Housing Wealth, Property Taxes and Labor Supply among the Elderly

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We investigate the relationship between housing wealth, property taxes, and elderly labor supply. Using twenty years of restricted access data from the Health and Retirement Study (HRS) containing plausibly exogenous variation in housing wealth from the recent boom/bust cycle and MSA-specific housing price indexes, we estimate longitudinal and difference-in-difference models. Our findings suggest elderly households respond to variation in housing wealth and property taxes in the predicted opposing directions, that labor decisions are sensitive to changes in both housing wealth and financial wealth, and that the effects of housing wealth on labor outcomes are gendered and subject to age-related heterogeneity.

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I. Introduction

Over recent decades, striking changes in the demographic composition of the U.S. labor force and the nature of elderly labor supply have taken place concurrently. Unprecedented growth in the number of elderly headed households complemented the only upswing in elderly labor force participation rates seen in modern history. In 2012, more than one out of every five workers in the U.S. was age 55 or older, compared with just one out of every eight as recently as 2000. While demographic factors clearly play the largest role in explaining this shift, the past two decades have also witnessed a reversal in the persistent trend toward earlier retirement that dominated the post WWII environment (Haider and Loughran, 2001). Figure 1 shows Current Population Survey (CPS) estimated labor force participation rates for various age groups over the period 1948-2010. [Figure 1 about here] For workers age 55 and up, there was a strong decline over the 1960s, 1970s and 1980s. However, this trend abruptly reversed course in the early 1990s, reaching a point where over 60 percent of Americans between age 55 and 64 are employed. Also, Figure 2 shows the ratio of part-time to full-time employment among workers aged 65 and up has actually been declining since the mid1990s, due to a persisting increase in rates of full-time employment. [Figure 2 about here] These striking changes motivate careful investigation of the factors influencing the labor decisions of older workers.

Over the same period, the value of residential homes varied dramatically, with a particularly strong boom/bust cycle characterizing the last fifteen years. Given the fact that housing wealth is the primary component of retirement asset portfolios for so many aging U.S. households (Lusardi and Mitchell, 2007), fluctuations in the housing sector make older households particularly exposed to unexpected wealth shocks. Hence, the relative scarcity of research examining potential linkages between the two is surprising. While several studies examine the relationship between housing wealth and levels of current consumption and savings (Bhatia, 1987; Engelhardt, 1996; Benjamin, Chinloy and Jud, 2004; Case, Quigley and Schiller, 2005), very few papers systematically relate housing wealth to elderly labor supply, especially current labor supply. Additionally, property taxes, as a factor directly linked to home values and applicable to every homeowner, may affect elderly labor decisions through current liquidity constraints. Very few studies consider the role of property tax burdens in making labor decisions among older households.

This study uses the Health and Retirement Study (HRS) to investigate the role of two key housing related variables – housing wealth and property taxes – in determining elderly labor supply. The longitudinal nature of HRS data facilitates various strategies to mitigate endogeneity concerns associated with estimating the inter-temporal labor supply elasticity. We reach five main findings. First, changes in housing wealth influence elderly labor supply at similar levels of intensity to changes in financial assets and, unsurprisingly, work in the same direction. Second, changes in housing wealth influence female labor supply to a greater extent than male labor supply when considering the extensive margin of labor participation. Third, changes in property tax liabilities offset a portion of the effect associated with

gains/losses in housing wealth. Fourth, changes in housing wealth exert stronger effects on workers in their late 50s, late 60s and early post-retirement than they do on workers in their early 50s, early 60s or late post-retirement. Lastly, when changes in MSA level housing price indexes are used to proxy for housing wealth shocks, the negative effects of housing wealth on elderly labor supply surface through a difference-in-difference specification.

I. Background and Theory

A. Determinants of Elderly Labor Supply

Within the considerable literature examining labor supply among older workers, there is consensus that certain factors influence elderly labor force participation and retirement decisions. One of the most commonly studied factors is financial wealth (e.g., Coronado and Perozek 2003; French 2005; Coile and Levine 2006 & 2011a; Kostol and Mogstad 2013). Life-cycle theory predicts unexpected gains in wealth should boost the consumption of goods and services as well as leisure. Some papers try to understand this relationship through focusing on the effects of inheritances and lottery winnings that are naturally framed as unexpected wealth shocks. Evidence suggests that the recipients of unanticipated financial wealth are more likely to reduce labor supply (see, e.g., Joulfaian and Wilhelm 1994). To examine the effect of financial wealth on labor decisions among the elderly, other plausible unexpected shocks in wealth have been used. For example, Coronado and Perozek (2003) find that older individuals that held corporate equity immediately prior to the bull market of the 1990s retired, on average, 7 months earlier than otherwise similar individuals who did not.

Three other benefit-related factors widely acknowledged to influence elderly labor are Social Security eligibility and/or Social Security wealth (Burtless and Moffitt 1985; Krueger and Pischke 1992; Gruber and Kubik 1997; Coile and Gruber 2000 & 2007; Coile and Levine 2011b; Gruber and Orszag 2003; Liebman, Luttmer and Seif 2009; Vere 2011), pension and medicare (Ruhm 1996; French 2005; French and Jones 2011; Kaushal 2014), and Disability Insurance benefits (Kostol and Mogstad 2013). Besides the life-cycle framework, forward-looking models and option value models have also established the effects of policy-related benefits; generally finding these factors help explain current labor supply and retirement decisions. Additionally, some conditions within the macro-economic environment, such as labor market tightness and the performance of the stock market, have consistently been shown to impact people's retirement behaviors (e.g., Coile and Levine 2006, 2007 and 2011a; Disney, Ratcliffe, and Smith 2010; Gustman, Steinmeier and Tabatabai 2010; Goda, Shoven and Slavov 2011 & 2012). Coile and Levine (2011a) show that workers age 62 to 69 are responsive to local unemployment rates and long-term fluctuations in stock market returns, and that the impact of the unemployment rate is nearly 50 percent larger than the effect of the stock market crash. Not surprisingly, changes in health have also been widely verified as a threat that may force older workers to exit the

labor force (e.g., Hanoch and Honig 1983; Coile and Levine 2007; Hurd and Rohwedder 2008).

While studies considering the effect of retirement assets on elderly labor supply are well developed on several margins, there are two significant aspects that have received little attention to date. First, most studies focus exclusively on the timing of retirement decisions, whereas few papers have investigated the effect of wealth on the intensive margin. More importantly, although it serves as the dominant component of retirement asset portfolios for most elderly households, housing equity has been given very little attention. In fact, since households endogenously choose housing consumption and make decisions regarding mortgage indebtedness, very little can be said about how elderly labor supply responds to changes in housing wealth without careful empirical work designed to identify exogenous variation.

B. The Role of Housing Wealth

Housing wealth has recently attracted attention from a literature focusing on the link between consumption and housing wealth (e.g., Bhatia 1987; Benjamin et al., 2004; Lettau and Ludvigson 2004; Case et al., 2005; Campbell and Cocoo 2007; Kishor 2007; Bostic et al., 2009) Consistent with family labor supply models and life-cycle theory (Ashenfelter and Heckman 1974), the consensus is that unexpected gains (losses) in housing wealth lead to increases (decreases) in current consumption. Since leisure time has frequently been cited as an important component of the consumption portfolio of elderly households, our study adds to this emerging literature.

Most existing work examining the influence of housing wealth on elderly labor supply focuses on the timing of retirement (Sevak 2002; Farnham and Sevak 2007; Disney, Ratcliffe, and Smith 2010; Zhao 2011), generally finding evidence to support the idea that such wealth effects are present. These studies rely on the assumption that the leisure is a normal good and that, like other categories of wealth, housing wealth impacts the elasticity of retirement. Farnham and Sevak (2007) find that a 10% increase in housing wealth is associated with a reduction in expected retirement age of 3.5 to 5 months. Zhao (2011) reveals quantitatively large impacts of housing wealth, and identifies the importance of three working channels including a resizing effect, a bequest motive, and collateral borrowing. Conversely, Disney, Ratcliffe, and Smith (2010) analyze British survey data and find little evidence of these effects. Our study adds to the literature by considering the influence of housing wealth on both the extensive (participation) and intensive (work status and hours worked) margins of elderly labor supply. We do so in a manner that accounts for wealth held in financial assets and other factors influencing elderly labor supply.

A broadening of scope to incorporate housing wealth is past due. We show that around 80 percent of households age 50 and over are homeowners and that for the majority of these households, housing wealth accounts for over half of aggregate wealth. This concentration of housing wealth combines with limited sources of liquid assets and current income to make elderly households particularly vulnerable

to unexpected housing wealth shocks. As predicted within the life-cycle framework, households consumption-smooth by saving during working years to boost future consumption during retirement and/or periods of reduced labor supply. Studies in this area consistently find accumulated pre-retirement wealth influences the level of expected spending households believe they will have in retirement (e.g., Bernheim, Skinner, and Weinberg 2001; Hurd and Rohwedder 2003).

Even given the expected influence of housing wealth on labor outcomes, it is not hard to understand the relative dearth of research on the topic. The biggest challenge to identifying the effect of housing wealth on labor supply has been overcoming a potential endogeneity problem. Housing wealth is typically defined as the value of owned property less the financial obligations tied to the property (i.e., mortgage debt). Note that households make dynamic utility maximizing decisions regarding both components. Choices like moving into a significantly higher/lower cost area or upsizing/downsizing house size are the most obvious of these intertwined decisions. Additionally though, control over housing wealth becomes even more nuanced once behaviors like home upkeep/renovation, pre-paying down mortgage principle, and taking out home-equity loans are accounted for. Our study follows a strategy that has been used to recent success in addressing other questions related to housing wealth, framing geographic variation in the previous boom/bust cycle in home prices as generating variation in housing wealth that is plausibly exogenous at the household decision making level – particularly when focusing on otherwise similar renters vs. homeowners in areas experiencing the same housing market conditions.

Figure 3a summarizes the 120-year historical trend of home values in the U.S., aggregated annually, based on the Case-Schiller repeat-sales housing price index. [Insert Figure 3a about here] Other than minor fluctuations in the late 1970s and late 1980s, national aggregate home price indexes moved in relatively stable patterns, showing very little change in real terms between the early 1950s and mid 1990s. However, since the late 1990s, the U.S. experienced a gradual but significant boom in the housing market until the crisis of 2007. Between 1996 and 2006, U.S. nominal home values nearly doubled, and then abruptly fell to the previous late 1990s level by the end of 2011, meaning the gains accumulated from the housing boom were completely destroyed. Figure 3(b) shows the national housing price index and national appreciation rate of home equity since 1991, based on Federal Housing Finance Agency (FHFA) data. [Insert Figure 3(b) about here] These periods of housing boom and subsequent collapse provide sufficient exogenous variation for examining the effects of housing wealth. Figure 3(c) presents the recent 20-year Home Equity Conversion Mortgage (HECM) loans and its average property values from 1990 to 2010. [Insert Figure 3(c) about here] Both counts as well as the value/magnitude of HECM loans share a similar pattern with the recent housing boom/bust cycle (although there appears to be a minor lag associated with movement in HECM loans). This verifies the idea that housing wealth serves as a precautionary buffer that can be cashed out in the event of a financial or health related downturn (Skinner, 1996).

C. Comparison of Wealth Effects

Several studies have compared the potential differences between the effects of housing wealth and financial market wealth, reaching a degree of consensus that housing wealth shocks have a greater effect on current consumption than financial wealth (e.g., Benjamin et al., 2004; Lettau and Ludvigson 2004; Case et al., 2005; Campbell and Cocoo 2007; Kishor 2007). The main reason typically provided along with this finding is that unanticipated wealth shocks must be perceived as permanent in order to affect current consumption. The perception is that households are more likely to expect transitory shocks to dominate changes in financial wealth, whereas permanent shocks are likely expected to account for most of the variation in housing wealth. In this study, we aim to develop an understanding of wealth effects on elderly leisure consumption, as reflected in current labor supply. It is possible that housing wealth shocks may also have a greater effect on elderly labor supply than similarly sized changes in financial wealth.

D. The Role of Property Tax

Property taxes should also influence elderly labor supply. As housing equity increases (decreases) due to unexpected positive (negative) shocks to home values, the property tax payment the homeowner must cover rises (falls).[1] Shan (2010) found that increasing property taxes during the recent housing boom tightened liquidity constraints among elderly households and influenced elderly mobility behaviors. As mentioned earlier, many elderly households concentrate their assets in the housing sector, and do not have high incomes or other liquid assets. During the housing boom, this countervailing effect should incentivize an increase in labor supply. Remaining in the labor force longer and/or working more intensively mitigates the financial pressure of higher property taxes, potentially working to offset at least a portion of the housing wealth effect. Without controlling for property tax liabilities, the estimated effect of housing wealth would be biased toward zero, since the coefficient then reflects the *total net effect* (i.e., combines the expected negative effect of housing wealth and the expected positive effect of property tax liabilities). To our knowledge, Shan (2008) is the only study that considers the effects of property taxes on elderly labor supply. However, she did not find significant effects and did not separately test for the effects of changes in housing wealth. Hence, there is a need for more empirical research that simultaneously accounts for the role of both countervailing factors. In our analysis, both difference-in-difference and longitudinal approaches are used. Each of these methodologies is discussed in greater detail in Section IV.

[1] Homeowner's holding the majority stake in their property see these increases directly through higher property tax bills they pay, whereas homeowner's still in mortgages where the lender is collecting property taxes over the course of the year experience higher mortgage payments.

E. Contributions and Extensions

While our study is not the first to consider the effect of housing wealth on elderly labor supply, we extend this relatively thin literature in three specific ways. First, the papers in this area generally focus on how housing wealth affects the timing of retirement decisions rather than current labor supply decisions, generally finding that greater housing wealth leads to earlier retirement (Sevak, P. 2002; Coronado and Perozek 2003; Farnham and Sevak 2007; Disney, Ratcliffe and Smith 2010; Ondrich 2010). Second, previous studies were limited by data availability, such that they were not able to examine the role of the recent great recession and gain from the plausibly exogenous variation it created. Our data environment shows periods of prolonged gains in housing wealth but also covers several years where large losses in housing wealth were common. Finally, no previous study has included both housing wealth and property tax liabilities in regressions exploring elderly labor outcomes. This is troubling since the two are, by construction, directly linked to one another, and are expected to operate in offsetting directions.

In addition, since the boom/bust cycle created dramatically different price movements across U.S. geographies, our extensions involve matching MSA specific housing price indexes from FHFA to each elderly household surveyed by HRS. For example, elderly homeowners in Texas experienced dramatically different housing wealth transitions than otherwise similar households living in Florida, during a time period where their financial portfolios likely behaved similarly. Adding this perspective to the existing HRS self-reported housing price estimates further identifies these plausibly exogenous wealth shocks, and allows even more precise identification (dif-in-dif) based on a comparison of renters and homeowners living in the same cities. Housing price indexes also overcome the drawback of potential measurement error in self-reported home values, and using both measures positions our study to become the first to directly test whether or not these two commonly used measures of house price lead to the same answer to our questions of interest.

The remaining portions of this paper are organized as follows. Section III describes our data. Section IV outlines our empirical methodology. Section V presents our estimation results. Section VI concludes and discusses future directions.

II. Data

The primary data used in this study come from the Health and Retirement Study (HRS), sponsored by the National Institute on Aging. The HRS is a nationally representative biannual longitudinal data set, surveying individuals over age 50 and their spouses. It provides comprehensive information regarding socio-economic and demographic variables, health status, financial and housing wealth, income, benefits, social security, pensions, and employment history. The data we use are the ten waves from 1991 through 2010. They contain five cohorts including the original HRS cohort (OHRS), the Assets and Health Dynamics cohort (AHEAD), the Children of

Depression cohort (CD), the War Baby cohort (WB), and the Early Baby Boomer cohort (EBB). Figure 4 shows around forty percent of our data come from the OHRS cohort, while the AHEAD cohort represents another fifth. [Figure 4 about here]

Table 1 provides the specific timing of the survey for each cohort. [Insert Table 1 about here] The OHRS cohort, born 1931 to 1941, was first interviewed in 1992 and subsequently every two years thereafter. The AHEAD cohort, born in 1924 or earlier, was first interviewed in 1993. With the exception of a three year gap between 1995 and 1998, they also follow the bi-annual survey pattern. The CD and WB cohorts were added to the HRS survey in 1998, and consist of individuals born between 1924 and 1930, and 1942 and 1947, respectively. The EBB cohort, born between 1948 and 1953, was first interviewed in 2004, and subsequently every two years. Since each cohort entered the survey at a different time, it is highly unlikely our eventual results could be driven by the characteristics or economic experiences of a particular cohort. However, we still explored robustness checks that included various cohort groupings, finding all our main results are retained.

The HRS compiles responses to detailed questions of employment history that are consistent across waves. This allows us to construct dependent variables measuring elderly labor supply reflecting both the extensive margin and intensive margin. These include labor force participation, full-time or part-time working status, and hours worked per year. Figure 5 illustrates the working status shares of respondents by age, including working full-time, working part-time and not working. [Insert Figure 5 about here] As expected given the structure of the Social Security program, the share of elderly persons working full-time declines monotonically with age and declines dramatically during the early to mid 60s. Whereas over half the sample works full-time prior to reaching age 60, by 69 fewer than 1 in 10 is still doing so. The peak of part-time employment proportion is 18.65% at the age group of 65 to 67 years old, which suggests part-time employment serves as an alternative form of labor supply post retirement, or for workers preparing to retire soon.

The key variables of interest in our study relate to housing wealth. HRS asks questions about home ownership, self-assessed home value, mortgage payment, and the nature of loans on households' first and second mortgages. While it is common to use home value as a proxy for housing wealth, home value only reflects the amount of housing services consumed, not the amount of accumulated housing wealth. For most households there is a prolonged period following purchase where extensive liabilities are owed to banks, meaning how heavily the household is in debt determines their housing wealth. In our analysis, the net value of home equity is used to reflect housing wealth. Figure 6 displays the asset allocations of elderly households that we analyze in this study over the period 1991 through 2010. [Insert Figure 6 about here] Unsurprisingly, home values and housing wealth share a strikingly similar trend over time, with a prolonged boom since the late 1990s, and a following bust beginning in 2007. However, there is an increasing gap around the bust period, which is consistent with the observed mortgage foreclosure crisis. Additionally, given the heterogeneity in households' experiences driven by different

mortgage lengths and decisions over second and third mortgages, these averages mask considerable variation that surfaces across different household experiences. Financial wealth and property taxes are also illustrated in the same chart, and they appear to be on a trend consistent with the housing market fluctuation. We observe that financial wealth falls below the level of housing wealth around 2000, which once again emphasizes the increasing importance of housing wealth among retirement portfolios for elderly American households.

Since the housing measures in the HRS are self-reported, a potentially valid criticism of using this measure is that respondents report perceived price variations, as opposed to actual market values. Figure 6b compares real growth rates of self-reported home value and housing wealth with the national real appreciation of home equity derived from MSA specific home price index, each deflated by the national consumer price index. [Insert Figure 6b about here] While the measures clearly show co-movement, more volatility is seen in the self-reported values. The figure illustrates overly optimistic prospects on home values during the boom and slightly pessimistic expectations during the housing market collapse. Perceptions over fluctuations in housing wealth may more directly influence homeowners' decision, which provides one argument for using self-reported value as the housing wealth measure. However, our extension of merging MSA-specific home value index with our household data will allow our study to be the first to examine the effect of perceptions versus reality when it comes to elderly homeowners' labor decisions. We match MSA level house price indexes from the FHFA, along with MSA level unemployment rates from the BLS, and state level tax burden rate from the Tax Foundation, with household survey data through state-county identifiers provided by restricted HRS data.[2]

Table 2 presents labor force participation rates, by age and by housing wealth percentile. [Insert Table 2 about here] We see decreasing participation rates with age for all respondents, regardless of their position within the housing wealth distribution. The three most dramatic transitions are the age groups of 59-61, 62-64 and 64-67, consistent with previous evidence from the literature on retirement timing. Through a simple comparison of households whose housing wealth lies in different percentile groups, a positive correlation between labor participation and housing wealth is observed. In the upper percentiles, the labor participation rate is significantly higher for all age groups. However, this pattern is not sufficient to claim a causal link between elderly labor and housing wealth, as other critical information is being ignored. First, there are several characteristics of respondents with more housing wealth accumulated that also influence, labor supply positively, such as better health or differences in skills and employment opportunities. Also, certain factors closely related to housing wealth (e.g., property tax liabilities) may have the opposite impact on elderly labor supply. As such, estimating the causal effect of housing wealth and property taxes on elderly labor supply requires further empirical

[2] House price indexes and unemployment rates are measured at state level, and local tax burden rates are computed at state level.

examination.

Table 3 lists all our variables, along with their descriptions and data sources. [Insert Table 3 about here] Table 4 displays summary statistics for the 127,336 observations used in our analysis, along with subsample statistics for homeowners and renters. [Insert Table 4 about here] As is common in cases where data are self-reported, a few intuitive filters are created. First, while the HRS survey targets only individuals older than 50, spouses (who can fill out the survey) can be much younger. Since this study aims to examine the effect of housing wealth and property taxes on labor supply among a particular group (i.e., elderly households), observations from respondents younger than 44 are dropped. This thins the sample by less than one percent[3].

Additionally, procedures are used to clean the data based on housing wealth, financial wealth and property taxes. Respondents with housing debt that greatly exceeds the value of their home have the option of foreclosure, while households with considerable negative financial wealth may have high risks of going through bankruptcy. In both cases, it is a stretch to assume large negative wealth values should enter later estimations. Also, extremely rich and extremely poor respondents may exhibit systematically different behaviors in the labor market, and we acknowledge that our estimated models may fail to capture this. Dropped observations due to wealth that is exceedingly high (over $1,000,000) or negative and large in absolute values also represent less than one percent of the original data. Household level financial assets are calculated as the dollar amount of wealth held in stocks, mutual funds, investment trusts, checking, savings, money market accounts, government saving bonds and other bonds. We drop observations that fail to report any of these financial assets, as pervasive zeros could represent two very different types of cases: reporting omissions (i.e., the true values are non-zero, but the respondent is skipping these questions) or non-banking households (perhaps driven by a lack of access) where all financial assets are truly zero. Fourth, since property taxes are a critical variable in our study, we ensure the self-reported property taxes are not unrealistically high. As such, observations with estimated property tax rates over ten percent of house values are excluded from the analysis.[4] After applying all the filters, the data contains 127,336 distinct observations, 103,593 coming from homeowners and 23,743 from renters. Summary statistics for the first differenced variables are also reported.

IV. Empirical Methodology

As outlined in Section II, elderly households are expected to respond to

[3] Since the sample covers households with a wide range of ages reported by the respondent, we restrict our analysis within various age groups separately, as well as the entire sample. Heterogeneous effects across age groups are discussed in Section 5.4.

[4] According to data from taxfoundation.org, no U.S. state had an average effective property tax rate exceeding 2% during our sample.

unexpected increases in wealth by supplying less labor, while responding to unexpected increases in financial liabilities by supplying more. Gains in wealth, in the form of both financial assets and housing equity, should raise the consumption of leisure and be associated with higher likelihoods of working part-time or exiting the labor force. At the same time, current liabilities stemming from holding those assets (e.g. property taxes), should have the opposite effect. This creates an interesting trade-off, as increased (decreased) housing wealth and increased (decreased) property tax liabilities are both associated with unexpected positive (negative) shocks to housing prices. We use the HRS and our supplemental data to estimate several empirical models that disentangle the dual nature of these effects, while controlling for other factors that have been shown to influence elderly labor supply.

A. Alternative Measures of Housing Wealth

We use two measures of housing wealth – self-reported values and MSA house price indexes – each carrying certain advantages and disadvantages over the other. MSA specific house price indexes (HPIs) represent a commonly used instrument that captures quasi-experimental variation in housing wealth, exogenous to households' individual shocks. This technique has been used to great success in the context of the recent boom/bust cycle in the housing market. However, we acknowledge two well known limitations of these measures. First, although HPIs document wide variation in price movements across metropolitan areas, they do not reflect important heterogeneity at the local neighborhood level. Ferreira and Gyourko (2012) provide several stylized facts related to heterogeneity in the length and amplitude of the housing boom and how they interact with neighborhood level pricing dynamics, even finding that several socio-economic characteristics are correlated to this meaningful heterogeneity. Second, HPIs only reflect the overall movement of home values at the MSA level, and are thus completely unrelated to the portion of heterogeneity in housing wealth driven by changes the mortgage liabilities that better represent the actual mechanism through which wealth in housing sector is accumulated.

Conversely, self-reported housing wealth carries its own advantages/disadvantages. The clearest advantage is that rich variation can be seen in the HRS household level housing wealth measures. This is likely being driven by the exact factors being missed by the HPIs that we mentioned above. For example, the HRS data accounts for unpaid mortgage debt. Additionally, self-reported housing wealth captures heterogeneity on many dimensions including very local/neighborhood level price variation. However, there are two concerns regarding its usage. First, a common critique of self-reported data is that measurement error may be present. That is, if households are not fully aware of their home value or mortgage liabilities, they may inaccurately report it on the HRS survey. Fortunately, previous work suggests that homeowner's report their house values and mortgages reasonably accurately (Bucks and Pence 2006), so we expect this issue to be minor.

Moreover, note that response errors in this case are not necessarily *noise*. The reason is that any systematic differences between household expectations and true market values may serve as a meaningful *signal*. In theory, housing wealth should impact behavior through *perceived* housing wealth shocks, such that beliefs regarding home equity may in fact be the appropriate measure. The second concern regarding these data relates to the advantage of the HPI indexes; that is, the nature of the variation found in self-reported housing wealth may be endogenous to labor outcomes. Specifically, households may initially *decide* among their housing options having already formed plans that involve supplying specific amount of labor in the future. Fortunately, the longitudinal nature the HRS data provides a mechanism for mitigating potential reverse causality bias associated with this threat. Since each measure holds certain advantages over the other, we use both in our analyses, finding qualitatively similar effects of housing wealth on labor supply in both cases.

B. Difference-in-Difference Estimations

In this section, we describe a difference-in-difference approach designed to identify the effect of housing wealth by comparing changes in the behavior of otherwise similar homeowners and renters during time periods containing exogenous fluctuations in housing value. We identify a treatment group (homeowners) that experienced quasi-experimental housing wealth shocks and a control group (renters) that did not. This identification strategy relies on our MSA level HPIs.

During the recent housing boom/bust cycle, homeowners experienced unexpected positive and negative shocks in housing wealth, whereas renters did not. While the self reported HRS measures do not reflect the housing market conditions for renters (i.e., renters in the survey do not estimate the value of comparable homes/condos or the value of the rental unit in which they reside) our MSA level HPIs do. As such, it is appropriate to use the aggregated measure to estimate the heterogeneous effect of time-specific or regional housing market conditions on labor decision between our control and treatment groups. For example, if housing wealth affects labor decisions, we would expect to see different patterns of labor supply between homeowners and renters over the boom/bust cycle. This strategy adopts what we believe is a reasonable assumption: with meaningful characteristics of households otherwise controlled for, homeowner/renter status is then exogenous in the sense that homeownership is not correlated to *other* characteristics that affect labor supply.

Specifically, we estimate the difference-in-difference between homeowners and renters during the housing boom/bust period as: $\left(\text{labor}_{\text{bust}}^{\text{homeowners}} - \text{labor}_{\text{bust}}^{\text{renters}}\right) - \left(\text{labor}_{\text{boom}}^{\text{homeowners}} - \text{labor}_{\text{boom}}^{\text{renters}}\right)$. As seen in Figure 6b, self-reported housing wealth and our regional HPIs both track a pronounced housing boom from 1997 to 2006, followed by a bust from 2007 to 2010. Our dif-in-dif models of labor supply are estimated using a pooled cross section of respondents from the control and treatment group between 1997 and 2010.

$$\begin{aligned}\text{labor outcome}_{it} = {} & \beta_0 + \beta_1 \text{bust}_t + \beta_2 \text{homeowner}_{it} + \beta_3 \text{bust} * \text{homeowner}_{it} \\ & + \text{property taxes}_{it} + \beta_5 \text{financial assets}_{it} + \beta_6 \text{health}_{it} + \beta_7 \text{demographics}_{it}\end{aligned}$$

$$+\beta_8 \text{unemployment rate}_{mt} + \beta_9 \text{local tax burden}_{st} + \varepsilon_{it} \quad (1)$$

where *labor outcome* contains three outcomes: 1) a dummy variable for *labor force participation*, 2) a categorical variable for *working status* indicating full-time, part-time or no work, and 3) a continuous variable reflecting naturally logged *annual working hours*. *Bust* equals 1 if the respondent was surveyed between 2007 and 2010, and 0 if surveyed between 1997 and 2006. The coefficient β_1 captures the effect of the housing cycle that was common to renters and homeowners. *Homeowner* is a dummy variable for homeownership. Its coefficient (β_2) captures time-invariant differences between renters and homeowners. *Bust*homeowner* is the interaction term accounting for homeowner status during the bust period, making β_3 our coefficient of interest, as it measures the effect of housing wealth on labor supply. The remaining right hand side variables include property taxes, financial assets, a health status indicator, the local unemployment rate and local tax burden, demographic characteristics including gender, age, race, education, and marital status, and wave specific dummies.

An alternative approach to measuring the effect of housing wealth through a difference-in-difference model is to identify the heterogeneity in labor supply between homeowners and renters according to more precisely measured movements in housing values across regions and over time. In this approach, our MSA specific HPIs are used to proxy for changes in housing wealth experienced by homeowners. Hence, an interaction term between the growth rate of the applicable HPI and homeowner status becomes the variable of interest. Since changes in home prices are capitalized into housing wealth but home price levels are not, we estimate the model as follows:

$$\begin{aligned}\text{labor outcome}_{it} = {} & \beta_0 + \beta_1 \text{hpi\_g}_{mt} + \beta_2 \text{homeowner}_{it} + \beta_3 \text{hpi\_g} * \text{homeowner}_{imt} \\ & + \text{property taxes}_{it} + \beta_5 \text{financial assets}_{it} + \beta_6 \text{health}_{it} + \beta_7 \text{demographics}_{it} \\ & + \beta_8 \text{unemployment rate}_{mt} + \beta_9 \text{local tax burden}_{st} + \beta_{10} \text{wave}_t + \varepsilon_{it} \quad (2)\end{aligned}$$

β_3 is the coefficient of interest, capturing the difference-in-difference estimate of the housing wealth effect. Intuitively, the model compares renters and homeowners in the same housing market to see whether the effect of homeownership on elderly labor supply in influenced by the magnitude of housing price changes in that MSA.

C. Extension to a Non-linear Model

In our difference-in-difference specifications, the first dependent variable is a dummy for labor force participation; hence a probit/logit model is expected to more accurately model the potential non-linear relationship. For example, under a non-linear logit specification, equation (1) becomes:

$$\text{labor participation}_{it} = F(u) = \frac{1}{1 + e^{-(\beta_1 \text{bust} + \beta_2 \text{homeowner} + \beta_3 \text{bust} * \text{homeowner} + X\beta)}} \quad (3)$$

The interacted variables are dummy variables for *bust* and *homeowner*, so the interaction effect is the discrete double difference given as:

$$\frac{\Delta^2 F(u)}{\Delta x_1 \Delta x_2} = \frac{1}{1+e^{-(bust+homeowner+bust*homeowner+X\beta)}} - \frac{1}{1+e^{-(\beta_1+X\beta)}} - \frac{1}{1+e^{-(\beta_2+X\beta)}} + \frac{1}{1+e^{-X\beta}} \quad (4)$$

In equation (2), the interacted homeowner dummy variable and change in HPI produce a continuous variable. As such, the interaction effect is the discrete difference with respect to homeownership (our treatment variable) of the single derivative with respect to housing price growth:

$$\frac{\Delta^2 \frac{\partial F(u)}{\partial x_1}}{\Delta x_2} = (\beta_1 + \beta_{12}) \begin{pmatrix} F\{(\beta_1 + \beta_{12})hpi\_g + \beta_2 + X\beta\} \\ \times (1 - F\{(\beta_1 + \beta_{12})hpi\_g + \beta_2 + X\beta\}) \end{pmatrix} - \beta_1[F(\beta_1 x_1 + X\beta)\{1 - F(\beta_1 hpi\_g + X\beta)\} \quad (5)$$

However, prior to the work of Ai and Norton (2003) most studies instead presented the marginal effect of the interaction term incorrectly as $\beta_3 F(\cdot)$. The influential Ai and Norton contribution proposes a more accurate way to estimate the magnitude of effect and standard errors for the interaction term in cases with these characteristics. Following their work, we present the estimated marginal effect as:

$$E(\beta_3) = \frac{\Delta^2 F(x, E(\beta))}{\Delta x_1 \Delta x_2} \quad (6)$$

and the estimate of consistent asymptotic variance of $E(\beta_3)$[5] is:

$$E(\sigma_3^2) \sim \frac{\partial}{\partial \beta'}\left[\frac{\Delta^2 F(x,E(\beta))}{\Delta x_1 \Delta x_2}\right] E(\Omega_\beta) \frac{\partial}{\partial \beta}\left[\frac{\Delta^2 F(x,E(\beta))}{\Delta x_1 \Delta x_2}\right]) \quad (7)$$

where $E(\Omega_\beta)$ is a consistent covariance estimator of $E(\beta_3)$.
Borrowing statistical software packages from Ai and Norton (2003), our later results provide the accurate magnitude and statistical significance for the interaction terms in equations (1) and (2).

D. Longitudinal Estimations

We argued previously that studies in this area often run into difficulties claiming identification of casual effects, due to endogeneity issues associated with self-reported housing wealth. In other applications, instrumental variable approaches have proven useful in overcoming similar challenges. However, while housing wealth is plausibly affected by social/economic/demographic household characteristics and other housing related variables (including the decision to purchase, choice over mortgage instrument, the extent to which equity is withdrawn through refinancing or additional mortgages, and early pay-down of mortgage principle), all these same variables influence labor supply directly, making them poor instruments. Since our analysis also examines the impact of housing wealth on elderly labor supply without the benefit of an uncontaminated instrument, we adopt various strategies to mitigate potential endogeneity bias, taking advantage of highly volatile conditions that created shocks to housing wealth that are plausibly unexpected/exogenous. In this sense, we follow the same empirical strategy seen in recent papers considering the effect of housing wealth on other household level behaviors (e.g., Lovenheim 2011, Lovenheim and Mumford 2013; Lovenheim and Reynolds 2013).

[5] The derivation is based on application of the Delta method as $E(\beta_3) \sim N(\beta_3, \frac{\partial}{\partial \beta'}\left[\frac{\Delta^2 F(x,\beta)}{\Delta x_1 \Delta x_2}\right] \Omega_\beta \frac{\partial}{\partial \beta}\left[\frac{\Delta^2 F(x,\beta)}{\Delta x_1 \Delta x_2}\right])$

As noted previously, there are two concerns plaguing models using self-reported housing wealth. One threat is that even though the HRS contains a detailed set of household level descriptives, it is still possible that unobserved factors that simultaneously affect labor supply and housing wealth exist. Cross-sectional estimation fails to account for these factors. Another concern comes from the underlying nature of the cross-sectional variation in housing wealth. Specifically, elderly households may initially *decide* among their housing related options having already formed plans that involve supplying specific amount of future labor. As such, cross-sectional correlations between the two may suffer from reverse causality bias. Fortunately, the longitudinal nature of the HRS data provides a mechanism for mitigating potential bias associated with either concern.

A simple cross-sectional model of elderly labor supply model begins as follows:

$$\text{labor outcome}_{it} = \beta_0 + \beta_1 X_{it} + \beta_1 Z_{it} + \varepsilon_{it} \tag{8}$$

where *labor outcome* includes a vector of alternative labor supply measures, including labor force participation, working status (further distinguishing between part-time and full-time work), and annual hours worked. X_{it} contains our main variables of interest including housing wealth, property taxes, and financial assets. Z_{it} contains other observed control variables regarding health, demographics, local unemployment rate and tax burden rate, and region and wave dummies.

Following (Liker, Angustyniak, and Duncan 1985), the common doubts about measurement error of self-reported data define a variable of interest as:

$$X_t^* = X_t + \rho u_{t-1} + v_t \tag{9}$$

where X_t is the true value of interest, and response bias and error are assumed to follow a random term of (v_t) and autocorrelation component of (ρu_{t-1}). Under OLS estimation, we have the estimated coefficient for variables of interest given as:

$$\text{plim}\,(E(\beta_1) = \frac{\beta_1 + \beta_2 b_{zx}}{1 + [\frac{\text{var}(u_t)}{\text{var}(X_t)}]} \tag{10}$$

Conversely, from a first-differenced model, we have a new estimator given as:

$$\text{plim}\,(E(\beta_1) = \frac{\beta_1}{1 + [(1-\rho)\text{var}(u_t) + \text{var}(v_t)]/\text{var}(\Delta X)} \tag{11}$$

where $\text{var}(\Delta X) = \text{var}(X_t) + \text{var}(X_{t-1}) - \text{cov}(X_t, X_{t-1})$.

Comparing between the two, three clear advantages of a first-differenced model surface. First, unobserved person-specific characteristics that affect both labor supply and housing wealth drop out of the first-differenced estimation. Second, if respondents are more likely to persistently overstate (understate) their housing and financial wealth, such that ρ is believed to be positive (negative) and significant, this bias is mitigated. Third, first differenced self-reported values are more accurate than the reported level values, since a portion of persistent memory error can be ruled out.

Our HRS data track households from 1991 through 2010, such that we can observe changing labor behaviors, as well as changes in housing wealth, property taxes, and other financial assets over time. We first-difference the data for each

observation[6] and estimate the following regression model for elderly homeowners:

$$\text{labor outcome}_{it} = \beta_0 + \beta_1 \Delta\text{housing wealth}_{mt} + \beta_2 \Delta\text{property taxes}_{it} + \beta_3 \Delta\text{financial assets}_{it} + \beta_4 \Delta\text{health}_{it} + \beta_5 \Delta\text{unemployment rate}_{mt} + \beta_6 \Delta\text{local tax burden}_{mt} + \beta_7 \Delta\text{age}_{it} + \beta_8 \text{wave}_t + \varepsilon_{it} \quad (12)$$

where $\Delta labor\ outcome_{it}$ represents the wave-to-wave changes in elderly labor supply along our three dimensions of interest.

Measures of labor participation, working status and annual working hours follow the same definition discussed previously. $\Delta labor\ participation_{it}$, $\Delta working\ status_{it}$ and $\Delta annual\ hours_{it}$ are the first-differenced values of the original variables. Hence, the coefficients β_1, β_2, and β_3 each represent an inter-temporal labor supply elasticity, since they estimate the change in labor supply resulting from a percentage change in the variable of interest. β_4 reflects the effect of respondent's time varying health status and is expected to sow that degraded health forces elderly individuals to reduce their labor supply. Most of the variables in our vector of demographic controls are time invariant, such that they drop out after differencing.[7] The exceptions are changes in age, which we do account for. β_5 and β_6 control for effects of the local unemployment rate and local tax burden, respectively. Wave dummies are still included and should now be interpreted as wave-to-wave transitions.

V. Results

A. Difference-in-Difference Estimations

The regression results presented in Table 5 provide our difference-in-difference estimate using HRS reported measures of housing wealth. [Insert Table 5 about here] We see clear evidence of significant housing wealth effects in the expected direction. From column (1), our interaction term of interest suggests elderly homeowners suffering through the housing bust period are 2.3 percent more likely to work than otherwise similar renters. The coefficient for homeowner status additionally supports the importance of housing wealth effects. Holding other factors constant, homeowners are 3.3 percent less likely to work than renters who do not accumulate housing wealth. Additionally, property tax burdens seem to have the expected countervailing positive effect on labor supply, while financial wealth impacts labor supply negatively. Column (2) shifts to an examination of work status, taking the different intensities of full-time and part-time work into account. All the results from the participation model carry over and, in fact, strengthen in terms of their intensity. However, there is weaker evidence coming from the model explaining hours worked, which is displayed in column (3). Although both the homeowner

[6] As outlined in Section 3, this means subtracting the value of the variable reported two years early for the majority of cases. For a small minority of observations the gap between waves is three years.

[7] The observed variation over time in educational attainment, number of children, and marital status is minimal and insufficient to analyze. As such, these variables are treated as time invariant.

variable and the interaction term of interest retain coefficients of roughly the same size as the work status model, statistical significance in lost on the interaction term. One possibility is that the housing bust period negatively correlates with demand for labor on the intensive margin, (i.e., a lackluster economy), and thus downwardly biases the potential effect of loss in home equity during the bust period. Another is that the underlying data generating process determining hours worked is simply more complicated – as we see the R^2 for this model drops and the standard errors on nearly all our variables increase.

Turning to our models measuring housing wealth using MSA level HPIs, we provide our dif-in-dif regression results in Table 6. [Insert Table 6 about here] Column (1) reflects our model of labor participation and again suggests both housing wealth and property taxes play the offsetting roles we expected. Our interaction term of interest is significant at the 5% level and indicates elderly homeowners from regions with high housing price appreciation are less likely to work, whereas higher property tax burdens are associated with elderly homeowners working with a higher probability. Similarly, we see the same pattern when moving to the model of work status reported in column (2), again with an increase in the estimated magnitude of the effect (although the two point estimates do not differ significantly from one another). Column (3) again provides less evidence that housing wealth influences the intensive margin of labor supply.

Although they are not a main focus of our study, a brief discussion of the estimated effects of our other explanatory variables is merited. In general:

- Better (poorer) health is associated with increased (decreased) labor supply. Our estimates are consistently statistically and economically significant and agree with a large number of studies showing these same effects.
- Our labor force participation and work status models suggest respondents from regions with higher unemployment rates are less likely to work, whereas the unemployment rate was not found to influence hours worked.
- Respondents with higher local tax burdens are less likely to work.[8]
- Females are less likely to work than males. Gender carries the strongest effect of any of our variables – even more influential than health.
- Married individuals are less likely to work than single individuals.
- While children make working more likely in terms of statistical significance, the estimated magnitude of the effect is small. Using the coefficients from our labor force participation models, each child raises the likelihood of working by about one tenth of one percent. So for example, the estimated effect of being married, which works in the opposite direction, is estimated as anywhere from 30 to nearly 100 times larger depending on the specification.
- Aging brings monotonically decreasingly likelihoods of working and reductions in hours worked.

[8] Property taxes have been controlled for through the variable of self-reported tax liabilities. Net of property tax burdens, more variation in local tax burden rate is income tax, either reducing the purchasing power of earnings, or serving as a disincentive to work.

- Black, Hispanic, and Asian workers all participate in the labor market at higher rates than whites, but significant differences are only retained in the hours worked model for individuals of Asian and Pacific Islander descent.
- More highly educated respondents are more likely to work, but are also less likely to work long hours. Both are consistent with studies that consider the income and substitution effects associated with earning higher wages (i.e., which have been shown to correlate with income.)

As discussed in Section IV., the magnitude and statistical significance of the interaction effect varies by observation. The results for corrected interaction effects of housing price index growth and homeowner status are illustrated in Figure 7(a). [Insert Figure 7(a) about here] It shows that interaction effects of housing wealth and homeowner status are always negative, and the statistical significance is persistently strong (see Figure 7(b)). [Insert Figure 7(b) about here]

Since we move from our difference-in-difference models to a longitudinal first-differenced model in the next section, we lose a majority of the socioeconomic control variables since they do not change (or change very little) over time. Finally, since these explorations clearly reveal gender plays a strong role in determining labor outcomes, we later present the results of models that separately consider male and female labor supply, finding interesting gendered effects relating to housing wealth.

B. Longitudinal Results

Table 7 displays the estimation results for our first-differenced regression models on homeowners' labor supply. [Insert Table 7 about here] We narrow the focus to homeowners since reported changes in housing wealth and property taxes – our two variables most directly of interest – rarely change for renters.[9] Column (1) reports the results concerning labor force participation for regressions including both genders. The estimated coefficient for housing wealth is -0.0026, suggesting that a ten percent increase in housing wealth reduces elderly homeowners' likelihood of being in the labor force by just over 2.5 percent. The coefficient on the property tax variable is also significant and positive as we expected. We also see the significant negative effect of financial assets, with a marginal effect of -0.0019, somewhat smaller than the coefficient on housing wealth, but we note the size of these effects cannot be distinguished from one another at conventional levels of certainly. That is to say, we would fail to reject a null hypothesis that variation in housing wealth exhibits the same effect as variation in financial wealth.

Touching briefly on the other explanatory variables in our longitudinal models, reiterating that most have dropped out since they do not vary over time, we find evidence that:

- Poor health status lowers the likelihood of staying in the labor force.
- Elderly workers facing higher local tax burdens are more likely to stay in the

[9] Renters could conceivably still experience changes in housing wealth if, for example, they owned rental property other than their residence. In practice, this is far too rare to consider in our analysis.

labor force.

- Facing worsening local employment conditions, elderly individuals are less likely to stay in the labor force.
- Aging brings monotonically decreasingly likelihoods of working.

These effects are all consistent with those from the difference-in-difference models.

1. Heterogeneous Responses by Gender

The second and third columns of results in Table 7 represent models of labor participation run separately for males and females. We find that in response to a ten percent increase in housing wealth; elderly females are less likely to work by 3.5 percent, whereas insufficient evidence is present to claim elderly males are influenced. When property tax liabilities increase by ten percent, women experience an increase in the likelihood of working of just over 5 percent, whereas for men the effect is around 3.7 percent. Additionally, the estimated effect of financial assets on male labor force participation is pinned relatively precisely to zero, whereas the effect on female participation is still significant and of nearly the same estimated magnitude as the housing wealth effect. In this context, we note that our models examine behaviors of older workers, who may (or may not) have more traditional cultural attitudes towards gender roles than younger households.

These potentially interesting age and cohort related effects at the very least motivate a closer examination of full and part-time work status, as previous studies have shown short and/or interrupted spells are more likely for women than they are for men(e.g., Polachek 1981; Becker 1985; Fuchs 1989; Vella 1994). Table 8 presents the estimation results concerning a work status model as previously outlined. [Insert Table 8 about here] All the coefficient estimates for our housing and financial wealth variables continue to be significant with expected sign in the regression using both genders (reported in column (1)). Columns (2) and (3) report the results of estimations using only females and males, respectively. The estimated marginal effects suggest that when housing wealth increases by ten percent, elderly males experience a 4.6 percent decrease in the value of their work status, whereas elderly women experience roughly a 4.0 percent decline. Similarly, a ten percent increase in property taxes leads to a 7 percent increase among elderly males, compared to a 6.9 percent increase for females. In both cases, the effect of gender in these specifications seems to dampen, with statistically insignificant differences for both the housing variables across gender specific subsamples. The data provides an explanation for the divergence between the nature of gendered effects shown in Tables 7 and 8, as we find it is more common for males to make more severe labor transitions (i.e., from full-time work directly to no work), whereas females make transitions to part-time work at higher rates than their male counterparts – consistent with the previous findings that motivated this additional investigation.

2. Heterogeneous Responses across Age Groups

One advantage of the HRS data is that we have a sufficient number of observations to investigate whether or not labor supply responses to changes in housing wealth and property taxes are heterogeneous over different age ranges. In particular, we are interested in whether near-retirement age workers (i.e., those into their 60s but not yet past 65) behave differently than workers of other ages when it comes to our main effects of interest. To explore this possibility, labor force participation is examined separately for five distinct age groups: individuals under 55, those age 55 to 61, those age 62 to 65, those age 66 to 72, and finally, those age 73 to 79.[10]

The results concerning potentially differential responses by age are presented in Columns (1) through (5) of Table 9. [Insert Table 9 about here] Beginning with the youngest group of workers, we column (1) suggests labor force participation is not related to changes in housing wealth or property taxes, but interestingly enough, does respond to changes in financial wealth. However, columns (2) indicates the influence of both housing related variables come back into play, quite strongly in fact, when workers are in their later 50s to very early 60s. Unsurprisingly though, the effect of housing wealth seems to wane when we focus narrowly on workers close to reaching ages that define eligibility for Social Security and/or pensions. Column (3) reports a statistically insignificant relationship with housing wealth, but does still retain the positive effect of higher property taxes on labor force participation – although we note the level of significance drops to the 10% level. Once past the ages representing critical eligibility thresholds, the significant effects of housing wealth resurface. Colum (4) shows that for workers age 66-72, a ten percent increase in housing wealth leads to over 4.5 percent increase in likelihood of working. Perhaps unsurprisingly, we find very few significant determinants of elderly labor supply when focusing on workers aged 73 and up, with only declines in health impacting their likelihood of working. We affectionately predict this group likely includes many workers that truly love their work, and desire to continue without much reaction to financial incentives.

Figure 8 shows how our estimated coefficients (and significance levels) of interest, describing the effect of housing wealth on labor force participation changes as age increases.[11] Using moving windows of five year, a w-shaped curve emerges. This supports the results from Table 9, showing heterogeneous effects across age groups, relating to the proximity to the conventional retirement age. In all specifications, health limitations are a major determinant of labor outcome.

3. Further Extensions regarding Hours Worked

In this section, we return to the intensive margin of labor supply, considering hours worked. Table 10 provides the estimation results for a first-differenced

[10] Workers age 80 and above constitute a very small portion of the data. Additionally, the lack of significant effects in the model of this oldest age group is not sensitive to their inclusion/exclusion.

[11] Results are from the estimation as equation (12).

specification exploring annual hours worked for our full sample, males, females, and working couples, respectively. The full sample, male only, and female only result all show insignificant effects of housing wealth and property taxes. One explanation for this lack of significance may be that elderly workers have less discretion over hours worked than they do over choices to exit the labor force entirely. Another interesting possibility is that elderly couples make joint work decisions, such that when housing wealth effects are accounted for–one member of the household primarily reacts. In this case, the housing wealth effects presented in columns (1), (2) and (3) would all be biased towards zero. In extreme cases, reactions of the two workers in a household could even move in *opposite directions*, for example if positive wealth shocks caused the household to transition from two workers to a single worker, but the single worker remaining supplied labor more intensively.

To account for this possibility, we examine working couples in column (4). We find that a ten percent increase in housing wealth leads to a 3.2 percent reduction in overall hours worked, measured at the household level. A ten percent increase in property taxes is found to increase hours worked by 11.8 percent. Hence, it seems elderly household's response in joint hours worked returns to a similar story as the one shown from labor participation.

4. Robustness Checks

To explore potentially asymmetric effects regarding the working-to-exited versus exited-to-working transitions, we also estimate non-linear multinomial logit models. Table 11 displays computed marginal effects from these estimations. [Insert Table 11 about here.] The results show housing wealth only influence elderly homeowners' decisions to exit the labor force, with an insignificant effect on the exited-to-working transition. On the other hand, property taxes influence both directional transitions significantly. We caution that these results are not surprising, given that our data carries far more cases of exiting the labor force than the reverse. It lies beyond the scope of our study to comment on whether a similar asymmetry would surface in other age groups where entry and exit occur with more similar frequency.

We also looked at specific subsamples as another simple robustness check. First, since households may reduce (increase) their consumption of housing in respond losses (gains) in housing wealth; we additionally consider the subsample of non-movers. We argue that a restriction to non-movers can, at the very least, mitigate any concerns associated with this issue. Our access to restricted geographic information of households from the HRS data allows us to identify household mobility status – verifying the household resided in the same location over multiple waves. The effects of housing wealth and property taxes, as well as key control variables including financial wealth and health status, all register highly similar effects. While not included, these results are available upon request. Furthermore, in the regressions using only non-movers, the gender-specific and age-related patterns still surface. In a final robustness check, we find our main results are retained when we include various cohort groupings.

V. Conclusion

Over the last two decades, elderly labor supply has become increasingly important, due to a rapidly aging labor force and a strong reversal of the previous trends towards earlier retirement. Evidence suggests most elderly households carry a large fraction of their asset portfolios in the form of home equity, while at the same time facing a relative lack of other liquid financial assets. In this paper, we use HRS data from 1991 through 2010 to investigate the effects of housing wealth, property taxes, and other financial wealth on labor outcomes. Our work benefits from examining a period with a clear housing market boom and a subsequent collapse, beginning in 2007. The rapid and unexpected fluctuations in home prices over this period led to plausibly exogenous variation in two key housing variables – housing wealth and property taxes – providing a setting for examining their effects on elderly labor supply.

We find consistent evidence that labor supply elasticity with respect to housing wealth and property taxes are both statistically and economic significantly, and of the nature predicted by the life-cycle model. Our findings suggest elderly homeowners are approximately 4.5 percent more likely to work if their property taxes increase by ten percent. Conversely, a ten percent increases in housing wealth raises the likelihood of working by about 2.5 percent. Across a number of specifications, changes in housing wealth display effects similar to those of financial wealth. This validates the idea that lower income elderly households, who are revealed by the data to have large concentrations of their overall wealth held in the housing sector, are particularly vulnerable to unexpected shocks to the value of their home.

Likely due to traditional gender roles and specialization in home/work production, we also identify important differences between male and female labor responses to both housing variables. Elderly female labor force participation is more responsive to changes in housing wealth than elderly male labor supply. Moreover, we find that age influences the nature of the effect of housing wealth. Current labor supply from workers in their late 50s and late 60s is found to be more responsive to changes in housing wealth than labor outcomes for workers still in their early 50s or very close to the traditional retirement age (65). Workers well beyond traditional retirement ages (i.e., 73 years and above), are found to be unresponsive to changes in either housing wealth or property taxes – perhaps an indication workers in these age ranges are unlikely to be working simply based on financial incentives.

While our study provides evidence that we argue answers several important questions relating to elderly labor supply, it leaves others unaddressed. For example, we find no evidence that plausibly exogenous changes in housing wealth influence the behavior of workers younger than age 55. However, it would be interesting to see if it influences these same workers in other ways that we are not focusing on in this study. Similarly, as time passes and new cohorts – with gender roles that may differ from those of previous generations – age into their 50s and 60s, it would be

interesting to see if the strongly gendered effects.

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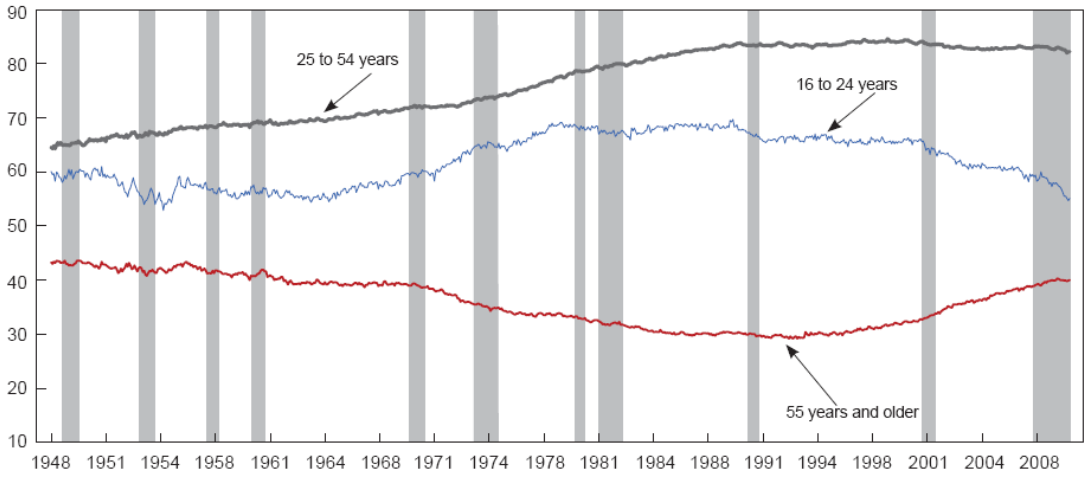
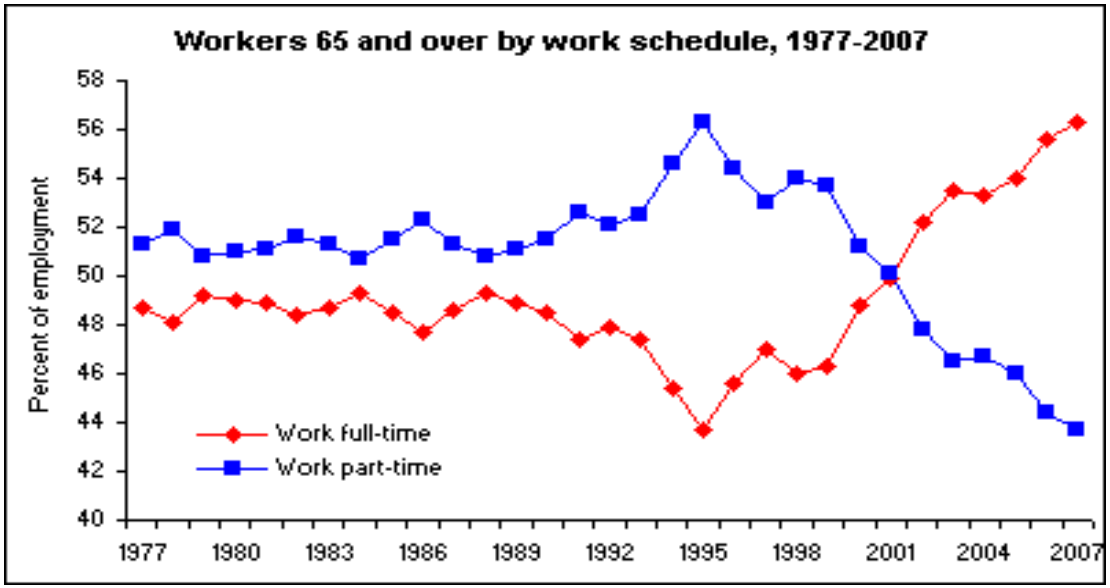
Figure 1: Labor Force Participation Rates for All Civilian Workers, by Age, Seasonally Adjusted, 1948-2010.



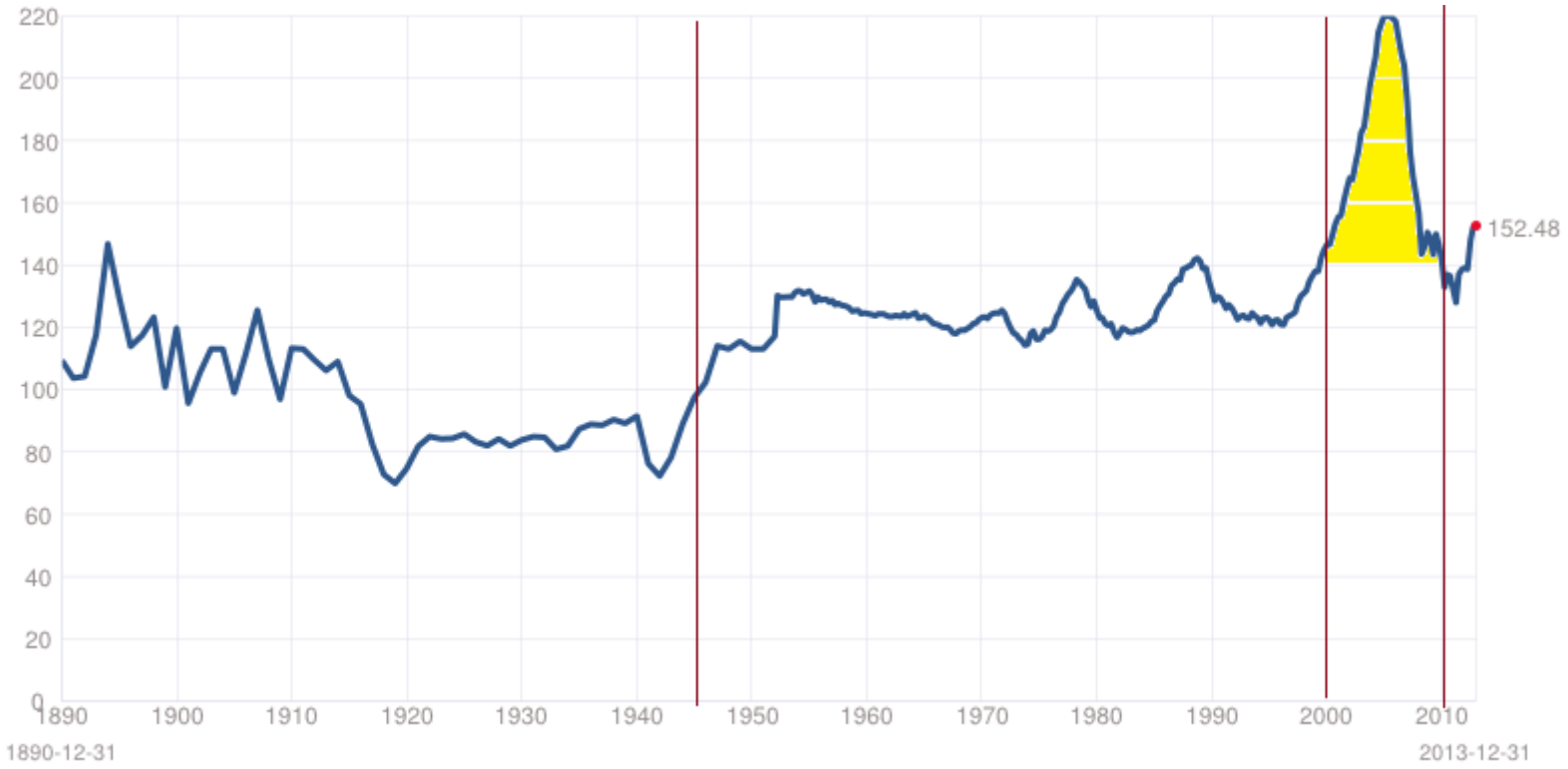
Source: Bureau of Labor Statistics, Current Population Survey, various years. Shaded areas represent recessions, as determined by the National Bureau of Economic Research (NBER).

Figure 2: Fraction of Elderly Workers in Full-time and Part-time Employment, 1977-2007.



Source: Bureau of Labor Statistics, Current Population Survey, various years.

Figure 3(a): The 120-year Historical Trend of Home Values in the U.S., 1890-2013.



Note: US national index levels, not seasonally adjusted. Historic prices are inflation adjusted February 2014 dollars. Min: 69.44 (1919). Max: 223.05 (2005).

Figure 3(b): The Recent 20-year Home Values and Appreciation Rate in the U.S.,1990-2011.

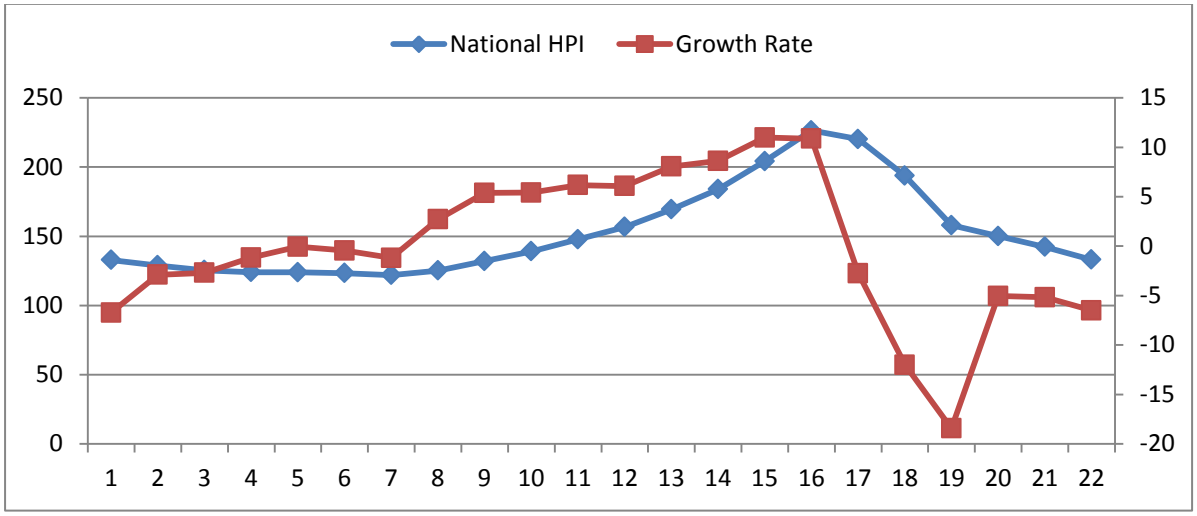


Figure 3(c): the recent 20-year HECM loans and the average property values.

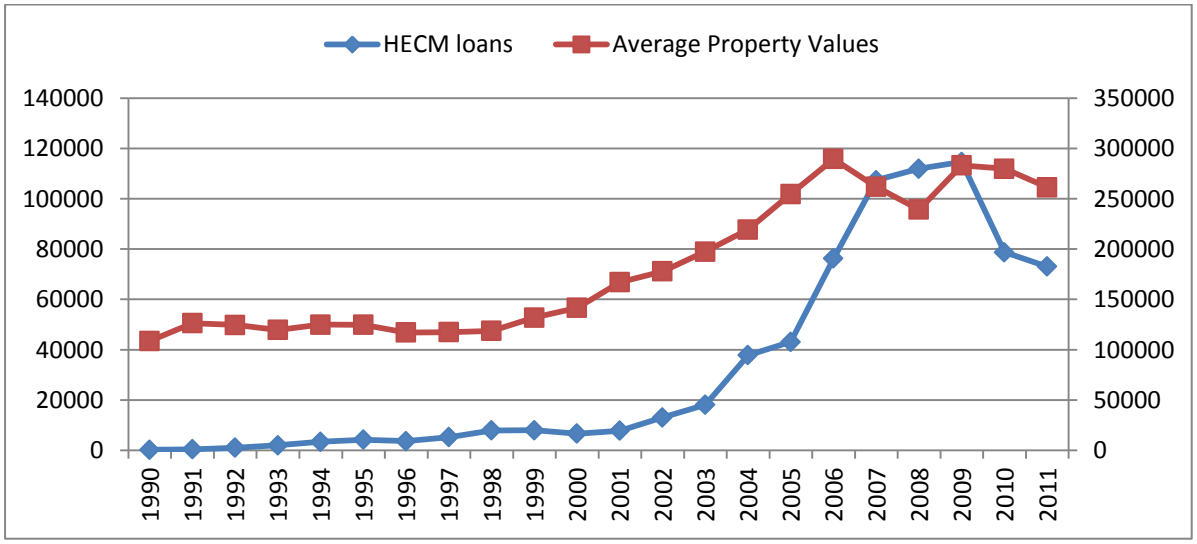


Figure 4: Percentage Breakdown, by cohort, HRS data sample, 1991-2010

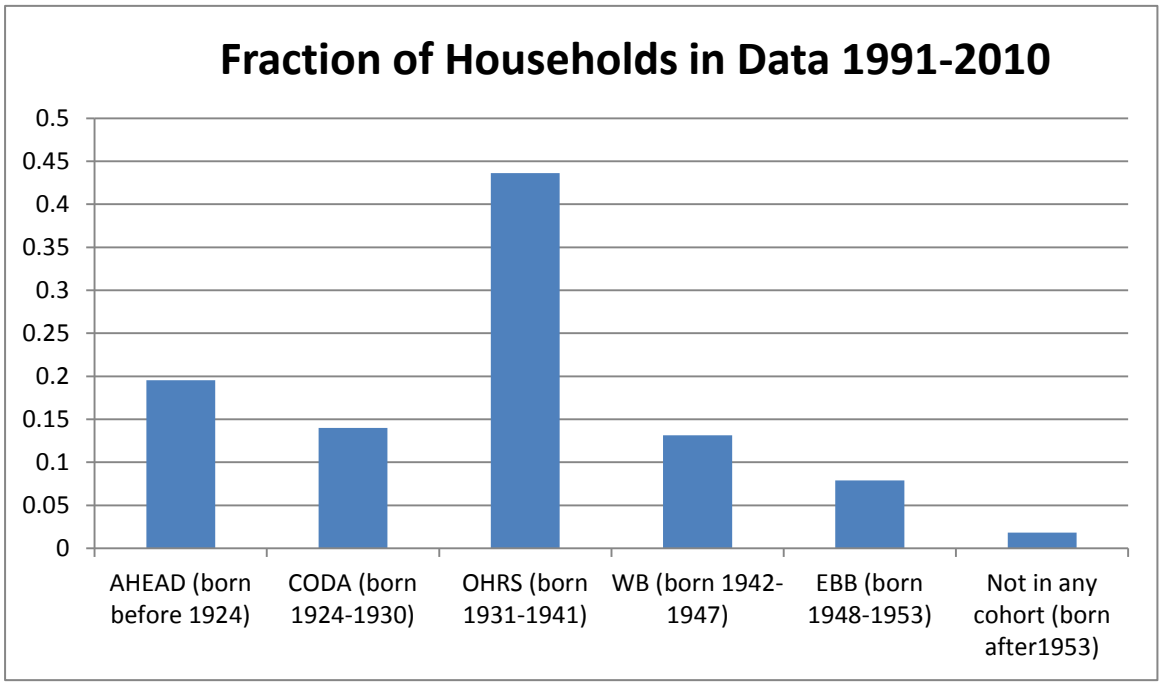


Figure 5: Labor Behaviors of Full-time, Part-time and Not Work by Age Group.

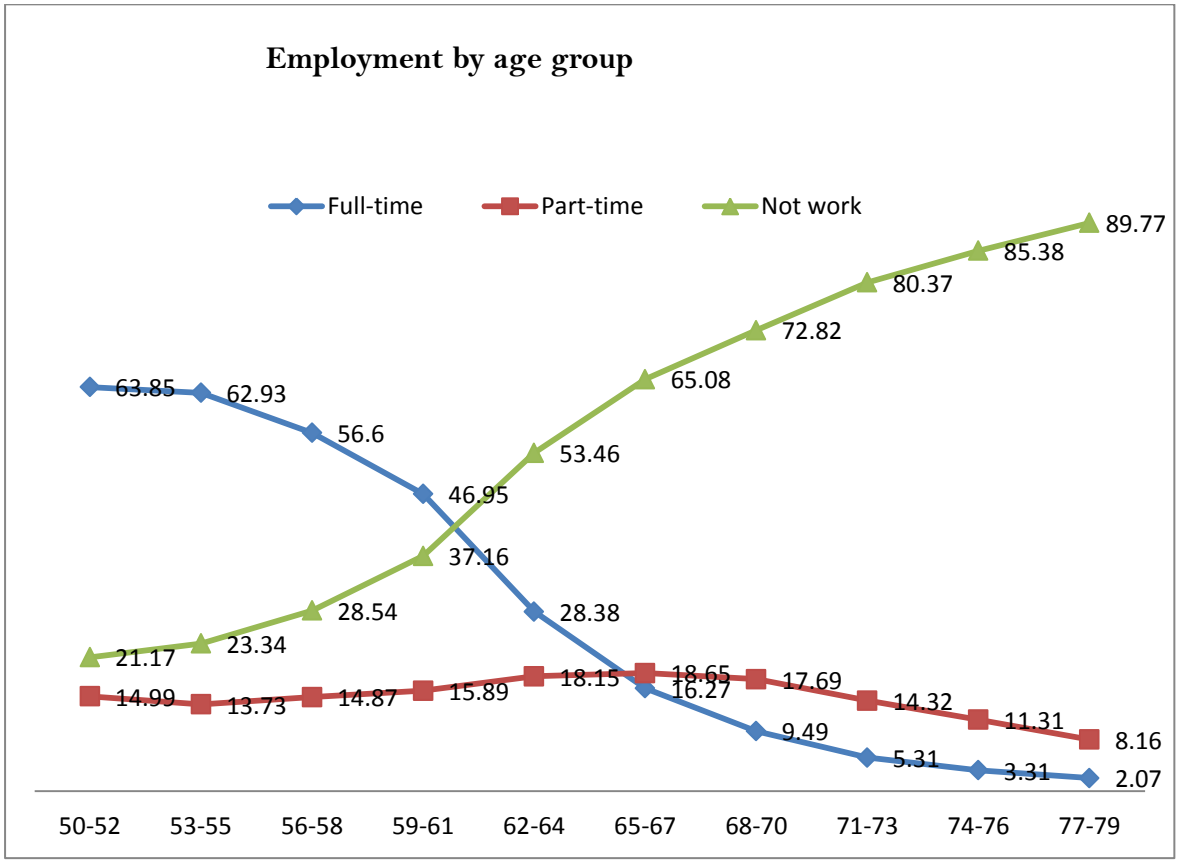


Figure 6(a): Assets Allocation of Elderly Households within Our Analysis 1991-2010.

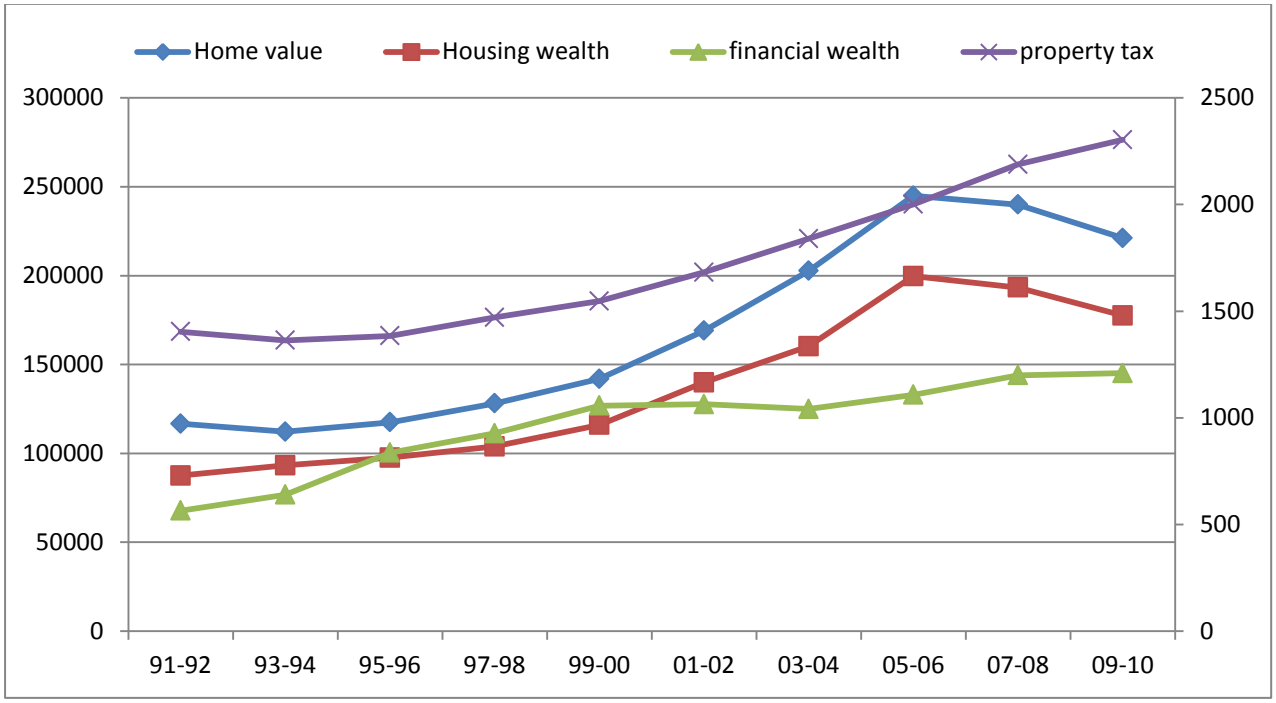
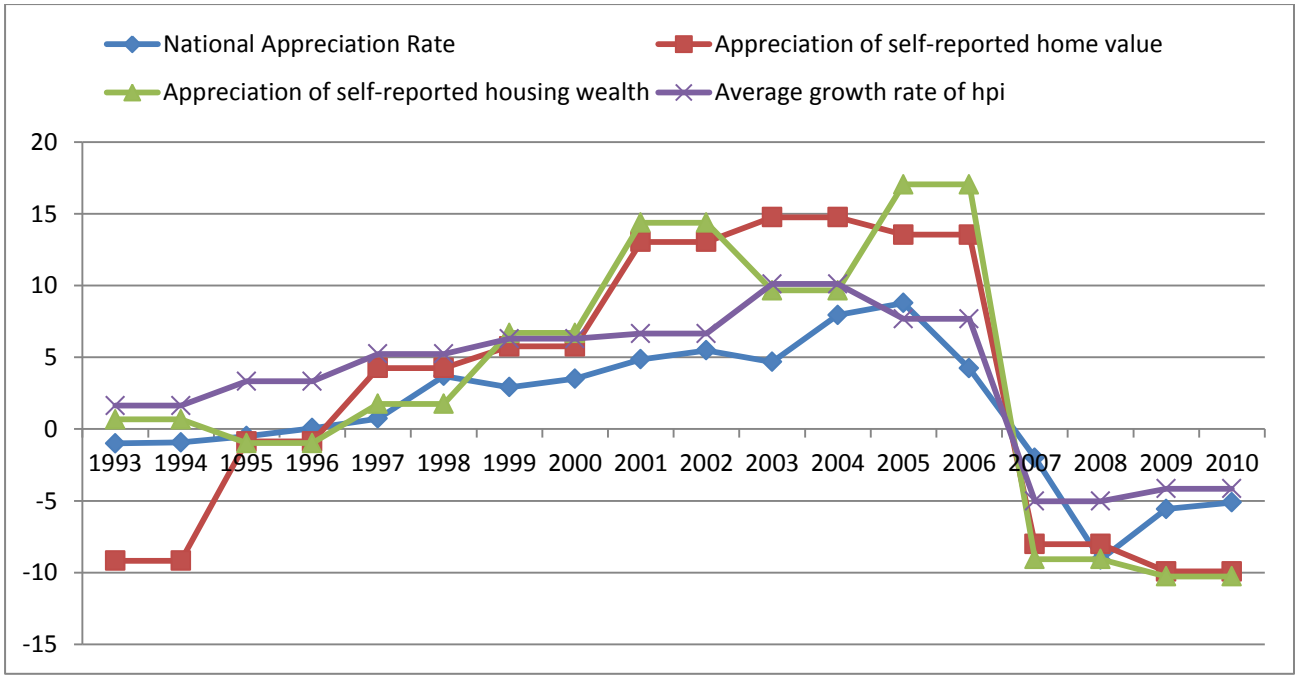


Figure 6(b): Real Growth Rate of Home Value and HPI Appreciation.



Footnotes: The MSA-specific housing price index are aggregated to national level, weighed by local population and deflated by consumer price index.
Source: Federal Housing Finance Agency, 1990-2010.

Figure 7(a): Interaction Effect of Housing Price Index Growth and Homeowner Status as a Function of the Predicted Probability of Labor Participation.

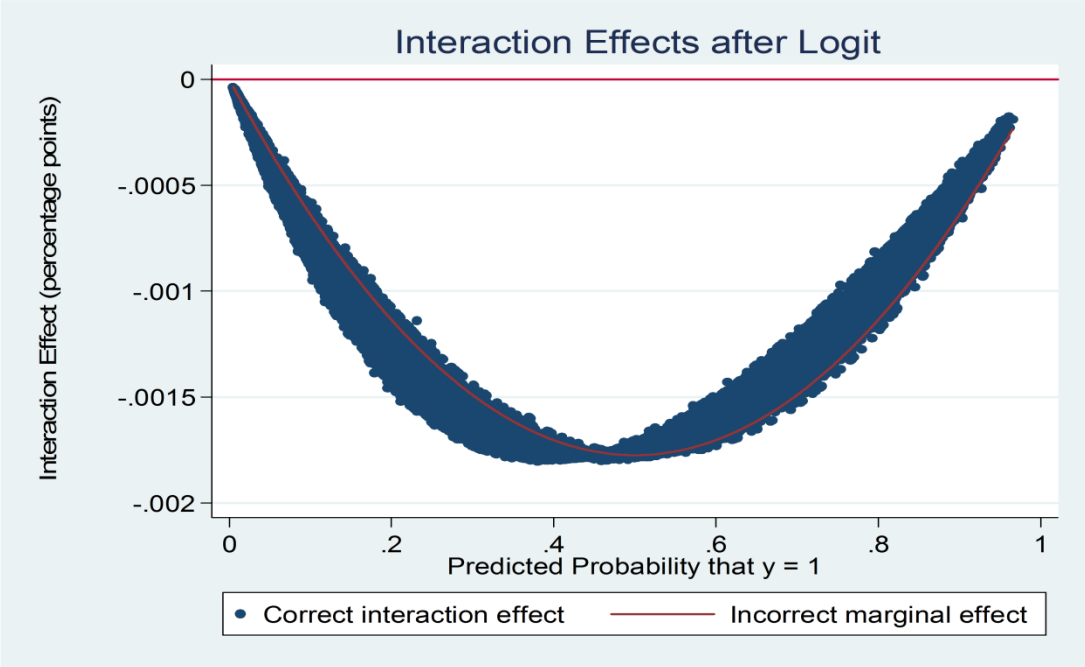


Figure 7(b): Z-statistics as a Function of the Predicted Probability of Labor Participation.

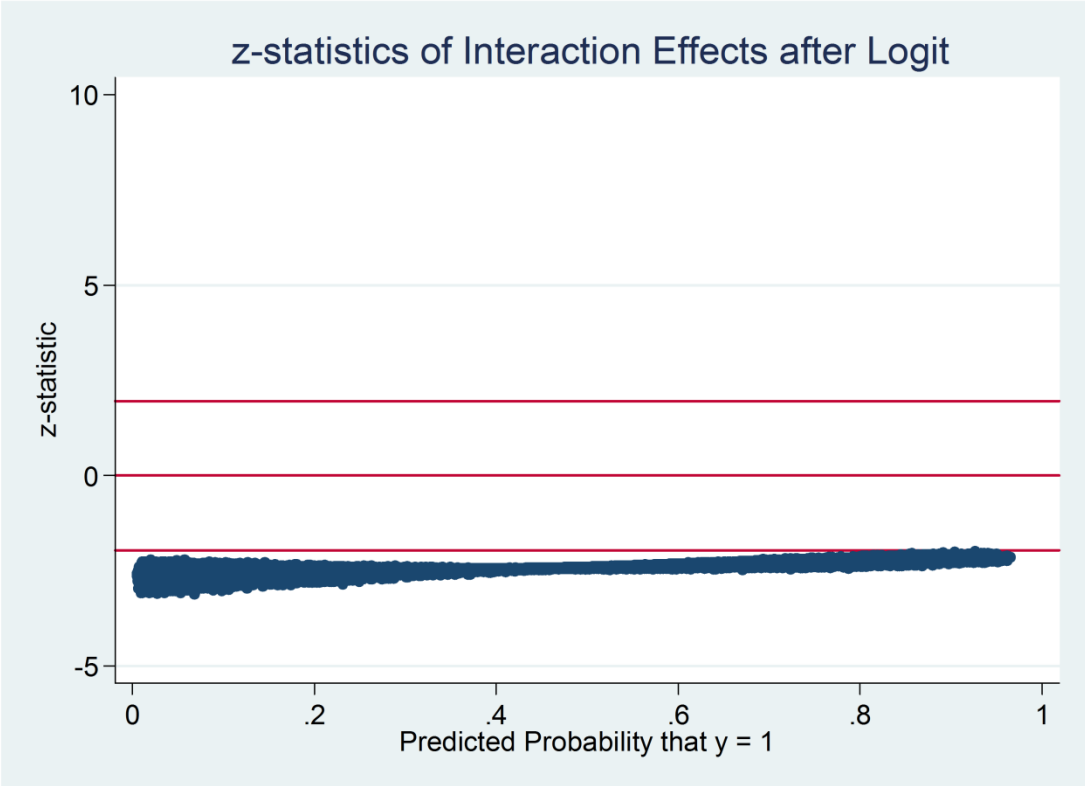


Figure 8: Heterogeneous Effect of Housing Wealth across Age Groups.

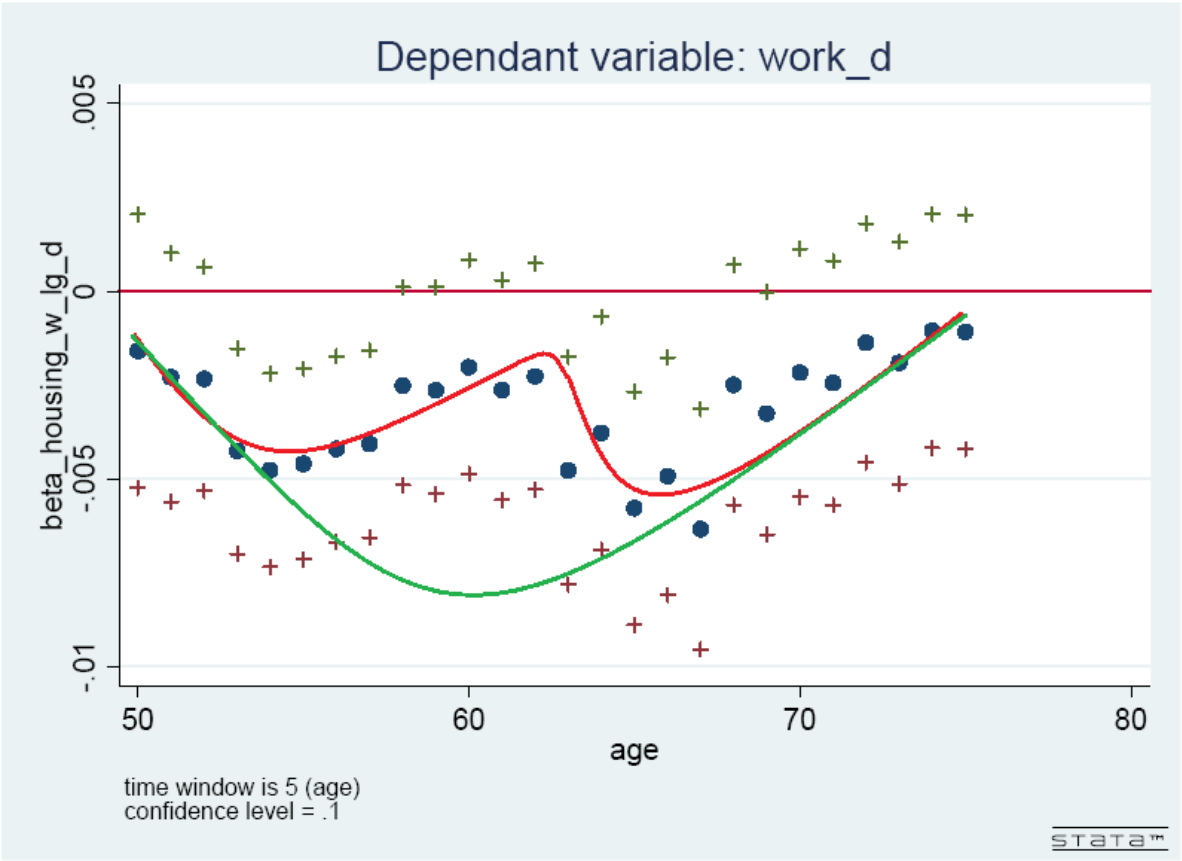


Table 1: The Composition of Entry Cohorts in Our Analysis by Wave.

Wave	Entry Cohorts				
	OHRS	AHEAD	CODA	WB	EBB
1	1992	1992	NA	NA	NA
2	1994	1993	NA	NA	NA
3	1996	1995	NA	NA	NA
4	1998	1998	1998	1998	NA
5	2000	2000	2000	2000	NA
6	2002	2002	2002	2002	NA
7	2004	2004	2004	2004	2004
8	2006	2006	2006	2006	2006
9	2008	2008	2008	2008	2008
10	2010	2010	2010	2010	2010
Individual-wave obs.	55544	24869	17802	16719	10072

Table 2: Labor Participation Rate by Age and Housing Wealth Quintile

Age	Housing wealth percentile			
	0-25%(low)	25-50%	50-75%	75-100%(high)
50-52	66.13 %	74.54 %	78.95 %	80.37 %
53-55	64.46 %	72.72 %	76.69 %	78.35 %
56-58	58.04 %	69.09 %	70.59 %	72.19 %
59-61	50.78 %	61.05 %	62.03 %	63.04 %
62-64	38.23 %	44.07 %	46.07 %	50.18 %
64-67	28.12 %	31.05 %	32.90 %	36.37 %
68-70	22.18 %	25.40 %	26.40 %	29.49 %
71-73	14.81 %	18.84 %	19.47 %	22.16 %
74-76	10.39 %	13.37 %	14.47 %	17.41 %
77-79	6.05 %	9.28 %	10.97 %	11.98 %

Table 3: Description of Variables.

Variable	Description	Data source
Labor-related:		
Labor force participation	Dummy equals one if the respondent is currently work.	RAND HRS
Working status	Categorical variable that equals two if working full time, one if part time, and zero if not working.	RAND HRS
Annual hours worked	Hours worked per week multiply weeks worked per year.	RAND HRS
Wealth-related:		
Homeownership	Dummy equals one if self-reported home value is greater than zero.	RAND HRS
Home assets	The total value of the primary residence.	RAND HRS
Housing wealth	The value of the primary residence less mortgages and home loan.	RAND HRS
Property tax	Self-reported property tax liabilities paid last year.	HRS
Financial assets	Sum of stocks, mutual funds, investment trusts, checking, savings, money market accounts, government saving bonds, other bonds and all other savings.	RAND HRS
Financial wealth	Net value of non-housing financial wealth, calculated by substracting non-mortgage debts from the sum of stocks, mutual funds, investment trusts, checking, savings, money market accounts, government saving bonds, other bonds and all other savings.	RAND HRS
Demographics:		
Cohort	Five cohort dummies: OHRS, AHEAD, CODA, WB and EBB.	RAND HRS
Age	Age in years.	RAND HRS
Age group	11 age group dummies of 44-49, 50-54, 55-59, 60-61, 62-63, 64-65, 66-67, 68-69, 70-74, 75-79, and 80+.	
Health	Categorical variable that equals five if self-report health is poor, four if fair, three if good, four if very good, and five if excellent.	RAND HRS
Female	Dummy equals one if the respondent is female.	RAND HRS
Number of children	Number of children within the household.	RAND HRS
Married	Dummy equals one if the respondent is married.	RAND HRS
Race	White, black, hispanic and other racial status.	RAND HRS
Education year	Number of years that the respondent spent in school.	RAND HRS
Education degree	Four education degree dummies of no degree, high school, college and above, and other degree.	RAND HRS
Location & wave:		
Wave	Ten wave dummies 1991 through 2010.	RAND HRS
Census region	Four census region dummies of northeast, midwest, west, and south.	RAND HRS
Housing price index	MSA specific housing price index	FHFA
Local tax burden rate	State specific local tax burden rate.	Tax Foundation
Unemployment rate	MSA specific unemployment rate aggregated from counties.	BLS

Table 4: Summary Statistics of Observations in the Analysis.

	Total					Homeowners			Renters		
	obs	Mean	Std.	Min	Max	obs	Mean	Std.	obs	Mean	Std.
Labor-related:											
Labor force participation	127,336	0.4056	0.4910	0	1	103,593	0.4297	0.4950	23,743	0.3007	0.4586
Working status	127,336	0.6765	0.8722	0	2	103,593	0.7144	0.8795	23,743	0.5114	0.8192
Annual hours worked	47,264	1826.75	821.1762	0	8736	39,972	1816.451	823.4542	23,743	1891.659	803.6989
Wealth-related:											
Homeownership	127,336	0.8135	0.3895	0	1						
Home assets	127,336	136,365	155,324	0	4,000,000	103,593	167,619.2	156,256.9	23,743	0	0
Housing wealth	127,336	110,537.8	132,882.5	1	1,000,000	103,593	135,872.2	135,139.3	23,743	0	0
△log(Housing wealth)	102,158	-1.1719	2.8941	-13.8155	13.7102	83,045	0.2992	2.1349	19,113	-2.2189	4.4512
Property tax	127,336	1383.654	1761.879	0	55,000	103,593	1700.78	1810.063	23,743	0	0
△log(property tax)	93,833	-0.0524	1.7494	-9.7981	10.2400	75,781	0.1734	1.4507	18,052	-1	2.4415
Financial assets	127,336	104,523.8	212,879.9	0	2,660,000	103,593	115,768.9	221,919.1	23,743	55,460.35	158,783.3
△log(Financial assets)	95,122	0.0676	1.7358	-12.2086	11.8133	78,863	0.0847	1.6635	16,259	-0.0153	2.0487
Demographics:											
Cohort dummies											
HRS	127,336	0.4362	0.4959	0	1	103,593	0.4523	0.4977	23,743	0.3663	0.4818
AHEAD	127,336	0.1953	0.3965	0	1	103,593	0.1650	0.3712	23,743	0.3278	0.4694
CODA	127,336	0.1398	0-.3468	0	1	103,593	0.1424	0.3495	23,743	0.1282	0.3344
WB	127,336	0.1313	0.3377	0	1	103,593	0.1413	0.3483	23,743	0.0876	0.2827
EBB	127,336	0.0791	0.2700	0	1	103,593	0.0806	0.2723	23,743	0.0727	0.2596
Other	127,336	0.0182	0.1337	0	1	103,593	0.0184	0.1383	23,743	0.0175	0.1310
Age (in years)	127,336	66.68	10.8	44	107	103,593	65.827	10.15	23,743	70.38	12.60
Age group dummies											
Age (44-49)	127,336	0.0252	0.1567	0	1	103,593	0.0262	0.1596	23,743	0.0208	0.1429
Age (50-54)	127,336	0.1035	0.3046	0	1	103,593	0.1068	0.3089	23,743	0.0888	0.2845
Age (55-59)	127,336	0.1730	0.3784	0	1	103,593	0.1804	0.3845	23,743	0.1408	0.3478
Age (60-61)	127,336	0.0728	0.2599	0	1	103,593	0.0771	0.2667	23,743	0.0544	0.2268
Age (62-63)	127,336	0.0666	0.2493	0	1	103,593	0.0705	0.2560	23,743	0.0495	0.2170
Age (64-65)	127,336	0.0615	0.2403	0	1	103,593	0.0651	0.2467	23,743	0.0460	0.2094
Age (66-67)	127,336	0.0557	0.2294	0	1	103,593	0.0590	0.2357	23,743	0.0414	0.1992
Age (68-69)	127,336	0.0541	0.2262	0	1	103,593	0.0567	0.2312	23,743	0.0428	0.2024
Age (70-74)	127,336	0.1383	0,3453	0	1	103,593	0.1430	0.3501	23,743	0.1178	0.3224
Age (75-79)	127,336	0.1090	0.3117	0	1	103,593	0.1069	0.3090	23,743	0.1184	0.3230
Age (80+)	127,336	0.1402	0.3472	0	1	103,593	0.1083	0.3108	23,743	0.2792	0.4486
Health (in a 5-point scale)	127,336	3.2646	1.1191	1	5	103,593	3.3491	1.0909	23,743	2.8962	1.1650
Female	127,336	0.5703	0.4950	0	1	103,593	0.5523	0.4973	23,743	0.6489	0.4773
Number of children	127,336	3.0995	2.0532	0	22	103,593	3.1075	1.9826	23,743	3.0647	2.3363
Married	127,336	0.7015	0.4576	0	1	103,593	0.7750	0.4176	23,743	0.3805	0.4855
Race dummies											
White	127,336	0.8288	0.3767	0	1	103,593	0.8533	0.3538	23,743	0.7217	0.4482
Black	127,336	0.0964	0.2951	0	1	103,593	0.0811	0.2730	23,743	0.1630	0.3694
Hispanic	127,336	0.0555	0.2289	0	1	103,593	0.0485	0.2148	23,743	0.0860	0.2803
Other race	127,336	0.0194	0.1378	0	1	103,593	0.0171	0.1296	23,743	0.0293	0.1686
Education (in years)	127,336	12.5852	2.9288	1	17	103,593	12.7792	2.8276	23,743	11.7383	3.1996
Education degree dummies											
No degree	127,336	0.2026	0.4019	0	1	103,593	0.1771	0.3818	23,743	0.3136	0.4640
High school	127,336	0.5949	0.4909	0	1	103,593	0.6039	0.4891	23,743	0.5557	0.4969
College & above	127,336	0.2015	0.4011	0	1	103,593	0.2179	0.4128	23,743	0.1301	0.3364
Other degree	127,336	0.0010	0.0318	0	1	103,593	0.0011	0.0302	23,743	0.0006	0.0251
Year	127,337	2000.928	5.5245	1992	2011	103,593	2000.86	5.5349	23,743	2001.227	5.4686
MSA level housing price index growth (in%)	121,226	3.8331	6.6041	-37.93797	33.0980	98,267	3.7997	6.5218	22,959	3.9762	6.9439
MSA level unemployment rate (in%)	127,003	5.8791	2.3697	1.4653	31.10975	103,342	5.8720	2.3756	23,661	5.9102	2.3437
State level local tax burden (in%)	127,020	9.6221	1.2026	4.8	12.78	103,354	9.5789	1.1747	23,666	9.8109	1.3008

Table 5 :Difference-in-difference Estimation of Housing Bust Effect.

Variable	Participation	Working status	Working hours
	(1)	(2)	(3)
Bust	0.00674	0.01521	-0.09492
	(0.0082)	(0.0138)	(0.0706)
Homeowner	-0.03312***	-0.06059***	-0.06585*
	(0.0072)	(0.0120)	(0.0257)
Bust*homeowner	0.02291***	0.03444***	0.03477
	(0.0081)	(0.0135)	(0.0309)
Property tax	0.00855***	0.01333***	0.00180
	(0.0009)	(0.0015)	(0.0032)
Financial wealth	-0.00490***	-0.00872***	-0.01238***
	(0.0006)	(0.0011)	(0.0022)
Health	0.06810***	0.11141***	0.02515***
	(0.0013)	(0.0022)	(0.0046)
Unemployment rate	-0.00622***	-0.01027***	-0.00118
	(0.0008)	(0.0014)	(0.0027)
Local tax burden	-0.00502***	-0.00796***	0.00196
	(0.0012)	(0.0020)	(0.0039)
Female	-0.10166***	-0.21409***	-0.23889***
	(0.0028)	(0.0047)	(0.0090)
Number of children	0.00122*	0.0009	0.00427*
	(0.0007)	(0.0011)	(0.0023)
Married	-0.03669***	-0.08040***	-0.11547***
	(0.00333)	(0.0056)	(0.0112)
Age (50-54)	-0.01524	-0.01795	-0.01389
	(0.0107)	(0.0179)	(0.0234)
Age (55-59)	-0.08328***	-0.17212***	-0.08380***
	(0.0102)	(0.0171)	(0.0226)
Age (60-61)	-0.18262***	-0.38528***	-0.15066***
	(0.0109)	(0.0183)	(0.0249)
Age (62-63)	-0.30299***	-0.65021***	-0.33279***
	(0.0109)	(0.0183)	(0.0257)
Age (64-65)	-0.37910***	-0.80292***	-0.42953***
	(0.0109)	(0.0182)	(0.0264)
Age (66-67)	-0.45061***	-0.94806***	-0.59215***
	(0.0109)	(0.0183)	(0.0275)
Age (68-69)	-0.49758***	-1.03843***	-0.72256***
	(0.0109)	(0.0183)	(0.0288)
Age (70-74)	-0.57028***	-1.15355***	-0.90488***
	(0.0103)	(0.0172)	(0.0264)
Age (75-79)	-0.64523***	-1.25474***	-1.05559***
	(0.0105)	(0.0176)	(0.0312)
Age (over 80)	-0.70169***	-1.31722***	-1.2501***
	(0.0105)	(0.0175)	(0.0397)
Hispanic	0.00433	0.02354**	-0.01976
	(0.0060)	(0.0101)	(0.0189)
Black	0.01003**	0.01740**	-0.02327
	(0.0048)	(0.0080)	(0.0149)
Otherrace	0.02575***	0.05889***	0.08310***
	(0.0095)	(0.0159)	(0.0267)
High school	0.03343***	0.05892***	-0.00295***
	(0.0038)	(0.0063)	(0.0146)
College	0.09233***	0.14981***	-0.08507***
	(0.0048)	(0.0080)	(0.0166)
Other degree	0.00609	-0.01320	-0.17002
	(0.0400)	(0.0670)	(0.1207)
Wave dummies			
R^2	0.3312	0.3820	0.1707
N	88,619	88,619	32,045

*, **, *** denotes significance at the 10%, 5%, and 1% level, respectively.

Note: Housing wealth, property taxes, and financial assets are naturally logged. Covariates not shown in this table also include wave dummies.

Table 6 : Difference-in-Difference Estimation of Housing Price Index Growth Effect.

Variable	Labor participation	Working status	Working hours
	(1)	(2)	(3)
Hpi_growth	0.00123***	0.00230***	0.00357***
	(0.0004)	(0.0007)	(0.0014)
Homeowner	-0.02807***	-0.05042***	-0.05905***
	(0.0064)	(0.0109)	(0.0219)
Hpi_growth*homeowner	-0.00085**	-0.00136*	-0.0009
	(0.0004)	(0.0007)	(0.0015)
Property tax	0.00862***	0.01302***	0.00284
	(0.0008)	(0.0014)	(0.0027)
Financial wealth	-0.00510***	-0.00954***	-0.01222***
	(0.0006)	(0.0010)	(0.0018)
Health	0.07047***	0.11722***	0.02173***
	(0.0011)	(0.0019)	(0.0036)
Unemployment rate	-0.00420***	-0.0074***	0.00137
	(0.0007)	(0.0011)	(0.0020)
Local tax burden	-0.00345***	-0.00548***	-0.00080
	(0.0010)	(0.0017)	(0.0031)
Female	-0.10996***	-0.23786***	-0.24736***
	(0.0024)	(0.0041)	(0.0072)
Number of children	0.00109*	0.00034	0.00306*
	(0.0006)	(0.0010)	(0.0018)
Married	-0.0410***	-0.09082***	-0.10358***
	(0.0029)	(0.0049)	(0.0091)
Age (50-54)	-0.03030***	-0.04886	-0.03443*
	(0.0082)	(0.0140)	(0.0173)
Age (55-59)	-0.09783***	-0.19522***	-0.09677***
	(0.0079)	(0.0135)	(0.0169)
Age (60-61)	-0.19884***	-0.40744***	-0.16394***
	(0.0086)	(0.0146)	(0.0188)
Age (62-63)	-0.31900***	-0.67273***	-0.34272***
	(0.0087)	(0.0148)	(0.0199)
Age (64-65)	-0.39988***	-0.83346***	-0.44328***
	(0.0087)	(0.0150)	(0.0210)
Age (66-67)	-0.47239***	-0.98155***	-0.60729***
	(0.0089)	(0.0152)	(0.0225)
Age (68-69)	-0.51529***	-1.06499***	-0.74086***
	(0.0089)	(0.0153)	(0.0238)
Age (70-74)	-0.59016***	-1.18203***	-0.91487***
	(0.0081)	(0.0139)	(0.0209)
Age (75-79)	-0.66008***	-1.27538***	-1.06525***
	(0.0083)	(0.0143)	(0.0254)
Age (over 80)	-0.71405***	-1.33557***	-1.23400***
	(0.0083)	(0.0142)	(0.0332)
Hispanic	0.01102**	0.03233***	-0.0279*
	(0.0052)	(0.0089)	(0.0152)
Black	0.01863***	0.03155***	-0.01507
	(0.0040)	(0.0069)	(0.0115)
Otherrace	0.02163***	0.05614***	0.07669***
	(0.0082)	(0.0141)	(0.0219)
High school	0.03357***	0.05947***	-0.00065
	(0.0032)	(0.0054)	(0.0111)
College	0.09257***	0.15387***	-0.06890***
	(0.0040)	(0.0069)	(0.0128)
Other degree	0.02544	0.02990	-0.06276
	(0.0360)	(0.0615)	(0.0991)
Wave dummies	controlled	controlled	controlled
R^2	0.3466	0.3917	0.1663
N	121,358	121,358	47,008

*, **, *** denotes significance at the 10% level, 5%, and 1% level, respectively.

Note: Housing wealth, property taxes, and financial assets are naturally logged. Covariates not shown in this table also include wave dummies.

Table 7: Longitudinal Model of Labor Force Participation of Homeowners

Variable	Both genders	The female	The male
	(1)	(2)	(3)
△Housing wealth	-0.00260***	-0.00346***	-0.00162
	(0.0007)	(0.0009)	(0.0011)
△Property tax	0.00448***	0.00513***	0.00369**
	(0.0010)	(0.0013)	(0.0015)
△Financial wealth	-0.00190**	-0.00296***	-0.00038
	(0.0008)	(0.0010)	(0.0012)
△Health	0.01253***	0.01215***	0.01245***
	(0.0015)	(0.0020)	(0.0022)
△Unemployment rate	-0.00254*	-0.00033	-0.00607***
	(0.0014)	(0.0018)	(0.0021)
△Local tax burden	0.02530***	0.02188***	0.02921***
	(0.0039)	(0.0052)	(0.0059)
△Age (50-54)	0.02238**	0.01805	0.01097
	(0.0106)	(0.0111)	(0.0306)
△Age (55-59)	-0.0147	0.00565	0.00901
	(0.0122)	(0.0136)	(0.0321)
△Age (60-61)	-0.02317*	-0.04033*	-0.01892
	(0.0136)	(0.0158)	(0.0334)
△Age (62-63)	-0.11564***	-0.11270***	-0.13440***
	(0.0150)	(0.0178)	(0.0348)
△Age (64-65)	-0.16361***	-0.16383***	-0.17738***
	(0.0165)	(0.0200)	(0.0363)
△Age (66-67)	-0.20350***	-0.20334***	-0.21600***
	(0.0181)	(0.0222)	(0.0380)
△Age (68-69)	-0.21981***	-0.22436***	-0.22578***
	(0.0197)	(0.0245)	(0.0399)
△Age (70-74)	-0.23652**	-0.24127***	-0.24056**
	(0.0214)	(0.0269)	(0.0419)
△Age (75-79)	-0.23865***	-0.24118***	-0.24383***
	(0.0233)	(0.0295)	(0.0442)
△Age (over 80)	-0.2281***	-0.2320***	-0.23055***
	(0.0255)	(0.0326)	(0.0470)
Wave dummies	controlled	controlled	controlled
R^2	0.0103	0.0089	0.0130
N	72,713	40,069	32,644

*, **, *** denotes significance at the 10% , 5% and 1% level, respectively.
Note: Housing wealth, property taxes, and financial assets are naturally logged.
Covariates not shown in this table also include wave dummies.

Table 8: Longitudinal Model of Working Decisions of Homeowners
(Full time/part time/no work)

Variable	Both genders	The female	The male
	(1)	(2)	(3)
△Housing wealth	-0.00414***	-0.00396***	-0.00456**
	(0.0011)	(0.0015)	(0.0018)
△Property tax	0.00695***	0.00687***	0.00715***
	(0.0017)	(0.0021)	(0.0026)
△Financial wealth	-0.00374***	-0.00520***	-0.00160
	(0.0013)	(0.0016)	(0.0021)
△Health	0.02202***	0.02099***	0.022801***
	(0.0024)	(0.0032)	(0.0037)
△Unemployment rate	-0.00564**	-0.00142	-0.01084***
	(0.0023)	(0.0029)	(0.0035)
△Local tax burden	0.04691***	0.04122***	0.05303***
	(0.0065)	(0.0085)	(0.0100)
△Age (50-54)	0.04342**	0.03167*	0.03346
	(0.0175)	(0.0181)	(0.0521)
△Age (55-59)	0.01389	-0.00288	0.00943
	(0.0202)	(0.0221)	(0.0546)
△Age (60-61)	-0.07728***	-0.09561***	-0.07969
	(0.0226)	(0.0256)	(0.0568)
△Age (62-63)	-0.28786***	-0.25155***	-0.35322***
	(0.0249)	(0.0289)	(0.0592)
△Age (64-65)	-0.38520***	-0.34128***	-0.45496***
	(0.0274)	(0.0324)	(0.0618)
△Age (66-67)	-0.47395***	-0.42043***	-0.54969***
	(0.0300)	(0.0361)	(0.0647)
△Age (68-69)	-0.50404***	-0.44617***	-0.58021***
	(0.0327)	(0.0398)	(0.0678)
△Age (70-74)	-0.52566***	-0.46404***	-0.60266**
	(0.0355)	(0.0437)	(0.0712)
△Age (75-79)	-0.51099***	-0.45020***	-0.58430***
	(0.0387)	(0.0479)	(0.0752)
△Age (over 80)	-0.48399***	-0.42269***	-0.55555***
	(0.0424)	(0.0529)	(0.0800)
Wave dummies	controlled	controlled	controlled
R^2	0.0173	0.0128	0.0234
N	72,713	40,069	32,644

*, **, *** denotes significance at the 10%, 5%, and 1% level, respectively.

Note: Housing wealth, property taxes, and financial assets are naturally logged. Covariates not shown in this table also include wave dummies.

Table 9: Labor Force Participation: Heterogenous Effects across Age Groups.

Variable	(1) younger than 55	(2) age 55-61 (pre-retirement age)	(3) age 62-65 (retirement age)	(4) age 66-72 (post-retirement age)	(5) age 73-79
△Housing wealth	-0.00135	-0.00422***	-0.00244	-0.00461***	-0.00149
	(0.00193)	(0.00132)	(0.00203)	(0.00163)	(0.00165)
△Property tax	0.00377	0.00716***	0.00585*	0.00587***	0.00068
	(0.00148)	(0.00207)	(0.00312)	(0.00226)	(0.00206)
△Financial wealth	-0.00667***	-0.00037	-0.00352	-0.00337*	-0.00027
	(0.00244)	(0.00157)	(0.00242)	(0.00180)	(0.00154)
△Health	0.02431***	0.01442***	0.01096**	0.01352***	0.01053***
	(0.00494)	(0.00311)	(0.00471)	(0.00347)	(0.00275)
Age(in years)	-0.00442***	-0.00679***	-0.01693***	-0.00633***	-0.00169
	(0.00182)	(0.00133)	(0.00352)	(0.00146)	(0.00124)
Wave dummies	controlled	controlled	controlled	controlled	controlled
R^2	0.0070	0.0054	0.0059	0.0048	0.0013
N	6,492	18,861	11,368	15,517	12,425

*, **, *** denotes significance at the 10% , 5%, and 1% level, respectively.

Note: Housing wealth, property taxes, and financial assets are naturally logged. Covariates not shown in this table also include wave dummies.

Table 10: Longitudinal Model of Working Hours.

Variable	Both genders	The female	The male	Working couples
	(1)	(2)	(3)	(4)
△Housing wealth	0.00083	-0.00410	-0.00254	-0.00322**
	(0.0018)	(0.0026)	(0.0027)	(0.0014)
△Property tax	0.00459	0.00580	0.00319	0.01180***
	(0.0031)	(0.0042)	(0.0044)	(0.0023)
△Financial wealth	0.00093	-0.00076	-0.00270	-0.00174
	(0.0022)	(0.0030)	(0.0033)	(0.0016)
△Health	0.01450***	0.01170*	0.01644***	0.02541***
	(0.0044)	(0.0063)	(0.0062)	(0.0031)
△Unemployment rate	-0.00118	-0.00534	0.00266	0.00132
	(0.0041)	(0.0056)	(0.0058)	(0.0030)
△Local tax burden	0.02463*	0.01960	0.03009	0.02397**
	(0.0131)	(0.0186)	(0.0184)	(0.0099)
△Age dummies	controlled	controlled	controlled	controlled
△Age dummies of spouse				controlled
Wave dummies	controlled	controlled	controlled	controlled
R^2	0.0085	0.0063	0.0126	0.0187
N	26,381	13,306	13,075	12,612

*, **, *** denotes significance at the 10%, 5%, and 1% level, respectively.

Note: Housing wealth, property taxes, and financial assets are naturally logged. Covariates not shown in this table also include wave dummies.

Table 11: Asymmetric Effects on Labor Force Exit and Reentry.

Variable	Homeowners		The male homeowners		The female homeowners	
	multinomial logit		multinomial logit		multinomial logit	
	(2)Enter	(3)Exit	(5)Enter	(6)Exit	(8)Enter	(9)Exit
Housing wealth	-0.00021	0.00241***	0.00037	0.00212*	-0.00067	0.00268***
	(0.00034)	(0.00077)	(0.00049)	(0.00083)	(0.00045)	(0.00066)
Property tax	0.00175***	-0.00267***	0.00120*	-0.00244**	0.00213***	-0.00283***
	(0.00049)	(0.00077)	(0.00072)	(0.00122)	(0.00065)	(0.00099)
Financial wealth	-0.00066*	0.00113*	0.00047	0.00079	-0.00146***	0.00133*
	(0.00039)	(0.00060)	(0.00058)	(0.00097)	(0.00051)	(0.00077)

*, **, *** denotes significance at the 10%, 5%, and 1% level, respectively.

Note: Housing wealth, property taxes, and financial assets are naturally logged. Covariates not shown in this table also include wave dummies.