms of out-of-pocket healthcare expenses (Panel B). Out-of-pocket healthcare spending for cases only starts to rise sharply upon dementia onset. As a further confirmation, we compare the trajectory of self-reported probability of moving to a nursing home in the next five years, and see little difference

between the two groups (Panel C), although the proportion of living in a nursing home jumps up sharply (from 5% to over 20%) among cases at dementia onset, with no discernible evolution in controls (Panel D). These are again consistent with the analogous event study results in the last four panels (Panels I-L) in Figure 3. These results suggest that neither out-of-pocket healthcare spending nor intentional spend-down is likely to explain the divergence in wealth between cases and controls.

3.3. Results from the cancer sample

Next, we examine whether the patterns observed so far apply to groups with other serious medical conditions, in particular cancer. If so, it would mean that factors other than cognitive impairment are influencing these trends. Figure 4 show analogous event study results on wealth, income and spending measures comparing individuals who reported having cancer and those who did not report having cancer. For most of the measures examined, we see very little change throughout the period spanning between 8 years prior to reported cancer onset and 6 years after. If anything, several income measures actually experience a relative *increase* among the cancer group compared to the control group. One possible reason for this is selection in cancer reporting—those who report having cancer and remain in HRS are likely those who have adequate healthcare access to be able to detect cancer relatively early on.

3.5 Long-run changes in household finances and heterogeneity results

Finally, we present DD results which summarize the changes in household finances in the years leading up to dementia onset in a single coefficient. We show results from using two versions of dependent variables measured in dollar amounts: the first is Winsorized dollar values that recode

the outlier values into the 95th percentile (for any values above) or 5th percentile value (for any values below and for net worth and financial wealth only which has negative values), the second is the same set of measures used in the event study analyses with inverse hyperbolic sine transformation applied to the variables in dollar amounts.

Table 2 shows DD results for all individuals in our analysis sample. Panel A shows the results for Winsorized amounts. During the 6 years leading to dementia onset compared to earlier, the wealth decline on average among cases relative to control is about $15,400 in net worth, $7,800 in financial wealth, and 5 percentage points in home ownership. In addition, total household income declines by $1176 more among cases relative to controls, which is almost entirely explained by the reduction in pension/annuity income ($740) and social security retirement income ($472). Panel B shows results for IHS transformed variables, which are even more striking and consistent with the event study results. Net worth declines by 23%, and financial wealth by 13% though with wide confidence interval. Of the income measures, individual earnings had the largest reduction in terms of percentages, at 73%, followed by pension/annuity income (43%), and household capital income (26%). Neither total household spending nor healthcare spending have significant declines by either measure.

We compare these results by subgroups to investigate any heterogeneity in long-run financial changes by gender, race and education. We focus on the IHS results that are more robust to skewness in distributions. We do not find much heterogeneity by gender—the 95% confidence intervals overlap for all financial measures we examine. While we are perhaps underpowered to test differences between Whites and non-Whites due to the small fraction of non-Whites in our sample, there is some evidence that Whites experience larger declines in net worth and various measures of income. The differences between subgroups are the most

prominent along the dimension of education, between individuals with and without high school degrees, with the former experiencing consistently larger wealth and income declines than the latter, likely because of higher baseline wealth and complexity in financial decisions.

4. Discussion and Next Steps

Using two decades of HRS data, we seek to explain the remarkable divergence in household wealth between individuals with and without dementia during the decade prior to dementia onset. Our evidence potentially supports two explanations. First, cognitive decline preceding dementia onset prompts individuals to exit from the labor force earlier, leading to lower earnings and possibly lower income from social security retirement account in the years to come. Second, cognitive impairment affects financial decision-making, leading to potentially suboptimal investment decisions which negatively impacts capital income. Both mechanisms could also lead to lower income from pension/annuity accounts. These effects are more prominent among individuals with higher socioeconomic status. Early detection of cognitive impairment and advanced financial planning are important in order to mitigate long-run financial consequences of dementia even before the clinical onset of the condition.

We plan additional analyses to further strengthen the validity of our findings and better understand the mechanisms underlying the relationships between dementia related cognitive decline and long-run changes in household wealth. First, we will use alternative dementia classification algorithms, such as the Langa-Weir method and continuous dementia probabilities or cognitive score to test the robustness of our findings; we will also use an indicator for mild cognitive impairment (MCI) as the alternative independent variable to further pinpoint the timing of wealth divergence. Second, in order to investigate the possibility that early life stressors or

shocks might have simultaneously led to decline in wealth and decline in cognitive functioning, we will tap into aggregated social security data and life history surveys of HRS to examine the role of life events such as job loss, disability, car accidents and major health events in explaining the current patterns.

Third, an important extension of the current analyses involves examining the timing of dementia diagnosis and how it may impact specific changes in wealth and spending (including bequests motives). To do this, we will utilize the linked HRS-Medicare data which contains clinical diagnosis of dementia. Finally, an additional outcome of interest is the well-being of surviving spouses as they are directly affected by both the cognitive decline of the dementia patients as well as the worsened financial circumstances.

References

Alzheimer's Association. 2022. '2022 Alzheimer's Disease Facts and Figures', *Alzheimer's & dementia*, 18.

Ameriks, John, Andrew Caplin, Minjoon Lee, Matthew D Shapiro, and Christopher Tonetti. 2022. "Cognitive Decline, Limited Awareness, Imperfect Agency, and Financial Well-being." In.: National Bureau of Economic Research.

Angrisani, Marco, and Jinkook Lee. 2019. 'Cognitive decline and household financial decisions at older ages', *The Journal of the Economics of Ageing*, 13: 86-101.

Christelis, Dimitris, Tullio Jappelli, and Mario Padula. 2010. 'Cognitive abilities and portfolio choice', *European Economic Review*, 54: 18-38.

Hsu, Joanne W, and Robert Willis. 2013. 'Dementia risk and financial decision making by older households: The impact of information', *Journal of Human Capital*, 7: 340-77.

Hudomiet, Péter, Michael D Hurd, and Susann Rohwedder. 2019. 'The relationship between lifetime out-of-pocket medical expenditures, dementia, and socioeconomic status in the US', *The Journal of the Economics of Ageing*, 14: 100181.

Hurd, Michael D, Paco Martorell, Adeline Delavande, Kathleen J Mullen, and Kenneth M Langa. 2013. 'Monetary costs of dementia in the United States', *New England Journal of Medicine*, 368: 1326-34.

Kelley, Amy S, Kathleen McGarry, Rebecca Gorges, and Jonathan S Skinner. 2015. 'The burden of health care costs for patients with dementia in the last 5 years of life', *Annals of internal medicine*, 163: 729-36.

Li, Jing, Jonathan Skinner, Kathleen McGarry, Lauren Hersch Nicholas, Shao-Pang Wang, Evan Bollens-Lund, and Amy S Kelley. 2023. "Wealth Trajectories among Older U.S. Adults at Risk of Dementia " Working paper.

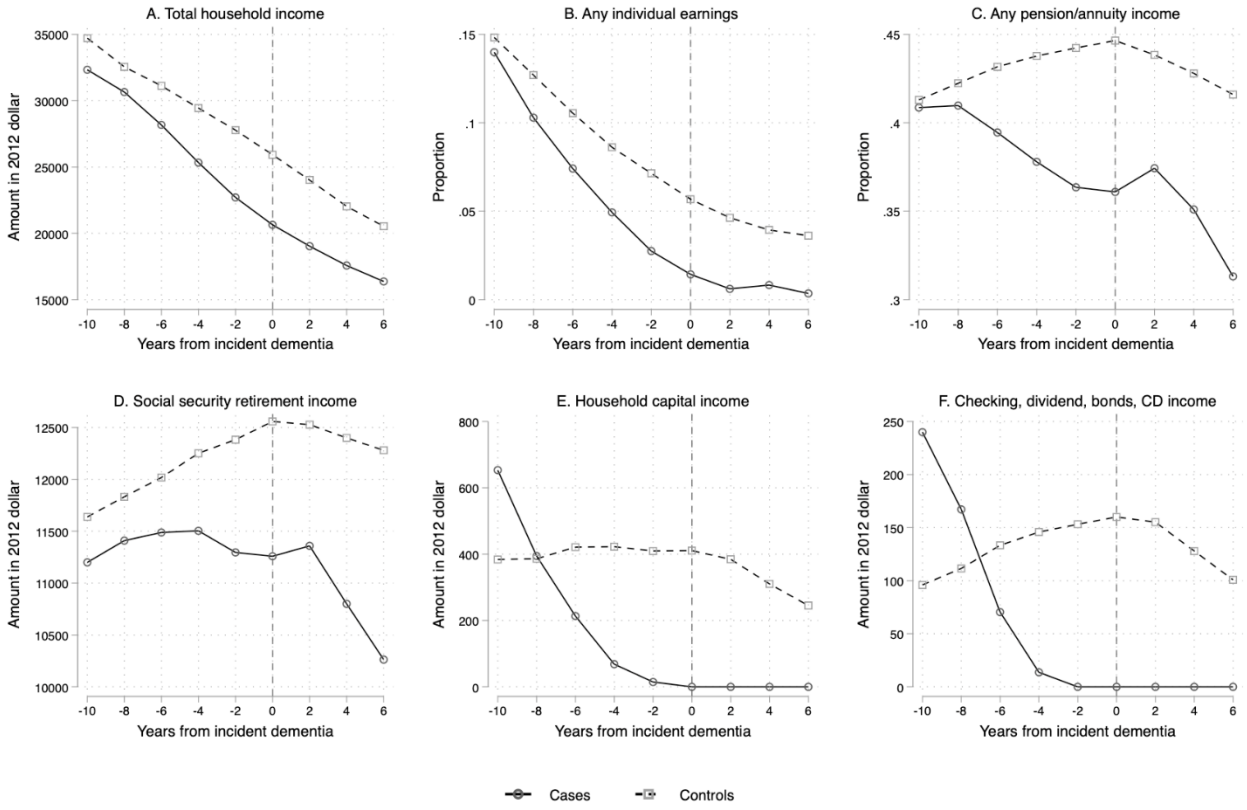
Nicholas, Lauren Hersch, Kenneth M Langa, Julie PW Bynum, and Joanne W Hsu. 2021. 'Financial presentation of Alzheimer disease and related dementias', *JAMA internal medicine*, 181: 220-27.

Peterson, Janey C, David PR Burnes, Paul L Caccamise, Art Mason, Charles R Henderson, Martin T Wells, Jacquelin Berman, Ann Marie Cook, Denise Shukoff, and Patricia Brownell. 2014. 'Financial exploitation of older adults: a population-based prevalence study', *Journal of general internal medicine*, 29: 1615-23.

Sudo, Felipe Kenji, and Jerson Laks. 2017. 'Financial capacity in dementia: A systematic review', *Aging & mental health*, 21: 677-83.

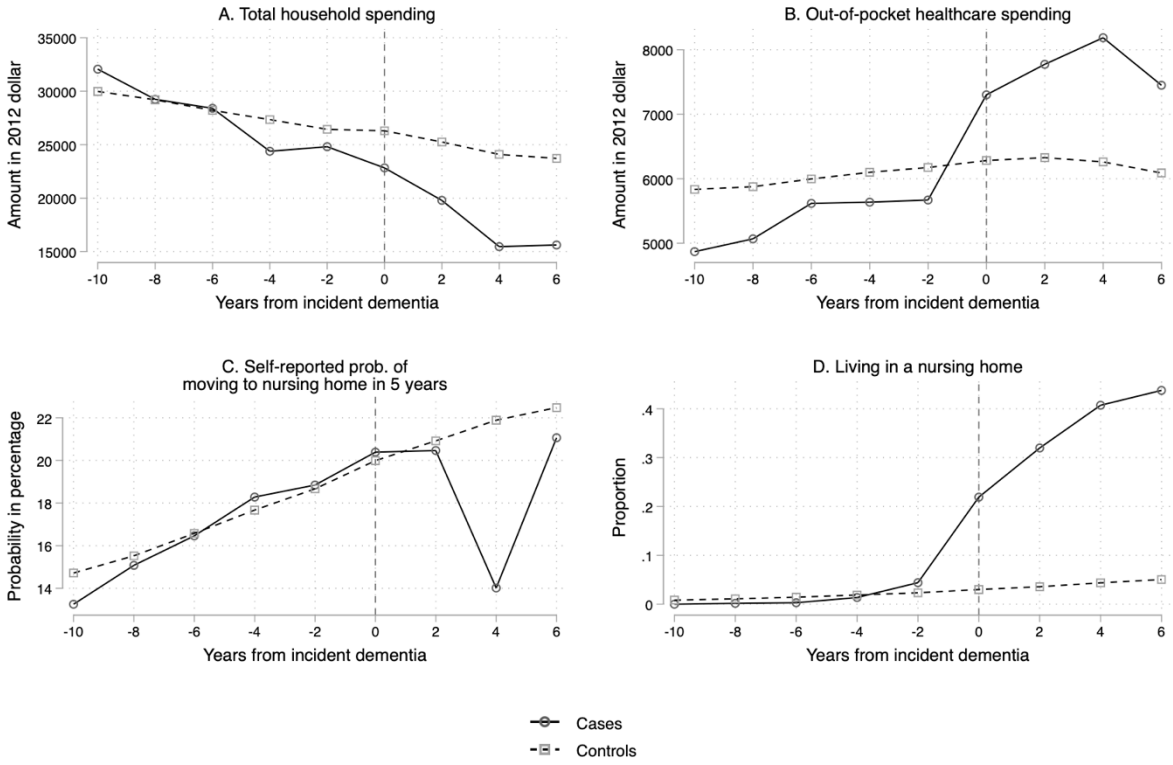
Wiener, Joshua M, Wayne L Anderson, Galina Khatutsky, Yevgeniya Kaganova, and Janet O'Keeffe. 2013. 'Medicaid spend down: New estimates and implications for long-term services and supports financing reform', *Washington, DC: RTI International*.

Figure 1. Trends in individual and household income among dementia cases and weighted controls



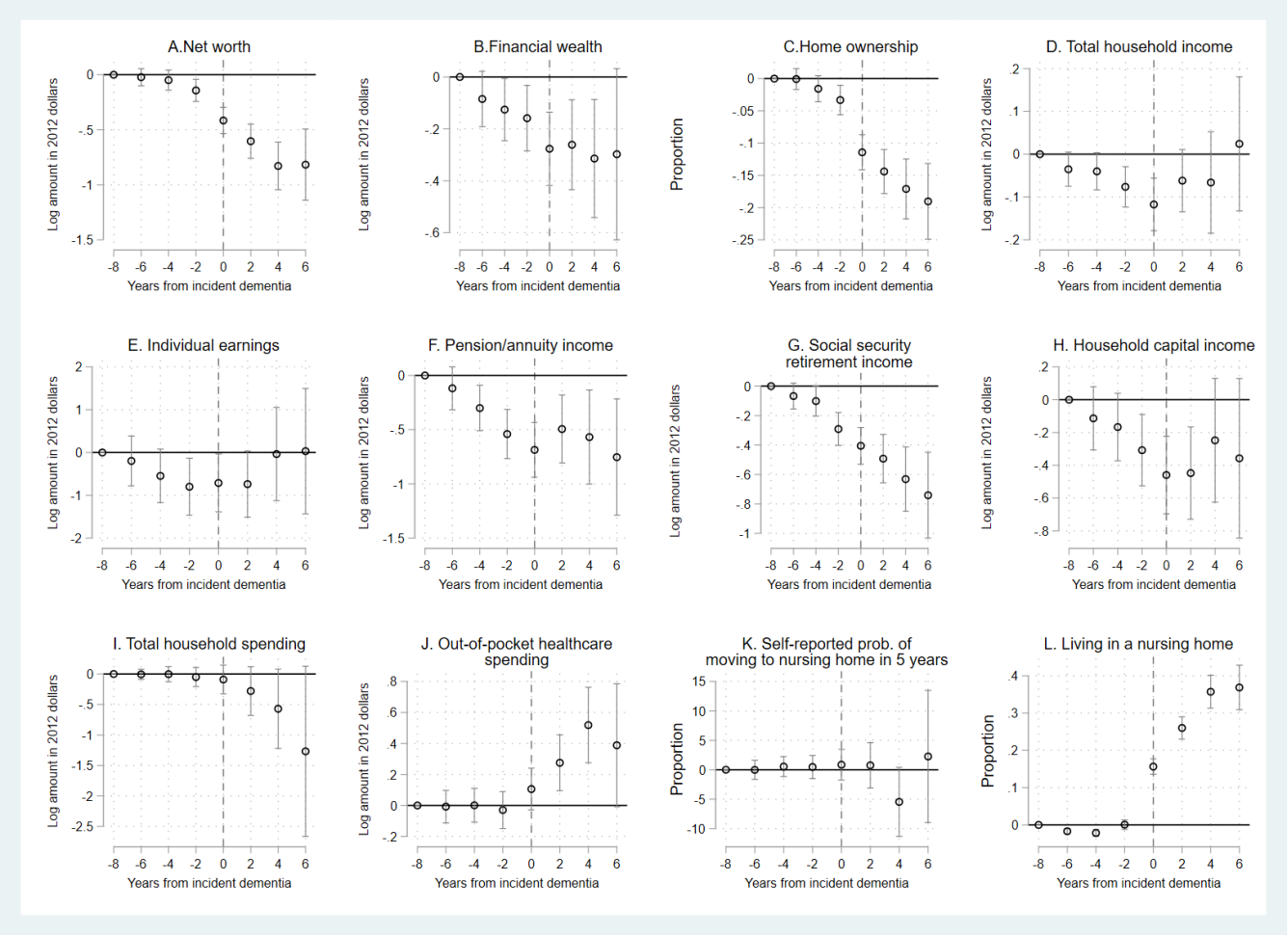
Notes: Values for controls were re-weighted to represent cases using propensity score estimated from a logistic function using age, gender, education (no high school degree, high school degree, some college or above) and marital status (married or partnered, divorced or separated, widowed, never married) as covariates. Control observations across all years were included in the propensity score estimation and weighting for each year relative to incident dementia.

Figure 2. Trends in household spending and nursing home status among dementia cases and weighted controls



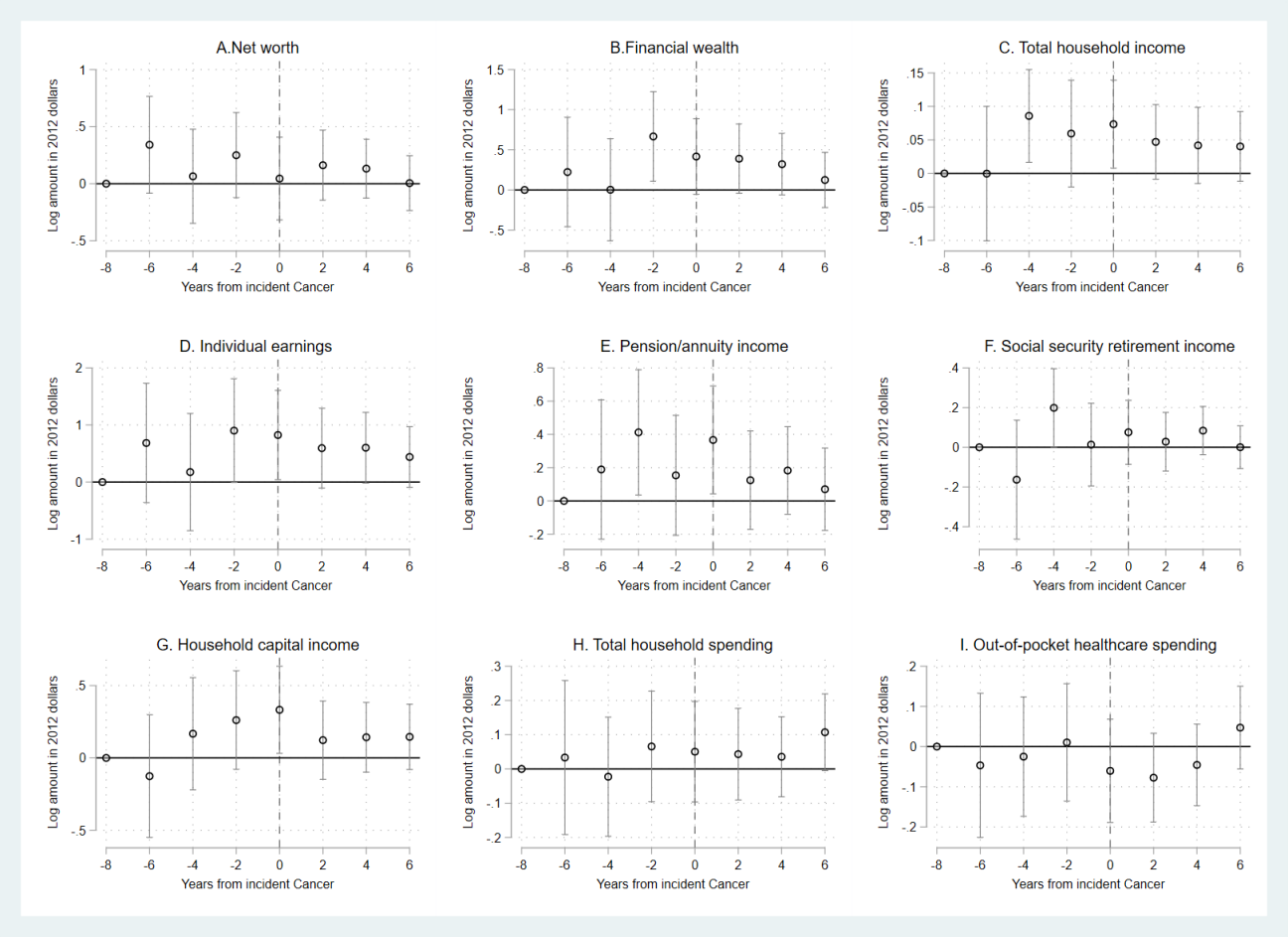
Notes: Values for controls were re-weighted to represent cases using propensity score estimated from a logistic function using age, gender, education (no high school degree, high school degree, some college or above) and marital status (married or partnered, divorced or separated, widowed, never married) as covariates. Control observations across all years were included in the propensity score estimation and weighting for each year relative to incident dementia.

Figure 3. Event study results for dementia cases and controls



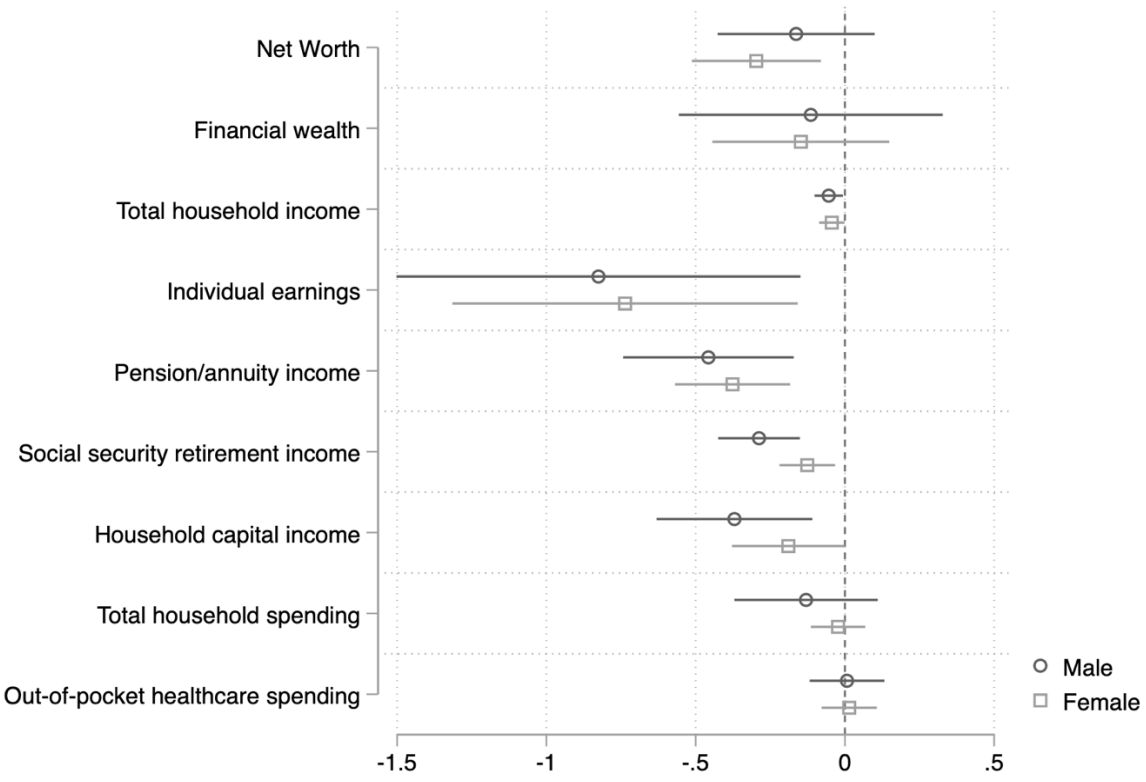
Notes: All event study regressions control for individual fixed effects, calendar year fixed effects, marital status and comorbidities. Inverse hyperbolic sine (HIS) transformation is applied to all dependent variables measured in dollar amounts (wealth, income and spending measures). The coefficients for IHS transformed dependent variables are equivalent to logged amounts. Standard errors are clustered at the household level.

Figure 4. Event study results for cancer cases and controls



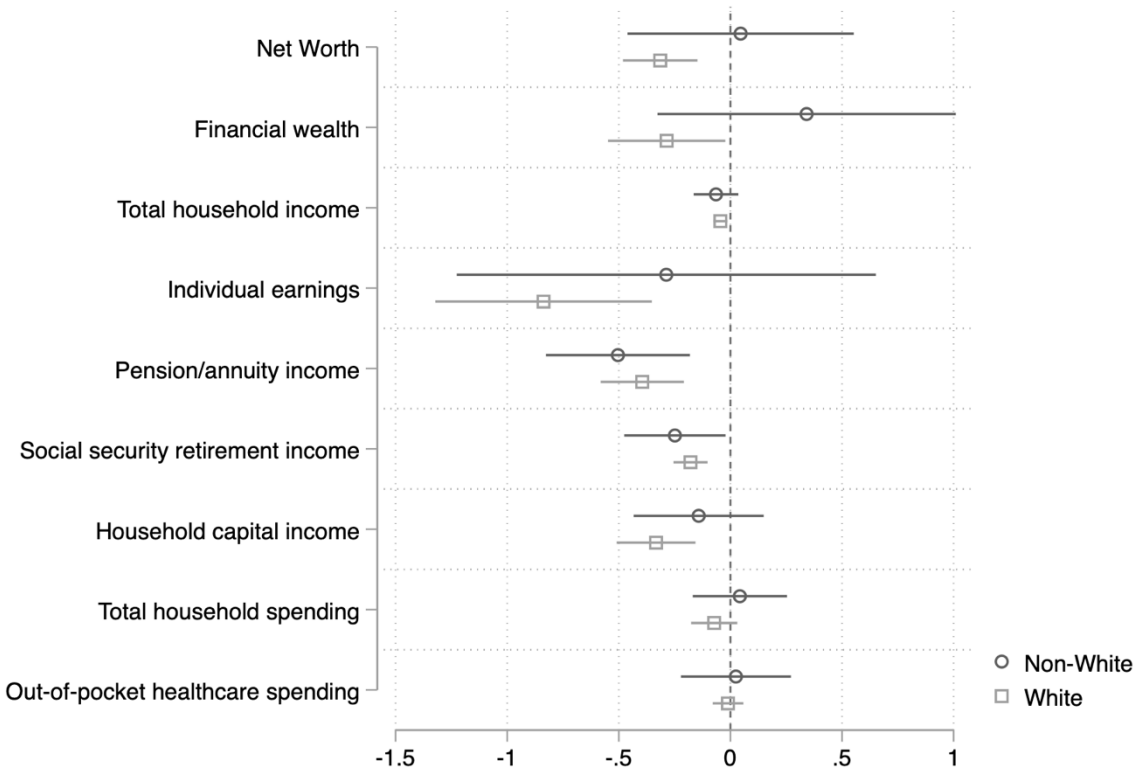
Notes: All event study regressions control for individual fixed effects, calendar year fixed effects, marital status and comorbidities. Inverse hyperbolic sine (HIS) transformation is applied to all dependent variables. The coefficients for IHS transformed dependent variables are equivalent to logged amounts. Standard errors are clustered at the household level.

Figure 5. Changes in household finances during the six years leading up to dementia onset relative to controls, by gender



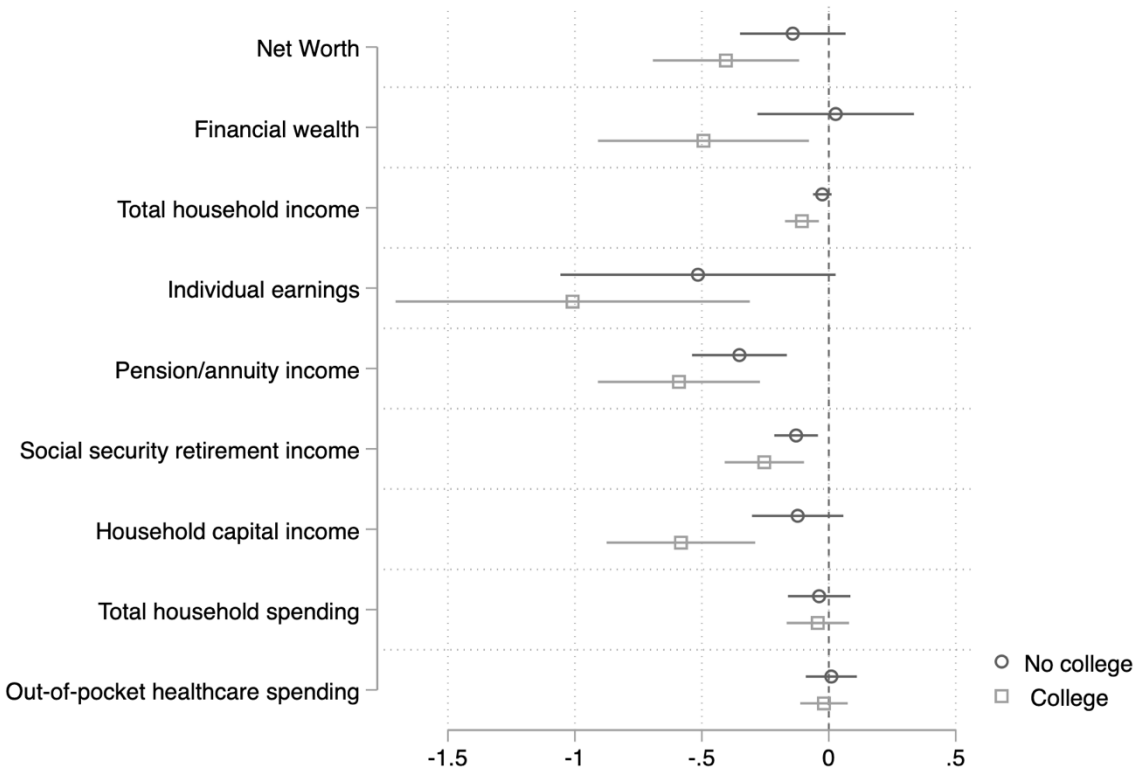
Notes: Each coefficient and 95% confidence interval come from a separate difference-in-differences regression where the post period includes the six years leading to dementia onset (financial measures collected at -4, -2, 0 years relative to dementia onset for cases), and the pre-period includes all measured collected at -6 years relative to dementia onset or earlier. Inverse hyperbolic sine (HIS) transformation is applied to all dependent variables. All regressions control for individual fixed effects, calendar year fixed effects, marital status and comorbidities. Standard errors are clustered at the household level.

Figure 6. Changes in household finances during the six years leading up to dementia onset relative to controls, by race



Notes: Each coefficient and 95% confidence interval come from a separate difference-in-differences regression where the post period includes the six years leading to dementia onset (financial measures collected at -4, -2, 0 years relative to dementia onset for cases), and the pre-period includes all measured collected at -6 years relative to dementia onset or earlier. Inverse hyperbolic sine (HIS) transformation is applied to all dependent variables. All regressions control for individual fixed effects, calendar year fixed effects, marital status and comorbidities. Standard errors are clustered at the household level.

Figure 7. Changes in household finances during the six years leading up to dementia onset relative to controls, by education



Notes: Each coefficient and 95% confidence interval come from a separate difference-in-differences regression where the post period includes the six years leading to dementia onset (financial measures collected at -4, -2, 0 years relative to dementia onset for cases), and the pre-period includes all measured collected at -6 years relative to dementia onset or earlier. Inverse hyperbolic sine (HIS) transformation is applied to all dependent variables. All regressions control for individual fixed effects, calendar year fixed effects, marital status and comorbidities. Standard errors are clustered at the household level.

Table 1. Summary statistics of cases and controls, two years prior to dementia onset among cases

	Case	Control, reweighted	Control, unweighted
Panel A. Covariates used in propensity score estimation			
Age (SD)	82.12 (6.61)	82.48 (7.59)	80.16 (4.98)
Female	0.63	0.62	0.66
Less than HS education level	0.40	0.41	0.21
HS degree or GED education level	0.33	0.32	0.38
Some college or above education level	0.27	0.27	0.41
Married or partnered	0.44	0.44	0.35
Divorced or separated	0.07	0.07	0.12
Widowed	0.47	0.48	0.49
Never married	0.02	0.02	0.04
Panel B. Other covariates			
Non-Hispanic Black	0.15	0.09	0.08
Non-Hispanic White/Other	0.76	0.86	0.88
Hispanic	0.08	0.05	0.04
Cancer	0.19	0.20	0.21
Lung Disease	0.12	0.12	0.12
Heart Condition	0.39	0.38	0.35
Stroke / TIA - core	0.18	0.11	0.09
Hypertension	0.67	0.67	0.65
Diabetes	0.25	0.21	0.20
Psychiatric Condition	0.19	0.12	0.11
Arthritis	0.71	0.71	0.71
Index of ADLs	0.47	0.22	0.10
Index of IADLs	0.82	0.35	0.14
Panel C. Financial variables			
Net worth - median ($)	128,128	199,180	267,618
Net worth – mean ($)	389,241	496,082	587,918
Financial wealth – median ($)	8,921	30,769	44,690
Financial wealth – mean ($)	146,411	204,895	235,462
Home ownership	0.61	0.65	0.69
Median household income ($)	22,710	27,781	29,847
Any individual earnings	0.03	0.07	0.09
Any pension/annuity income	0.36	0.44	0.51
Median social security retirement income ($)	11,296	12,383	12,635
Median household capital income ($)	15	409	1,056
Median checking, dividend, bonds and CD income ($)	0	153	486
Median household spending ($)	24,811	26,950	25,590
Median out-of-pocket healthcare spending ($)	5,670	6,173	6,101
Self-reported prob. of living in nursing home in the next five years (in percentage)	18.85	18.67	16.92
Fraction living in a nursing home	0.04	0.02	0.01
Observations	2,546	27,229	1,191

Notes: Means are reported, except noted otherwise. Column 2 shows values for controls weighted to represent cases using propensity score estimated from a logistic function using age, gender, education (no high school degree, high school degree, some college or above) and marital status (married or partnered, divorced or separated, widowed, never married) as covariates. Cases from 2 years prior to dementia onset and control observations across all years were included in the propensity score estimation for each year relative to incident dementia. Column 3 shows values for controls with a valid randomly assigned dementia onset year.

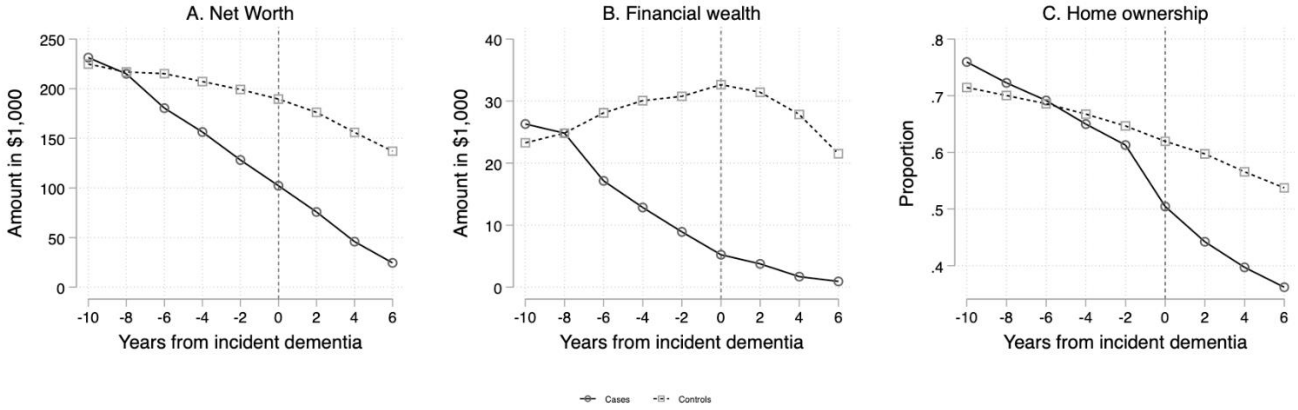
Table 2. Changes in household finances during the six years leading up to dementia onset relative to controls

	Wealth		Income					Spending	
	(1)	(2)	(3)	(4)	(5)	(7)	(8)	(9)	(10)
	Net Worth	Financial wealth	Total household income	Any individual earnings	Any pension/ annuity income	Social security retirement income	Household capital income	Total household spending	Out-of-pocket healthcare spending
Panel A. Winsorized dependent variable									
Long-run change	-$15,398**	-$7,834**	-$1,176**	-$651	-$740****	-$473****	-$120	$375	$77
	(7127)	(3795)	(528)	(643)	(157)	(90)	(251)	(1080)	(115)
Observations	39527	39527	39527	11462	39527	39527	39527	8128	39518
Panel B. Inverse hyperbolic sine transformed dependent variable									
Long-run change	-0.23****	-0.13	-0.05***	-0.73****	-0.43****	-0.18****	-0.26***	-0.05	0.01
	(0.06)	(0.13)	(0.02)	(0.22)	(0.08)	(0.04)	(0.08)	(0.05)	(0.04)
Observations	39527	39527	39527	11462	39527	39527	39527	8128	39518
Mean of Wealth/ Income/ Spending	$403,057	$129,437	$40,396	$9,672	$5,579	$11,522	$7103	$34,785	$7,028

Notes: Each column in Panel A and Panel B shows results from a difference-in-difference regressions where the post period includes the six years leading to dementia onset (financial measures collected at -4, -2, 0 years relative to dementia onset for cases), and the pre-period includes all measured collected at -6 years relative to dementia onset or earlier. All regressions control for individual fixed effects, calendar year fixed effects, marital status and comorbidities. Standard errors are clustered at the household level.

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Appendix Figure A1. Trends in household wealth and home ownership among dementia cases and weighted controls



Source: Li et al. (2023).

Notes: Values for controls were re-weighted to represent cases using propensity score estimated from a logistic function using age, gender, education (no high school degree, high school degree, some college or above) and marital status (married or partnered, divorced or separated, widowed, never married) as covariates. Control observations across all years were included in the propensity score estimation and weighting for each year relative to incident dementia.