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Abstract: While housing equity accounts for a large portion of many retiree's savings portfolios, they are not using their equity to increase consumption in retirement as suggested by the Life-Cycle Hypothesis. Defined benefit plans provide a guaranteed source of income in retirement where the household bears no risk, whereas households with a defined contribution plan are subject to potential risk depending on their asset allocation. This paper examines whether having a defined benefit plan mitigated some of the effects of the Great Recession. Using a difference-in-difference analysis, I examine the impact of the Great Recession on homeownership between households with a defined benefit plan compared to those with a defined contribution plan. I find that households with a defined contribution plan were 2.1-2.9 percent less likely to own a home after the Great Recession compared to households with a defined contribution plan. It is possible that households with defined contribution plans were willing to forgo homeownership to offset some of the losses experienced from the Great Recession. Future retirees face a potentially riskier housing market and are less likely to have a defined benefit plan. As a result, future retirees may be more willing to use their housing equity to increase consumption in retirement than was observed in past generations.

JEL Classification: J32, D14, J14

KEYWORDS: Great Recession, Housing Equity, Retirement, Pension

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1. Introduction

Owning a house has historically been a viewed as a safe investment receiving an average rate of return around 5 percent per year (S&P Dow Jones Indices LLC). While it does not receive a rate of return as high as the stock market (over 7% seen in the S&P 500 (Yahoo Finance)), there has been relatively low volatility in housing prices, which have tended to increase each year. As a result, nearly 80 percent of retirees own a house according the US Census Bureau (2018) and housing equity accounts for nearly half the net worth of retired Americans (Moulton et al. 2016). The Great Recession of 2007-2009 was one of the most severe economic downturns in American history and was unique among recent recessions due to simultaneous shocks in the labor, stock, and housing markets. During the recession, the S&P 500 averaged a 2.3 percent monthly decline (Yahoo Finance), unemployment rose from 5.0 percent to 9.5 percent (US Bureau of Labor Statistics), and the Case-Shiller Index averaged a 9.1 percent decline (S&P Dow Jones Indices LLC). Many older Americans (age 55 and older) saw a decline in home value simultaneous with a reduction in their retirement portfolios or income for those still working.

The Life-Cycle Hypothesis (LCH) suggests that households plan their consumption and savings paths throughout their lifetime by saving throughout their working years and then living off those savings plus return in retirement (Modigliani and Brumberg 1954). Because housing equity constitutes a large part of a many retiree's savings portfolios, the LCH suggest that they should use their accumulated housing equity to increase consumption in retirement. However, prior to the Great Recession this was not usually the case, as many households die while still owning large positive housing equity[1] (Borsch-Supan, Hajivassiliou, and Kotlikoff 1992; Ai et

[1] Section 2 provides background information on the housing-equity puzzle.

al. 1990; Feinstein and McFadden 1989; Fisher et al. 2007; Poterba, Venti, and Wise 2011; Venti and Wise 1989, 1990, 2001, 2004). With house values declining during the Great Recession, it is possible home ownership is no longer seen as the safe investment it once was and some households may choose to store their wealth elsewhere.

Over the last 30 years, American employers have shifted away from *defined benefit plans* in favor of *defined contribution plans* (Butrica et al. 2009; Hurd and Rohwedder 2010). Defined benefit plans are managed by the employer, who bear all the risk, and provide a guaranteed source of income in retirement for the remainder of the employee's life based on years of service[2]. Defined contribution plans – such as an employee sponsored 401(k) or 403(b) – are managed by the employee, who bears all the risk, and receive contributions from the employer. Defined contribution plans often carry more risk than defined benefit plans as they are sensitive to the portfolio and asset allocations the employee makes (Poterba et al. 2006). Thus, without the guaranteed income provided by a defined benefit plan, older (for the purpose of this paper, those age 55+ and in their late working years) and retired households (generally age 65+) were subject to greater losses in savings and wealth during the Great Recession. In this paper, I explore the role of defined benefit plans in homeownership after the Great Recession. Specifically, I examine whether households that had a defined contribution plan were willing to extract housing equity by foregoing homeownership and opting to rent instead, to offset some of these losses. Using the Health and Retirement Study, I analyze how homeownership rates have changed since the Great Recession based on age and pension status. Because the Great

[2] Defined benefit plans vary in terms from employer to employer as to how much income they get, when beneficiaries are eligible to start collecting, and whether the pension can be passed on to a spouse in the event of death.

Recession had a varying impact for different regions of the country, I also analyze homeownership rates for households in urban and rural areas.

I find that while all households saw losses in non-housing related wealth following the recession, households with a defined contribution plans saw a significant decrease in homeownership rates compared to those that had a defined benefit plan. A difference-in-difference analysis shows households with defined contribution plans were 2.1-2.9 percent less likely to own a home following the Great Recession compared to households with a defined benefit plan, which saw little or no change in homeownership. I find this change to be largely concentrated in households where at least one person is working and residing in urban households, as homeownership rates of rural households appear to not be affected by the Great Recession.

Results of this study suggest that households with a defined contribution plan were less likely to own a home after the Great Recession compared to households with a defined benefit plan, who had a guaranteed income. While other explanations cannot be entirely ruled out, it is possible these households chose to reconsider the role the house played in their savings portfolio as more older households with defined contribution plans were more likely to act as would be expected per the LCH. This is important because households under age 65 are significantly less likely to have a defined benefit plan than older retirees. The decline housing values during the Great Recession indicate that they may not behave as they did in past decades, and that housing equity may indeed carry some risk. Future retirees will be increasingly likely to have large parts of their savings portfolios in risky assets without the guaranteed income from a defined benefit plan. The results of this paper are important to help future generations of retirees understand the changing role of home equity in retirement planning so that they may act accordingly. These

results also help policymakers understand the changing dynamics of retirees' savings decisions and will help shape policy for the 21st century.

My findings make several contributions to the literature on the use of housing equity as households age. First, it provides an in-depth analysis of home ownership and transition rates for older Americans in the post-Great Recession era. This complements earlier studies done by Feinstein and McFadden (1989), Poterba, Venti, and Wise (2011), Venti and Wise (1989, 1990, 2001, 2004), and others. Second, this is one of the first papers to analyze the impact of pension plans on homeownership after the Great Recession. It provides new insights into how a defined benefit plan may influence how older Americans use their housing equity in retirement – something not observed before the Great Recession.

The next section proceeds with a discussion on the use of housing equity by older Americans in Section 2; Section 3 provides a description of the data and weighting; Section 4 discusses wealth, homeownership, and moving rates of older Americans before after the Great Recession; Section 5 lays out the empirical strategy used in this paper; Section 6 presents and discusses the results; Section 7 offers sensitivity analysis and robustness checks; and Section 8 offers concluding remarks.

2. The Use of Housing Equity by Older Americans

The LCH suggests that households should extract their housing equity in retirement to supplement their savings and social security to help increase consumption spending. Households can achieve this in one of three ways: downsizing to a smaller home, moving from owning to renting, or taking out a reverse mortgage. In fact, households over age 65 could increase their median income by as much as 40 percent if they sold their home and annuitized the money from the sale (Butrica and Mudrazija 2016). However, historically only around 2-9 percent of

homeowners move in a given year (Feinstein and McFadden 1989; Venti and Wise 2001, 2004, 1989). Since so many homeowners stay in their home, a reverse mortgage is an option that allows them to extract housing equity without moving, however only around 2 percent of retirees possess a reverse mortgage (Nakajima and Telyukova 2017; National Retirement Risk Index 2010). Some research suggests households do not appear to be aware of reverse mortgages or what they entail (Davidoff, Gerhard, and Post 2017; Kutty 1998; Venti and Wise 1990, 2004). Since the LCH indicates that homeowners should want to use their housing equity, an effort has been made to understand why many do not. Some possible reasons include bequests, precautionary savings, and non-economic reasons.

Past research has suggested that households may choose to forgo using equity in the house in order to leave it as a bequest (Feinstein and McFadden 1989; Hurd 1992). However, Hurd (1992) found no evidence to support a bequest motive because the consumption and savings paths are almost identical for homeowners who are parents and nonparents. He suggests that if there was a bequest motive then there should be a higher savings path for parents than nonparents, which was not the case. Venti and Wise (1989) also noted that the change in housing equity is the same for older homeowners regardless of parental status, suggesting that a bequest is not the main explanation for reluctance to use housing equity. Fisher et al. (2007) noted that if bequests were the motive, older Americans might treat their home as another part of their total financial portfolio, however, Hoynes and McFadden (1997) show that as house value increases, household total savings do not. Despite its intuitive appeal, there is no strong evidence to support a prospective bequest as a driving force behind not extracting housing equity in retirement.

Another possible explanation is that older Americans treat their house as a form of precautionary savings in the event of unexpected medical costs (Poterba, Venti, and Wise 2011; Venti and Wise 2001; Nakajima and Telyukova 2017). One of the biggest consumption expenditures of older Americans is long-term care. Given the uncertainty of if or when long-term care will become necessary, the house can serve as a form of precautionary savings to serve as a form of insurance to provide funds if needed (Fisher et al. 2007). Murray (2018) explores this explanation and finds that precautionary savings indeed accounts for up to 13 percent of households holding on to their housing equity.

A final theory is that as people age, they are less likely to view the house as an asset. Socioemotional Selective Theory (SST) is a lifespan theory of motivation popular in psychology that proposes that people monitor time horizons and adjust motivations, goals, and preferences as they age. Older people are more likely to perceive time as finite. Thus, they may place more importance on finding emotional meaning and satisfaction from life while investing fewer resources into gathering information and expanding horizons (Carstensen 2006). Fisher et al. (2007) noted that if this is the case, older Americans may hold on to their home because they are more driven by emotional attachment than financial gain. However, a reverse mortgage would allow a household to remain in their home and extract equity and satisfy both the LCH and SST.

In this paper, I explore an alternative explanation that was not observed prior to the Great Recession. Defined benefit plans are less common for recent retirees and those who are about to retire compared to older generations on whom many previous studies were conducted. In addition, the coinciding losses in wealth and house value during the Great Recession provides a unique opportunity to examine how having the guaranteed income from a defined benefit plan may have mitigated these losses compared to other households. The potential willingness of

some households with a defined contribution plan to part with their housing equity after the Great Recession shows how a defined benefit plan may have influenced the historical decision of so many older Americans to not use their housing equity to increase consumption in retirement. It is possible that due to having a guaranteed source of income from a defined benefit plan, households never considered the house when making retirement decisions. Households with defined contribution plans in a potentially risker housing market may be more willing to do so.

3. Data and Weighting

A. Data

This paper uses individual and household level data from eight waves of the restricted version of the Health and Retirement Study (HRS) from 1998-2014 to study homeownership before and after the Great Recession. The HRS is a longitudinal survey that includes about 20,000 households over age 50, representative of the overall United States population in that age group. The HRS defines an observational unit as an eligible household containing at least one person born within a given time period (which varies by phase)[3]. The HRS is administered by the University of Michigan Institute for Social Research in partnership with the RAND Center for the Study of Aging. The original target population for the HRS when the study was initiated in 1992 is adults born between 1931-1941 (designated 'HRS Cohort') and those born before 1924 (AHEAD cohort). Every six years the survey adds a new cohort starting in 1998 with those born between 1924-1930 (Children of the Depression) and 1942-1947 (War Babies Cohort). In 2004 those born between 1948-1953 (Early Baby Boomers Cohort) were added; and the last group added was in 2010 with the addition of those born between 1954-1959 (Mid-Baby Boomers Cohort).

[3] For more information on the HRS and its sample selection, see https://hrs.isr.umich.edu/publications/biblio/9047 (HRS Staff, 2008).

This study uses the HRS due to its specific focus on older Americans. While much of the research on housing uses the American Housing Survey, the HRS includes more information on retirement plans, asset composition, and spending in addition to demographical and housing characteristics, making it more appealing for this study.

This study restricts attention to two household types: those consisting of either one person aged 55 or older or a married couple where the male is aged 55 or older[4]. Urban and rural households are determined by the United States Department of Agriculture Rural-Urban Continuum Codes[5] included in the HRS. Metropolitan areas are classified as urban and non-metropolitan areas rural. All monetary values in the HRS are reported in nominal dollars and have been converted into real 2009 dollars using the PCE chain-type price index taken from the Federal Reserve Economic Database[6].

I use several key variables in this paper. The first is whether or not a household has a defined benefit plan. I construct an indicator variable using two metrics from the HRS. The HRS provides a variable for how much each person in the household is receiving from an employer pension annually. This is then constructed into a household variable by combining pension income if the household contains two people. If the household reports receiving pension income from the employer, then the indicator variable takes a value of one; if they reported receiving no pension income from the employer, this variable takes a value of zero. This study also includes households in their late working years who may not be collecting this income yet. In these cases, the HRS has information on whether or not they have a defined benefit plan from

[4] This study allows for divorced and widowed households and would fall under a household with one person.
[5] More information on the USDA Rural-Urban Continuum Codes are available at https://www.ers.usda.gov/data-products/rural-urban-continuum-codes/.
[6] Downloaded from the Federal Reserve Economic Database (https://fred.stlouisfed.org/series/PCEPI) on 5/13/2017 (US Bureau of Economic Analysis)

their current job. If they are working and have a defined benefit plan, then the indicator variable takes a value of one; if they are working and do not have a defined benefit plan, then it takes a value of zero.

I also construct an indicator variable for households that have a defined contribution plan while *not* having a defined benefit plan. The HRS provides a variable for the value of households defined contribution plans. I sum value for all the plans of the household. Since some households may extract the total value of their defined contribution plan, this variable takes the value of one if the household at any time reported a positive value for their defined contribution plans conditional on not also having a defined benefit plan, and a zero otherwise.

Non-housing wealth is defined as total household assets less household debt excluding the value of the primary residence, mortgages, and home loans. Income is defined as total household income and includes earnings, pension income, social security, and others. A detailed breakdown of the variables used in this analysis and how they were constructed can be found in Appendix A.

B. Weighting

Because the age distribution of the respondents of the research sample changes from wave to wave because to households exit and enter the survey, inverse probability weights are constructed for each age group and applied to all analyses in this paper[7]. The weight is based on the first year in the sample and constructed as follows:

$$weight = \left[\frac{\#\ of\ individuals\ age\ i\ in\ 1998}{\#\ of\ individuals\ age\ i\ in\ year\ x} \right]^{-1} \quad (1)$$

[7] A sensitivity check is conducted in section 7 to explore the results without the weights

4. Household Wealth and Homeownership Rates

A. Household Wealth

[INSERT TABLE 1 HERE]

Following the Great Recession, many households saw declines in their non-housing wealth. Table 1 shows that households with a defined benefit plan experienced a 5.5 percent decline in non-housing wealth compared to a 31.4 percent decline for households with a defined contribution plan. Households with a defined benefit plan aged 65 and older saw no decline in non-housing wealth after the Great Recession whereas households with a defined contribution plan did. Households age 65 and over are more than twice as likely to have a defined benefit plan as those aged 55-64 and that younger households are more likely to have a defined contribution plan. This is consistent with studies by Buessing and Soto (2006), Copeland (2006), and Wiatrowski (2004) that show that employers offering defined benefit plans have been on the decline over the last 30 years.

B. Homeownership Rates

[INSERT TABLE 2 HERE]

Table 2 shows homeownership rates for all households before and after the Great Recession and for households with both defined benefit and defined contribution plans. Overall, there was a 4-percentage point decline in homeownership rates following the recession. This is largely concentrated in households with defined contribution plans. These households saw declines in homeownership at all age groups and an increase in the rate of renting compared to households with a defined benefit plan. Households with a defined benefit plan saw modest or no declines in homeownership rates.

Households with a defined benefit plan tend to be concentrated among those already retired at the time of the Great Recession and they did not suffer as much as those between the ages of 55-64 and nearing retirement. However, those at all ages with defined contribution plans saw declines in non-housing wealth and a decrease in homeownership rates following the Great Recession. The declines in homeownership rates could be driven by a desire to use their housing equity to offset losses in retirement savings or they could no longer afford the mortgage. Since homeownership may no longer be considered as safe an asset as in prior decades, households may be storing more of their wealth in other assets.

C. Transition Rates

[INSERT TABLE 3 HERE]

Table 3 shows the transition rates[8] for households that moved for all households and households with and without a defined benefit plan. There was a 2.2-percentage point decrease in the percent of older households that moved following the Great Recession. For homeowners, there was a 13.8-percentage point decrease in the percent who moved from owning to owning and a corresponding 14.9-percentage point increase in the percent who moved from owning to renting. The change in moving for renters was relatively small compared to that for homeowners. Homeowners in the 55-64 age group saw a 15.7-percentage point decrease in the rate of homeowners moving to owning, the largest of all the age groups. Those aged 65-74 saw a 9.7-percentage point decline in moving from owning to owning and households aged 75-84 saw the smallest decline at 6.7-percentage points. A smaller number of households moved after the

[8] The transition rates in Table 3 are of the same format seen in Feinstein and McFadden (1989) and Venti and Wise (1989). Where is says own/rent in the column that represents the current residence. This table is to be read across showing the number of owners/renters, the percent of owners/renters that moved and the percent that moved to owning and the percent that moved to renting

Great Recession but out of those who did, they were more likely to move to renting and forgo homeownership.

Table 3 also shows this breakdown for households with both defined benefit and defined contribution plans. The percent of older households that move after the Great Recession is relatively similar for households with defined benefit and defined contribution plans. The percent of households who moved from owning to owning declined 13.1-percentage points for households with a defined benefit plan, and is largely concentrated among households aged 55-64 and corresponds to the only age group that saw a modest decline in homeownership in Table 2. The percent of households who moved from owning to owning declined 17.8-percentage points for households with defined contribution plans and this decline occurred at all ages, corresponding to a drop in homeownership rates at all ages for this group shown in Table 2.

In summary, pre-retirement age households are less likely to have defined benefit plans than older and retired households and more likely to have defined contribution plans. Households with defined contribution plans saw more significant changes in homeownership than households with defined benefit plans. This will be further analyzed using regression analysis.

5. Empirical Strategy

A. Difference-In-Difference

I use a difference-in-difference estimation strategy to measure the effect of the Great Recession on homeownership for households with and without defined benefit plans using the following regression:

$$\text{prob}(homeownership_{it} = 1 \mid X) = \beta_0 + \beta_1 DC_{it} + \beta_2 Post_t + \beta_3 DC_{it} Post_t + \boldsymbol{\gamma' X_{it}} + \boldsymbol{\phi_i} + \boldsymbol{\lambda_t} + \varepsilon_{it} \qquad (2)$$

The dependent variable representing homeownership status for household i at time t and is an indicator variable that is equal to one if the household reports owning a house and a zero if they report renting or other[9]. DC_{it} is an indicator variable that is equal to one if the household has a defined contribution plan and is equal to zero if they have a defined benefit plan. $Post_t$ is an indicator variable that is equal to one in the years after the Great Recession (2010-2014). The coefficient of interest is β_3, which captures the effect of the Great Recession on homeownership. I expect this value to be negative if households without a defined benefit plan were less likely than those with one to own a house following the Great Recession.

The demographic controls included in the vector $\boldsymbol{X}_{it}$ are as follows: inverse hyperbolic sine (IHS) of income, lagged IHS of non-housing wealth, an indicator for marital status, an indicator for being unemployed, years of education, number of children, age, and age squared. ϕ_i represents state fixed effects and λ_t represents year fixed effects. The IHS is used in place of logged values to incorporate zero and negative values[10]. Table 4 shows the means and differences of observable characteristics for households with defined benefit and defined contribution plans separated by the treatment period.

[INSERT TABLE 4 HERE]

Since the Great Recession had varying impacts on different parts of the country, I split the sample into urban and rural households to test for heterogeneous effects across geographic areas. For this purpose, equation (2) was re-estimated for urban and rural households independently.

[9] The HRS has a third category for living in "other." This includes such scenarios as living in a recreational vehicle, living with parents rent free, and other types of residential situations besides home ownership and renting

[10] See Burbidge, Magee, and Robb (1988) and Pence (2006) for derivation and use of the IHS transformation.

B. Treatment and Control States

Homeownership rates for households with a defined contribution plan appear to have been more affected by the Great Recession and serve as the treatment group. Defined benefit plans are the complement to a defined contribution plan and serve as the control group. In equation (2), β_3 represents the effect of the Great Recession on homeownership status for households without a defined benefit plan. The interpretation of β_3 as the causal effect of the Great Recession on homeownership status requires two assumptions. First, the decision to own a home should be exogenous to other policies or observable factors. For this assumption to be true, in the absence of the Great Recession the difference in homeownership trends for households with and without a defined benefit plan should be similar before and after 2010.

[INSERT TABLE 5 HERE]

Table 5 shows a balance test to determine if there were changes in observable characteristics before and after the Great Recession. For each demographic variable, I estimate a variation of equation (2) with each control as the dependent variable without the other control variables. This test shows that some of the demographic variables, including non-housing wealth and children, have statistically significant changes after the Great Recession. While such factors might influence the decision to own a home, when adding these controls into the estimation, the baseline results (shown in the next section) do not fluctuate significantly. Since there is imbalance, I conduct an analysis outlined in Oster (2017) to include bounds on the treatment effect to show these results can serve as an upper bound. While it is not impossible to rule out other causes, this eases the concern that the results might be driven by other factors.

Second, the interpretation of β_3 as causal requires the outcomes in the treated and control groups to follow parallel trends prior to the Great Recession. I asses the validity of this assumption in two ways. First, the homeownership rates for both groups are visually graphed in Figure 1. Prior to 2010, homeownership rates between the two groups had the same general

[INSERT FIGURE 1 HERE]

trend. Following 2010, households with a defined benefit plan continue the same trend while households without show a decline. A trendline is included to show the trend had it not changed after the Great Recession. Second, I test this assumption by interacting a linear time trend ($Trend_t$) with the treatment variable, restricting the period to 1998-2008, and estimating the following regression equation while including the same controls as in equation (2):

$$\text{prob}(homeownership_{it} = 1 \mid X) = \beta_0 + \beta_1 DC_{it} + \beta_2 Trend_t DC_{it} + \boldsymbol{\gamma' X_{it}} + \boldsymbol{\phi_t} + \boldsymbol{\lambda_t} + \varepsilon_{it} \qquad (3)$$

If the treatment and control groups have similar trends prior to the Great Recession, then β_2 in equation (3) should be small and statistically insignificant. Table 6 presents the results of equation (3) for all households, urban households, and rural households. β_2 is small and statistically insignificant for all three models providing evidence of parallel trends prior to the Great Recession.

[INSERT TABLE 6 HERE]

6. Results

[INSERT TABLE 7 HERE]

A. All Households

Table 7 shows the results from difference-in-difference regression depicted in equation (2). Column 1 shows the regression outline in equation (2) without controls and, in Column 2, I

add demographic controls to ensure they do not impact the results. Column 1 indicates that households with a defined contribution plan were 2.9 percent less likely to own a home after the Great Recession than households with a defined contribution plan, an effect that is statistically significant at the one percent level. Column 2 shows that when including demographic controls, the effect decreases to 2.1 percent, but remains statistically significant at the five percent level. This eases the concern that the results might have been driven by changes in income, non-housing wealth, or other factors. A sensitivity analysis is conducted in Section 7 to show that these results are robust to observation changes due to adding controls. These estimates show that the Great Recession influenced housing decisions among households with a defined contribution plan, but no corresponding effect was seen on households with a defined benefit plan. It appears that having a defined benefit plan as a guaranteed source of income provided security against losses they may have suffered that households with a defined contribution plan did not have.

B. Urban vs Rural Households

Columns 3 and 4 of Table 7 show the results from difference-in-difference regressions when the sample is restricted to just urban households. Column 3 shows the results without demographic controls and Column 4 shows the results with demographic controls. Column 3 shows that urban households with a defined contribution plan were 3.3 percent less likely to own a house than their urban counterparts with a defined benefit plan. This effect is statistically significant at the one percent level. This percentage falls to 2.6 percent when adding controls, as seen in Column 4, and remains significant at the one percent level. The small changes seen when adding controls again ease the concern about other factors driving the results.

Columns 5 and 6 show the results from the difference-in-difference regressions when the sample is restricted to just rural households. Column 5 does not include demographic controls

and Column 6 does. None of the results are statistically significant, suggesting that the Great Recession did not impact homeownership for rural households the way it did urban households. This is a trend seen in other studies showing that urban households were affected more severely by the Great Recession than their rural counterparts (Thiede and Monnat 2016; Mattingly, Smith, and Bean 2011). Bailey, Jenson, and Ransom (2014) note that many rural areas were already suffering with a troubled labor market due to lower levels of education and aging populations, perhaps because the decline in the manufacturing sector had already produced economic hardships in these areas (Slack 2014). The fact that rural households did not experience the same economic decline as urban households likely explains why the lack of significant change in homeownership differential between households with and without defined benefit plans.

7. Sensitivity and Robustness Checks

[INSERT TABLE 8a HERE]

To ensure that the changing sample from adding controls is not what is influencing the coefficient change, I re-estimate the results from Table 6 Column 1 but restrict it to the sample found in Column 2. The results of this are shown in Panel A of Table 8a. The treatment effect decrease by 0.3 percentage points showing that households with a defined contribution plan are 3.2 percent less likely to own a house after the Great Recession compared to households with a defined benefit plan. This small change provides evidence the changing sample is not influencing the results.

The HRS sample used in this study also incorporates the recession that started in March 2001 and ended in November 2001. There should be no impact on homeownership from this recession since the impact of the housing market was unique to the Great Recession. To test this, I re-estimate equation (2) with using the 2001 recession as the treatment period instead of 2008.

The results of this regression are shown in Panel B of Table 8a and show that there was no impact of homeownership for households without a defined benefit plan compared to those that did have one. This provides further evidence that it was indeed the Great Recession that is causing these results not just economic downturns in general.

Panel C of Table 9a shows the results of the difference-in-difference models without using age weights mentioned in Section 3. The results without the weights are slightly more negative but show the same trend as the results using the age weights. The age weights place slightly more emphasis on older age groups to account for survival bias. The results being more negative without weights makes sense because the Great Recession had a greater impact on homeownership for those 55-64 compared to those 65 and older, and removing the age weights gives the younger age group a larger share of the sample.

Due to the imbalance of observables, I cannot rule out the impact of unobservables on the results, however it is possible to provide bounds on the treatment effect to show how the unobservable might impact the results. Oster (2017) provides an extension to Altonji, Elder, and Taber (2005), which outlines the procedure[11]. Oster (2017) shows that assuming the role of observables is proportional to the role of observables in determine treatment effect, it is possible to determine a bound on the treatment effect. If the bound does not include zero, this provides information on the direction unobservable might influence the results. The bounds from this procedure, using the Stata code accompanying Oster (2017), are shown in Panel D of Table 8a. The bound on the treatment effect does not include zero for any of the regressions, suggesting that the estimates shown in Table 6 may be an upper bound.

[11] Several recent studies have incorporated this procedure including Baranov et al. (2015), Gunes and Tsaneva (2016), and Ozier (2018),

[INSERT TABLE 8b HERE]

In Table 8b I split the sample in two different ways to measure the impact of the Great Recession on homeownership. In Panel A I restrict the sample so that at least one person in the household is working. This shows that working households with a defined contribution plan were 2.1 percent less likely to own a house after the Great Recession compared to households with a defined benefit plan. Urban households with defined contribution plans were 2.3 percent less likely to own a home following the Great Recession though only significant at the ten percent level, and much like the full sample, there is no significant effect for rural households. In Panel B I restrict the sample to households that are fully retired. The effect of having a defined contribution plan is of similar magnitude as the full sample but is not statistically significant. This is not unexpected as a large percentage of households that were already retired at the time of the Great Recession had defined benefit plans (see Table 1) and those that did not, had most likely started to adjust their portfolio away from stocks and risky assets once they hit retirement (Fagereng, Gottlieb, and Guiso 2017). As such, they most likely did not see as severe losses as pre-retirement households who still possessed risky assets. Hurd and Rohwedder (2010) note that retirees were likely to suffer less than those who were in their late working years. It is important to note that the number of Americans working past age 65 has been increasing since the 1990s (Hurd and Rohwedder 2010; Kaul and Goodman 2017; Toosi 2015). Therefore, this effect is not necessarily isolated to just households under age 65, but to households that have not fully decided to retire. In summary, having a defined contribution plan lead to a significant decrease in homeownership after the Great Recession compared to households with a defined benefit plan, however this effect appears to be largely concentrated among urban households where at least one person is working.

These sensitivity and robustness checks show that the results are robust and most likely not driven by unobservable factors and that they were indeed caused by the Great Recession.

8. Conclusions and Discussion

The Great Recession was one of the most severe economic downturns in contemporary American history. Households experienced declines in income, savings, and property values. For Americans that were retired or near retirement, these losses could be difficult if not impossible to recover. Having a defined benefit plan may have possibly mitigated some of the losses that may have been suffered in other assets. Households with defined contribution plans saw losses in their retirement portfolio and wealth without the security that a defined benefit plan provides. As a result, households with defined contribution plans saw larger declines in homeownership compared to households with a defined benefit plan. Additionally, households with defined contribution plans saw a larger decline in the amount of homeowners who moved from owning to owning and a larger increase in the percent of homeowners who moved from owning to renting. It is possible that in the future, homeownership may no longer be regarded as the safe investment it once was; storing wealth in excess housing equity carries new risk. In addition, an increasing number of households no longer have defined benefit plans and rely more heavily on defined contribution plans. With much savings tied up in potentially more risky assets, households with a defined contribution plan appear less likely to store wealth in housing equity in retirement, needing it to maintain spending levels. This is a new phenomenon; historically, many households have died with large sums of housing equity they could have used.

This paper provides some of the first evidence of the impact of the Great Recession upon homeownership in the context of housing equity use by older Americans. I find that households with a defined contribution plan were 2.1-2.9 percent less likely to own a house than those with a

defined benefit plan after the Great Recession. By contrast, homeownership rates after the recession were relatively unchanged for the latter group. Comparing this effect between urban and rural areas, I find that this effect appears largely concentrated in urban areas where households with a defined contribution plan were 2.6-3.3 percent less likely than those with a defined benefit plan to own a home after the Great Recession. In households where at least one person is working, households with a defined contribution plan were 2.1 percent less likely to own a home after the recession compared to households with a defined benefit plan. No such differential effect was found in rural areas or households that are fully retired, which is consistent with other studies that show the impact of the Great Recession was more heavily concentrated in urban areas and that older retirees are more likely to have defined benefit plans and less likely to have risky assets which both mitigate the impact of the Great Recession.

In the post-Great Recession era, an increasing number of retirees are going to be living off their accumulated savings in risky assets with defined benefit plans disappearing in favor of defined contribution plans. Since house prices declined during the Great Recession, there is no guarantee that housing prices will not decline again. Storing wealth in housing equity is now potentially associated with some risk. It is likely that future retirees without defined benefit plans, being unable to count on their home value always increasing, may reduce housing equity and even forgo homeownership altogether, storing that wealth in other assets. Historically, having a defined benefit plan gave households enough guaranteed income that they possibly chose not to use the equity in their house even though they were able to do so. Future households may not have this luxury. As America's population ages and people live longer in retirement, understanding how Americans finance their retirement – and how this will change in

the future – is important as federal, state, and local policymakers look to shape policy for the 21st century.

9. References

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10. Tables and Figures

Table 1. Household Wealth Before and After the Great Recession

Age		All Households		With DB Plan		With DC Plan	
		1998-2008	2010-2014	1998-2008	2010-2014	1998-2008	2010-2014
ALL	Median Income	30,657	32,066	38,452	41,888	62,666	63,465
	Median Non-Housing Wealth	49,415	28,270	92,575	87,454	91,940	63,041
	% with DB Plan	41.81	32.35				
	% with DC Plan	12.26	21.24				
55-64	Median Income	51,292	46,725	55,960	62,236	76,387	80,623
	Median Non-Housing Wealth	53,168	16,019	107,587	70,203	87,622	54,042
	% with DB Plan	20.03	10.68				
	% with DC Plan	34.68	37.29				
65-74	Median Income	33,880	36,985	42,761	49,289	51,198	45,442
	Median Non-Housing Wealth	57,740	46,236	99,935	104,443	96,737	88,578
	% with DB Plan	44.86	40.28				
	% with DC Plan	11.82	22.67				
75-84	Median Income	25,626	26,116	34,473	37,655	39,773	28,254
	Median Non-Housing Wealth	49,379	40,333	87,211	88,955	84,135	52,138
	% with DB Plan	53.09	46.98				
	% with DC Plan	1.83	8.74				

Note: Median income and non-housing wealth are reported in real 2009 dollars

Table 2. Homeownership rates Before and After the Great Recession

		All Households		With DB Plan		With DC Plan	
Age		**1998-2008**	**2010-2014**	**1998-2008**	**2010-2014**	**1998-2008**	**2010-2014**
ALL	Own	76.70	72.86	83.86	82.85	88.40	84.55
	Rent	19.98	26.09	13.57	16.21	10.58	16.21
55-64	Own	81.06	69.28	91.40	87.10	89.11	84.51
	Rent	16.82	29.85	7.31	12.17	9.11	15.00
65-74	Own	80.05	79.66	88.4	89.06	87.60	85.63
	Rent	17.88	19.55	10.30	10.28	11.39	14.03
75-84	Own	75.43	76.30	81.04	83.08	90.96	81.96
	Rent	19.81	22.65	15.06	16.29	8.67	17.54

Note: Columns may not sum to 100% because the HRS includes a third option for homeownership called “other.”

Table 3. Transition Rates for Households that Moved

		1998-2008											
		All Households				With DB Plan				With DC Plan			
AGE		***N***	**% Move**	**Own**	**Rent**	***N***	**% Move**	**Own**	**Rent**	***N***	**% Move**	**Own**	**Rent**
ALL	Own	41,246	8.13	71.04	25.21	17,539	8.04	70.09	26.28	8,024	8.87	82.90	14.79
	Rent	9,628	20.48	13.55	80.69	2,524	21.86	14.64	79.28	938	30.10	29.83	67.63
55-64	Own	14,212	9.26	84.59	13.79	3,034	9.66	91.51	7.78	5,899	9.79	86.55	11.60
	Rent	2,789	25.95	22.97	71.25	227	30.39	30.47	65.80	630	31.88	36.85	59.12
65-74	Own	15,403	7.56	76.18	20.87	7,829	7.40	77.07	20.47	1,938	7.93	77.94	18.92
	Rent	3,239	20.54	13.16	82.05	897	22.70	17.25	76.98	246	28.81	22.91	76.13
75-84	Own	9,313	7.68	59.51	34.54	5,417	8.04	59.03	34.44	211	6.39	73.41	26.59
	Rent	2,261	17.47	10.1	84.26	938	19.09	13.70	6.53	23	32.90	11.32	88.68
		2010-2014											
ALL	Own	13,462	5.89	57.27	40.08	4,388	5.68	57.02	40.77	3,925	5.49	65.15	33.42
	Rent	4,317	19.79	12.59	84.11	757	19.11	17.98	77.62	636	26.95	16.83	82.02
55-64	Own	5,912	6.37	68.86	32.9	796	5.60	58.99	41.01	2,717	5.79	66.17	32.17
	Rent	2,298	24.66	12.61	84.9	94	31.43	16.30	83.70	436	27.43	16.24	81.86
65-74	Own	3,776	4.85	66.44	29.84	1,693	4.64	76.10	20.87	932	5.02	61.10	37.68
	Rent	845	19.74	13.25	83.9	187	19.98	21.15	78.85	142	27.19	20.24	79.76
75-84	Own	2,934	5.38	52.86	43.49	2,257	4.99	54.95	44.09	331	5.87	69.79	30.21
	Rent	837	13.66	12.05	85.91	423	17.43	22.20	77.80	60	25.33	6.89	93.11

Note: Columns may not sum to 100% because the HRS includes a third option for homeownership called "other." This table shows on the columns whether or not the household is an owner or a renter and if they move, the percent that move to owning or renting for the rows. For example: For all households between 1998-2008, 8.13% of households that are current owners decided to move and 71.04% of them decided to move to owning and 25.21% decided to move to renting

Table 4. Summary Statistics by Treatment Group and Time Period

	Households with DB Pension			Households with DC Pension			
	Pre	**Post**	**Diff**	**Pre**	**Post**	**Diff**	**Diff in Diff**
$\sinh^{-1}$(Income)	11.29	11.38	-0.08***	11.68	11.59	0.09***	0.17
	(0.75)	(0.83)		(1.14)	(1.47)		
$\sinh^{-1}$(Non-Housing Wealth)	10.87	10.50	0.37***	11.02	9.89	1.13***	0.76
	(4.84)	(5.88)		(5.10)	(6.52)		
Years of Education	12.55	13.27	-0.72***	13.24	13.65	-0.42***	0.30
	(2.89)	(2.79)		(2.89)	(2.72)		
Number of Children	3.02	2.98	0.04	3.16	2.82	0.33***	0.29
	(2.02)	(2.00)		(1.96)	(1.80)		
Married	0.61	0.57	0.03***	0.74	0.72	0.02***	-0.01
	(0.48)	(0.52)		(0.44)	(0.45)		
Unemployed	0.01	0.02	-0.01***	0.03	0.05	-0.03***	-0.02
	(0.09)	(0.13)		(0.16)	(0.23)		
Age	73.92	75.67	-1.75***	63.95	64.06	-0.11	1.64
	(8.38)	(9.89)		(5.71)	(7.51)		
Observations	27,089	9,966		15,025	9,728		

Note: The first two columns for each group provides the means and standard deviations for the treatment and control groups in the pre-period (1998-2008) and the post period (2010-2014). The last column for each group provides the results from a t-test to see if there are significant differences between the treatment and control in the pre-period. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

Table 5. Balance Test

Dependent Variable	All Households	Urban	Rural
$\sinh^{-1}$ (Income)	-0.176***	-0.186***	-0.175***
	(0.027)	(0.031)	(0.050)
$\sinh^{-1}$ (Non-Housing Wealth)	-0.778***	-0.794***	-0.524*
	(0.140)	(0.159)	(0.277)
Years of Education	-0.260***	-0.330***	-0.071
	(0.070)	(0.080)	(0.050)
Number of Children	0.284***	-0.305***	-0.126
	(0.050)	(0.056)	(0.112)
Married	0.011	0.018	-0.013
	(0.004)	(0.014)	(0.026)
Unemployed	-0.019***	0.021***	0.009
	(0.004)	(0.004)	(0.008)
Age	-1.324***	-1.570***	0.114
	(0.210)	(0.234)	(0.456)

Note: Standard errors are clustered at the household level. Each cell represents a separate regression. Columns 1 includes the full sample. Column 2 restricts the sample to urban households. Column 3 restricts the sample to rural households. All specifications include state fixed effects and year fixed effects. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

Table 6. Test for Significant Pre-Trends

	All Households	Urban	Rural
	(1)	(2)	(3)
DC Plan X Time Trend	0.003	0.004	-0.005
	(0.003)	(0.003)	(0.006)
Observations	31,111	25,597	5,514
R^2	0.148	0.154	0.145

Note: Standard errors are clustered at the household level. Controls include an indicator for marital status, and indicator for being unemployed, years of education, age, age squared, IHS of income, lagged IHS of non-housing wealth, and state fixed effects. These regressions were only run in the pre-period which is from 1998-2008.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

Table 7. Estimation Results

	All Households		Urban		Rural	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
DC Plan x Post-2008	-0.029***	-0.021**	-0.033***	-0.026***	-0.004	0.009
	(0.010)	(0.009)	(0.011)	(0.010)	(0.021)	(0.020)
Observations	50,372	46,218	41,714	38,177	8,658	8,041
R^2	0.021	0.164	0.024	0.152	0.033	0.149
Covariates	NO	YES	NO	YES	NO	YES

Note: Standard errors are clustered at the household level. Columns 1 and 2 include the full sample. Columns 2 and 4 restrict the sample to urban households. Columns 5 and 6 restrict the sample to rural households. Controls include an indicator for marital status, and indicator for being unemployed, years of education, age, age squared, IHS of income, and lagged IHS of non-housing wealth. All specifications include state fixed effects and year fixed effects. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

Table 8a. Sensitivity Checks

	All Households	Urban	Rural
	(1)	(2)	(3)
Panel A: Equal Observations with Controls			
DC Plan x Post-2008	-0.032***	-0.037***	-0.002
	(0.010)	(0.011)	(0.022)
Observations	46,218	38,177	8,041
R^2	0.021	0.024	0.033
Covariates	NO	NO	NO
Panel B: 2001 Recession as Treatment Period			
DC Plan x Post-2002	0.005	0.008	-0.004
	(0.010)	(0.011)	(0.017)
Observations	46,218	38,177	8,041
R^2	0.164	0.170	0.159
Covariates	YES	YES	YES
Panel C: No Age Weights			
DC Plan x Post-2008	-0.024***	-0.027***	-0.002
	(0.008)	(0.009)	(0.018)
Observations	46,563	38,478	8,085
R^2	0.157	0.161	0.158
Covariates	YES	YES	YES
Panel D: Coefficient Bounds			
Without Controls	-0.029***	-0.033***	-0.004
With Controls	-0.021**	-0.026***	0.009
Treatment Effect Bounds	[-0.051, -0.021]	[-0.067, -0.026]	[0.009, 0.027]

Note: Standard errors are clustered at the household level. Panels A-C represent separate regressions. Panel A shows the same regression in Table 7 Column 1 but restricted to the sample of Table 7 Column 2. Panel D shows the bounds on the treatment effect suggested by Oster (2017) using the Stata code provided with the article. Columns 1 includes the full sample. Column 2 restricts the sample to urban households. Column 3 restricts the sample to rural households. Controls include an indicator for marital status, and indicator for being unemployed, years of education, age, age squared, IHS of income, and lagged IHS of non-housing wealth. All specifications include state fixed effects and year fixed effects.

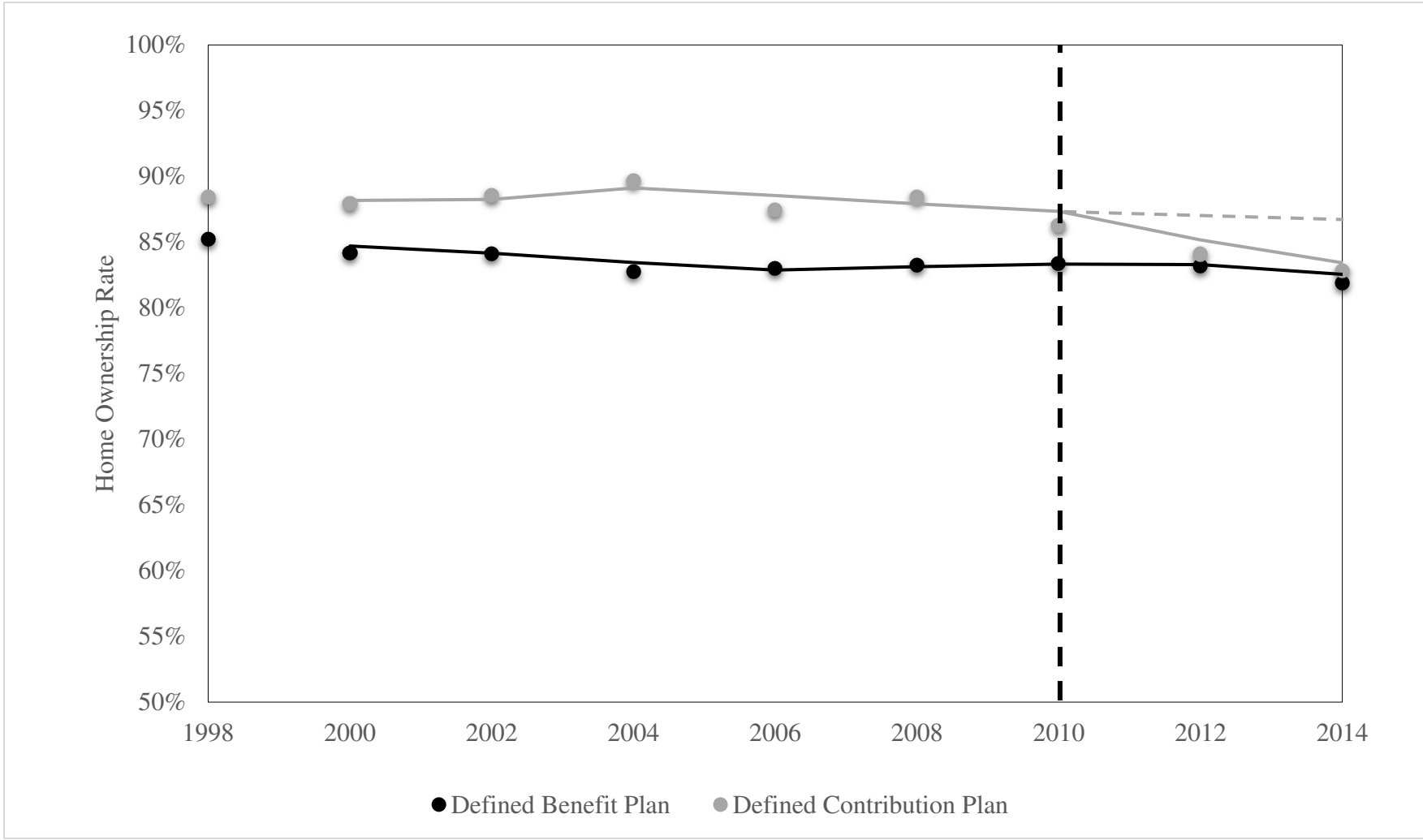
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

Table 8b. Sensitivity Checks

	All Households	Urban	Rural
	(1)	(2)	(3)
Panel A: One Person in Household Working			
DC Plan x Post-2008	-0.021**	-0.023*	-0.002
	(0.010)	(0.012)	(0.023)
Observations	20,336	16,703	3,633
R^2	0.123	0.130	0.117
Covariates	YES	YES	YES
Panel B: Household Completely Retired			
DC Plan x Post-2008	-0.025	-0.029	-0.002
	(0.017)	(0.019)	(0.034)
Observations	22,110	18,321	3,789
R^2	0.190	0.195	0.198
Covariates	YES	YES	YES

Note: Standard errors are clustered at the household level. Each panel represents a separate regression. Columns 1 includes the full sample. Column 2 restricts the sample to urban households. Column 3 restricts the sample to rural households. Controls include an indicator for marital status, years of education, age, age squared, IHS of income, and lagged IHS of non-housing wealth. All specifications include state fixed effects and year fixed effects. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

Figure 1. Pre- and Post-Trends for Treatment and Control States



Note: The line in the figure is a two-period moving average trendline

Appendix A: Description of Variables

Variables from the HRS are taken from two sources. The first is the Enhanced FAT files compiled by the RAND Center for the Study of Aging, which compiles the raw data from the survey into one file for each wave making it easier to merge with other waves. The second is from the RAND HRS data file. Developed at RAND with funding from the National Institute on Aging and the Social Security Administration, it is a cleaned file containing HRS data from all waves of the survey (RAND HRS Data 2016). RAND takes the raw responses from the HRS –in some cases, questions vary across waves – and combine them into a variable that is consistent across waves.

Variable	**Description**
Household Residence	Household residence type comes from the enhanced FAT files where it is self-reported whether a person owns, rents, lives in other, or unknown. The "other" category means anything outside of owning or renting, and the respondent is asked to specify. These specifications include but are not limited to: an assisted living facility, retirement facility, nursing home, motel, living rent-free with friends or family, and recreational vehicle. This variable is split into a dummy variable that takes a value of 1 if the respondent reports owning and a 0 if the respondent reports renting or other. If it is unknown, the variable is coded as missing.
Household Income	Household income comes from the RAND HRS file and is a sum of all the self-reported income to the household, which includes: individual earnings, capital income, pension income, annuity income, social security, other government transfers, and other household income.
Non-Housing Wealth	Non-Housing Wealth comes from the RAND HRS file and is the sum of the self-reported values of real estate excluding the primary residence, vehicles, businesses, IRA accounts, stock value, checking accounts, checkable deposits, bonds, and other savings minus household debt.
Defined Benefit Plan	The Defined Benefit Plan indicator variable is created using two variables from the RAND HRS File. The first is pension income and the second is whether or not a pension is offered at the current job. Pension income is reported separately for the respondent and the spouse, these are combined to determining a total household value of pension income. If either the respondent or the spouse report having a defined benefit plan at their current job or the household reports receiving.

	income from a defined benefit plan, the household is recorded as having a defined benefit plan.
Defined Contribution Plan	The Defined Contribution Plan indicator variable is creating using the self-reported balance of their defined contribution accounts. There are four variables that households can report. For each individual I sum these four variables. I then sum across the household to get the total value of defined contribution plans for the household. If a household ever reported having a positive value in their defined contribution plan, this variable takes a value of one. This variable takes a value of zero if they do not or if they also report having a defined benefit plan.
Years of Education	Years of Education comes from the RAND HRS file.
Number of Children	Number of Children comes from the RAND HRS file.
Age	Age comes from the RAND HRS file. The household variable for age is determined by the age of the male in married households and the age of the individual in single households.
Marital Status	Marital Status comes from the RAND HRS file. This is a dummy variable taking a value of 1 if they report they are married and a value of 0 for any other marital status.