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HOUSING WEALTH, ELDERLY LABOR OUTCOMES AND FINANCING RETIREMENT

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THE DEPARTMENT OF ECONOMICS

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Table of Contents

List of Tables

List of Figures

Abstract

The first chapter of my dissertation uses the restricted access version of the Health and Retirement Survey (HRS) data to examine elderly workers responses to changes in housing wealth, property taxes and financial wealth. The findings suggest older workers respond to variation in housing wealth and property taxes in the predicted opposing directions, that wealth influences labor supply to a lesser extent than factors like health and marital status, and that the effect of housing wealth on labor supply varies significantly by gender and age. Collectively, this set of findings answers several questions, but additionally motivates my second essay.

In my second chapter, the effects of housing wealth and property taxes on older households are further explored, focusing on the timing of retirement and unretirement decisions. Early retirement expectations are also considered and I identify factors associated with cases where gaps exist between expectations and later retirement realizations. I again use the restricted access HRS data to carry out this investigation. The findings complement my first essay by verifying that both retirement and unretirement transitions are affected by housing wealth, property taxes and financial wealth in expected directions. However, only financial wealth serves as major mechanisms through which expectations influence retirement behaviors. Unexpected changes in retirement decisions seem to be directly influenced by housing wealth shocks.

Chapter 3 focuses on the market for reverse mortgages. Reverse mortgages have played an increasingly important role as one of the major options available to elderly homeowners who wish to use their current home equity to finance consumption during their retirement. This places it on par with other important housing related decisions, such as downsizing, migrating to low cost regions, direct withdrawals of home equity, and exiting homeownership in favor of renting or even moving into an assisted living arrangement. My analysis relies primarily on loan level Home Equity Conversion Mortgage (HECM) data from the Department of Housing and Urban Development (HUD) and housing price index data from the Federal Housing Finance Agency (FHFA). The paper aims to investigate factors influencing the demand for reverse mortgages,

emphasizing the role of changes in housing prices. The primary contribution of the paper comes from exploring the potentially asymmetric effect of changing housing prices on reverse mortgage originations. Intuitively, both the current price level and the expected future price level should influence this decision making process. While the results should be viewed as preliminary, I find evidence to support this claim. Finally, the essay examines whether or not these effects vary across different types of family arrangements (e.g., single, married, with and without children).

Chapter 1: Housing Wealth, Property Taxes and Labor Supply among the Elderly

1.1 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 1.1 shows Current Population Survey (CPS) estimated labor force participation rates for various age groups over the period 1948-2010. [Figure 1.1 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 1.2 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 1.2 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. We adopt two alternative measures of housing wealth; self-reported values and MSA level housing price indexes. Since each carries certain advantages and disadvantages over the other, the two sources of variation are explored using different models. First, we take advantage of plausibly exogenous variation in housing wealth using a within-MSA renter vs. homeowner difference-in-difference approach. Second, we examine within-household longitudinal variation in self-reported housing wealth using multiple estimation strategies that mitigate endogeneity concerns. 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 force 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 middle-to-late 50s and their middle-to-late 60s than they do on workers in their early 50s and early 60s. Finally, using changes in MSA-specific housing price indexes as a proxy for housing wealth shocks, we find the negative influence of housing wealth on elderly labor supply surfaces through a within-MSA renter versus homeowner difference-in-difference specification.

1.2 Background and Theory

1.2.1 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.

1.2.2 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 1.3.1 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 1.3.1 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 1.3.2 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 1.3.2 about here] These periods of housing boom and subsequent collapse provide sufficient exogenous variation for examining the effects of housing wealth. Figure 1.3.3 presents the recent 20-year Home Equity Conversion Mortgage (HECM) loans and its average property values from 1990 to 2010. [Insert Figure 1.3.3 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).

1.2.3 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.

1.2.4 The Role of Property Taxes

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

[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.

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.

1.2.5 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.

1.3 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 1.4 shows around forty percent of our data come from the OHRS cohort, while the AHEAD cohort represents another fifth. [Figure 1.4 about here]

Table 1.1 provides the specific timing of the survey for each cohort. [Insert Table 1.1 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 1.5 illustrates the working status shares of respondents by age, including working full-time, working part-time and not working. [Insert Figure 1.5 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 1.6.1 displays the asset allocations of elderly households that we analyze in this study over the period 1991 through 2010. [Insert Figure 1.6.1 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 1.6.2 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 1.6.2 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 Fgiexpectations 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 1.2 presents labor force participation rates, by age and by housing wealth percentile. [Insert Table 1.2 about here] We see decreasing participation rates with age for all respondents, regardless of their position within the housing wealth distribution.

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

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 examination.

Table 1.3 lists all our variables, along with their descriptions and data sources. [Insert Table 1.3 about here] Table 1.4 displays summary statistics for the 127,336 observations used in our analysis, along with subsample statistics for homeowners and renters. [Insert Table 1.4 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

[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.

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.

1.4 Empirical Methodology

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

1.4.1 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

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

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.

1.4.2 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.

$$\begin{aligned}\text{labor outcome}_{it} = {} & \beta_0 + \beta_1 \text{bust}_t + \beta_2 \text{homeowner}_{it} + \beta_3 \text{bust} * \text{homeowner}_{it} \\ & + \text{property taxes}_{it} + \beta_5 \text{financial assets}_{it} + \beta_6 \text{health}_{it} + \beta_7 \text{demographics}_{it} \\ & + \beta_8 \text{unemployment rate}_{mt} + \beta_9 \text{local tax burden}_{st} + \varepsilon_{it} \end{aligned} \quad (1)$$

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:

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

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.

1.4.3 Extensions 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:

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

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:

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

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:

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

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

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

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).

1.4.4 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

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

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).

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:

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

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:

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

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

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

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

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.

[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.

1.5 Results

1.5.1 Difference-in-Difference Results

The regression results presented in Table 1.5 provide our difference-in-difference estimate using HRS reported measures of housing wealth. [Insert Table 1.5 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 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 1.6. [Insert Table 1.6 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.
- 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 1.7.1 [Insert

[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.

Figure 1.7.1 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 1.7.2). [Insert Figure 1.7.2 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.

1.5.2 Longitudinal Results

Table 1.7 displays the estimation results for our first-differenced regression models on homeowners' labor supply. [Insert Table 1.7 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

[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.

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 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.

1.5.2.1 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 1.8 presents the estimation results concerning a work status model as previously outlined. [Insert Table 1.8 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.

1.5.2.2 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 1.9. [Insert Table 1.9 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

[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.

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 1.8 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.

1.5.2.3 Further Extensions regarding Hours Worked

In this section, we return to the intensive margin of labor supply, considering hours worked. Table 1.10 provides the estimation results for a first-differenced 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

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

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.

1.5.2.4 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 1.11 displays computed marginal effects from these estimations. [Insert Table 1.11 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.

1.6 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.

Table 1.1: The Composition of Entry Cohorts in Our Analysis by Wave.

Wave	Entry Cohorts				
	HRS	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.	10413	7758	4210	3488	3623

Table 1.2: 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 1.3: 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: HRS, 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	Four race dummies of white, black, hispanic and other racial	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	Federal Housing Finance
Local tax burden rate	State specific local tax burden rate.	Tax Foundation
Unemployment rate	MSA specific unemployment rate aggregated from counties.	Bureau of Labor Statistics

Table 1.4: Summary Statistics of Observations in the Analysis.

	Total					Homeowners		Renters	
	obs	Mean	Std.	Min	Max	Mean	Std.	Mean	Std.
Labor-related:									
Labor force participation	127,336	0.4056	0.4910	0	1	0.4297	0.4950	0.3007	0.4586
Labor force participation (boom)	68,653	0.3860	0.4868	0	1	0.4121	0.4922	0.2751	0.4466
Labor force participation (bust)	20,063	0.3446	0.4752	0	1	0.3693	0.4826	0.2400	0.4272
Working status	127,336	0.6765	0.8722	0	2	0.7144	0.8795	0.5114	0.8192
Working status (boom)	68,653	0.6343	0.8537	0	2	0.6759	0.8641	0.4581	0.7836
Working status (bust)	20,063	0.5487	0.8099	0	2	0.5855	0.8217	0.3928	0.7376
Annual hours worked	50,065	1,826.75	821.1762	0	8,736	1,816.451	823.4542	1,891.659	803.6989
Annual hours worked (boom)	25,554	1,797.097	841.7751	0	8736	1,787.397	842.891	1,859.576	831.9664
Annual hours worked (bust)	6,657	1,678.674	837.978	0	6240	1,663.996	834.5813	1,775.23	854.1558
Wealth-related:									
Homeownership	127,336	0.8135	0.3895	0	1				
Home assets	127,336	136,365	155,324	0	4,000,000	167,619.2	156,256.9	0	0
Housing wealth	127,336	110,537.8	132,882.5	1	1,000,000	135,872.2	135,139.3	0	0
△log(Housing wealth)	102,158	-1.1719	2.8941	-13.8155	13.7102	0.2992	2.1349	-2.2189	4.4512
Property tax	127,336	1383.654	1761.879	0	55,000	1700.78	1810.063	0	0
△log(property tax)	93,833	-0.0524	1.7494	-9.7981	10.2400	0.1734	1.4507	-1	2.4415
Financial assets	127,336	104,523.8	212,879.9	0	2,660,000	115,768.9	221,919.1	55,460.35	158,783.3
△log(Financial assets)	95,122	0.0676	1.7358	-12.2086	11.8133	0.0847	1.6635	-0.0153	2.0487
Demographics:									
Age (in years)	127,336	66.68	10.8	44	107	65.827	10.15	70.38	12.60
Health (in a 5-point scale)	127,336	3.2646	1.1191	1	5	3.3491	1.0909	2.8962	1.1650
Female	127,336	0.5703	0.4950	0	1	0.5523	0.4973	0.6489	0.4773
Number of children	127,336	3.0995	2.0532	0	22	3.1075	1.9826	3.0647	2.3363
Married	127,336	0.7015	0.4576	0	1	0.7750	0.4176	0.3805	0.4855
Race dummies									
White	127,336	0.8288	0.3767	0	1	0.8533	0.3538	0.7217	0.4482
Black	127,336	0.0964	0.2951	0	1	0.0811	0.2730	0.1630	0.3694
Hispanic	127,336	0.0555	0.2289	0	1	0.0485	0.2148	0.0860	0.2803
Other race	127,336	0.0194	0.1378	0	1	0.0171	0.1296	0.0293	0.1686
Education (in years)	127,336	12.5852	2.9288	1	17	12.7792	2.8276	11.7383	3.1996
Education degree dummies									
No degree	127,336	0.2026	0.4019	0	1	0.1771	0.3818	0.3136	0.4640
High school	127,336	0.5949	0.4909	0	1	0.6039	0.4891	0.5557	0.4969
College & above	127,336	0.2015	0.4011	0	1	0.2179	0.4128	0.1301	0.3364
Other degree	127,336	0.0010	0.0318	0	1	0.0011	0.0302	0.0006	0.0251
Year	127,337	2000.928	5.5245	1992	2011	2000.86	5.5349	2001.227	5.4686
MSA level housing price index growth (in%)	121,226	3.8331	6.6041	-37.93797	33.0980	3.7997	6.5218	3.9762	6.9439
MSA level unemployment rate (in%)	127,003	5.8791	2.3697	1.4653	31.10975	5.8720	2.3756	5.9102	2.3437
State level local tax burden (in%)	127,020	9.6221	1.2026	4.8	12.78	9.5789	1.1747	9.8109	1.3008

Table 1.5: Difference-in-Difference Estimation of Housing Bust with Boom (1997-2006) and Bust (2007-2010).

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***
	(0.0033)	(0.0056)	(0.0112)
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)
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 and a set of age group dummies.

Table 1.6: 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)
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)
R^2	0.3466	0.3917	0.1663
N	121,358	121,358	47,008

*Significance at the 10% level. **Significance at the 5% level. ***Significance at the

Table 1.7: 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	-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)
R^2	0.0103	0.0089	0.0130
N	72,713	40,069	32,644

*Significance at the 10% level. **Significance at the 5% level. ***Significance at the 1%

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

Table 1.8: 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)
R^2	0.0173	0.0128	0.0234
N	72,713	40,069	32,644

*Significance at the 10% level. **Significance at the 5% level. ***Significance at the 1% level.

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

Table 1.9: Labor Force Participation: Heterogeneous Effects across Age Groups.

Variable	(1)	(2)	(3)	(4)	(5)
	younger than 55	age 55-61 (pre-retirement age)	age 62-65 (retirement age)	age 66-72 (post-retirement age)	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)
R^2	0.0070	0.0054	0.0059	0.0048	0.0013
N	6,492	18,861	11,368	15,517	12,425

*Significance at the 10% level. **Significance at the 5% level. ***Significance at the 1% level.

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

Table 1.10: 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)
R^2	0.0085	0.0063	0.0126	0.0187
N	26,381	13,306	13,075	12,612

*Significance at the 10% level. **Significance at the 5% level. ***Significance at the 1% level.

Note: Housing wealth, property taxes, and financial assets are naturally logged. Covariates not shown in this table also include wave dummies and a set of age group dummies. Column (4) restrains the sample to the working couples, so spouse's age group dummies are also included.

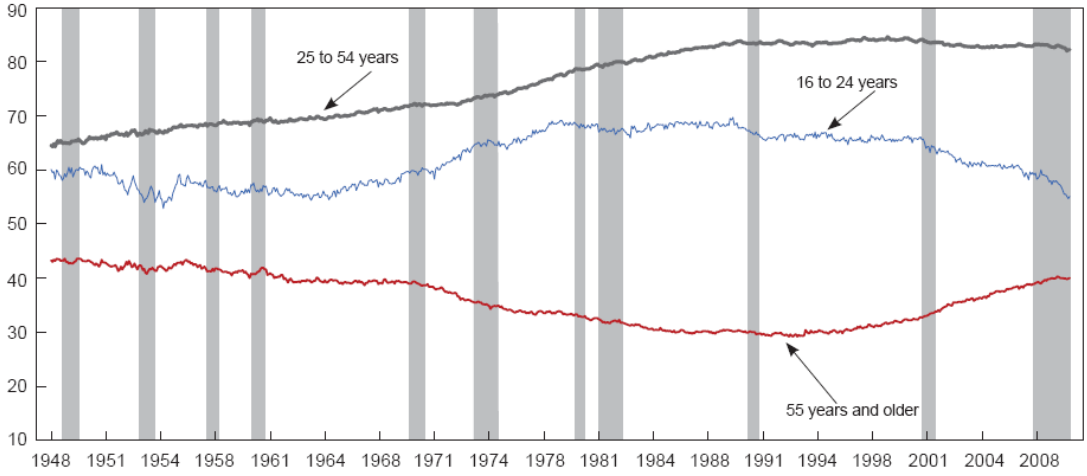
Table 1.11: Asymmetric Effects on Labor Force Exit and Reentry.

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	-0.00018	0.00222***	0.00031	0.00188**	-0.00058	0.00253***
	(0.00034)	(0.00052)	(0.00122)	(0.00088)	(0.00045)	(0.00066)
Property tax	0.00168***	-0.00250***	0.00105	-0.00226*	0.00208***	-0.00266***
	(0.00049)	(0.00077)	(0.00385)	(0.00122)	(0.00065)	(0.00098)
Financial wealth	-0.00066*	0.00113*	0.00045	0.00082	-0.00147***	0.00132*
	(0.00039)	(0.00060)	(0.00172)	(0.00099)	(0.00051)	(0.00077)

*Significance at the 10% level. **Significance at the 5% level. ***Significance at the 1% level.

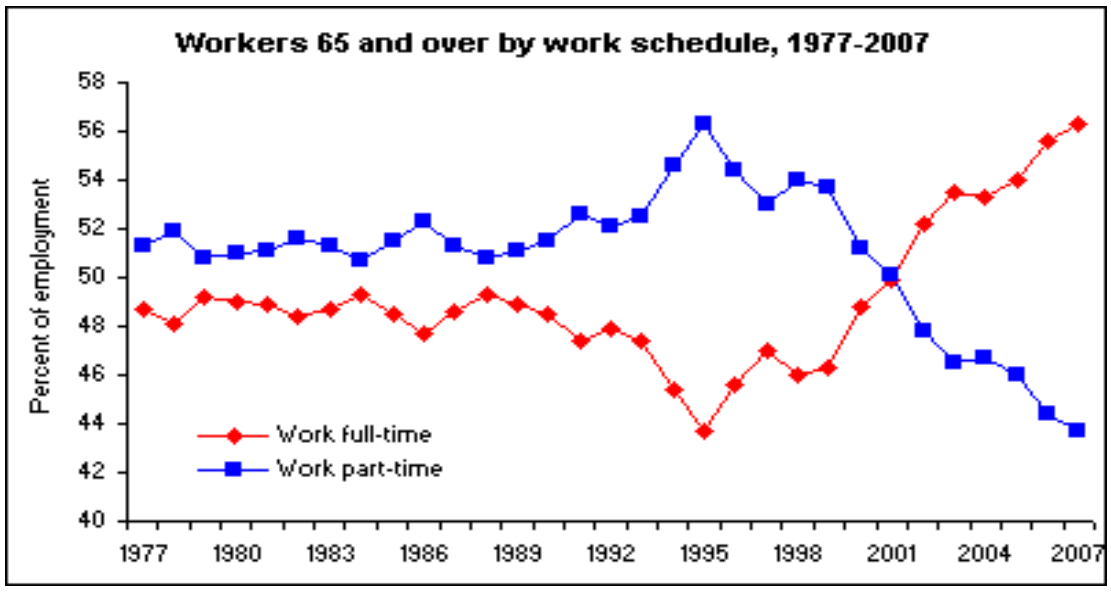
Note: Housing wealth, property taxes, and financial assets are naturally logged. Covariates not shown in this table also include wave dummies and age group dummies.

Figure 1.1: Labor Force Participation Rates for All Civilian Workers, by Age, Seasonally Adjusted, 1948-2010.



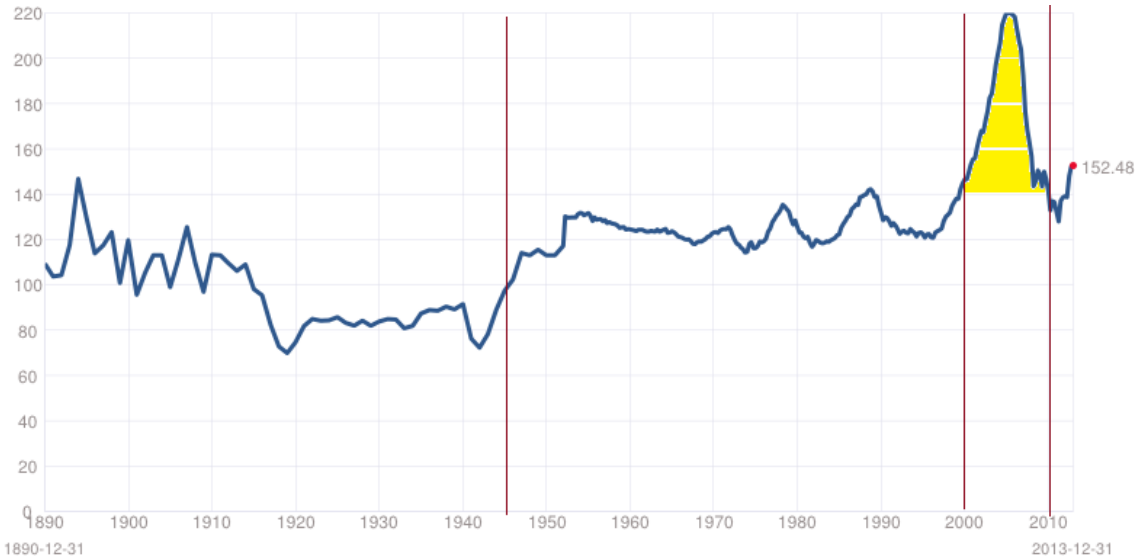
Source: Bureau of Labor Statistics, Current Population Survey, various years. Shaded areas represent recessions, as determined by the National Bureau of Economic Research (NBER).

Figure 1.2: Fraction of Elderly Workers in Full-time and Part-time Employment, 1977-2007.



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

Figure 1.3.1: 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 1.3.2: The Recent 20-year Home Values and Appreciation Rate in the U.S.,1990-2011.

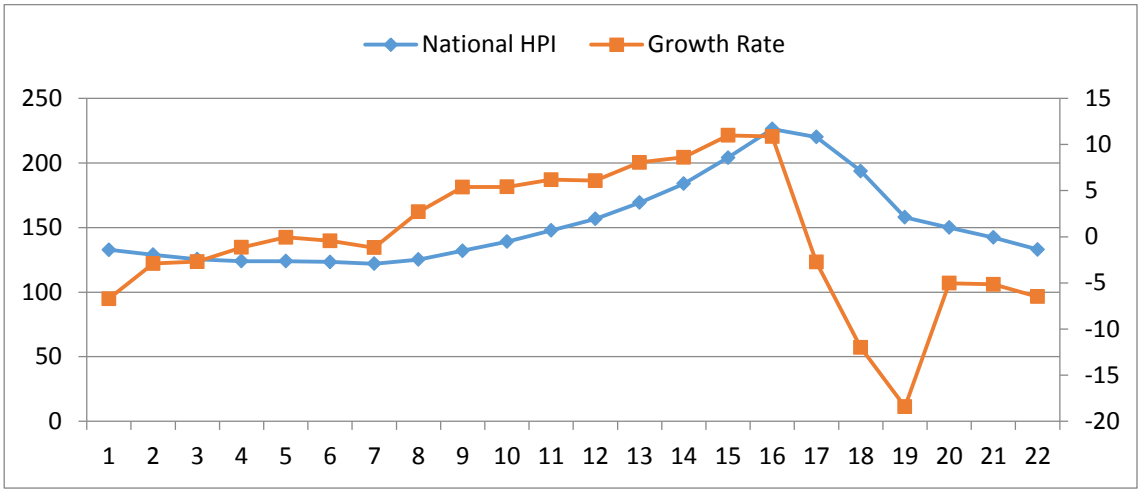


Figure 1.3.3: the recent 20-year HECM loans and the average property values.

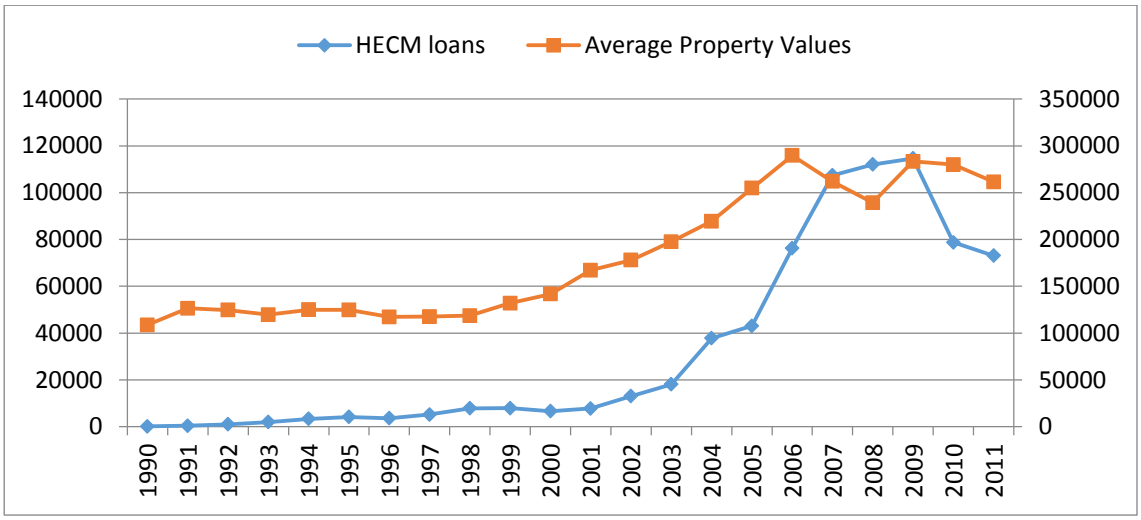


Figure 1.4: Percentage Breakdown, by cohort, HRS data sample, 1991-2010

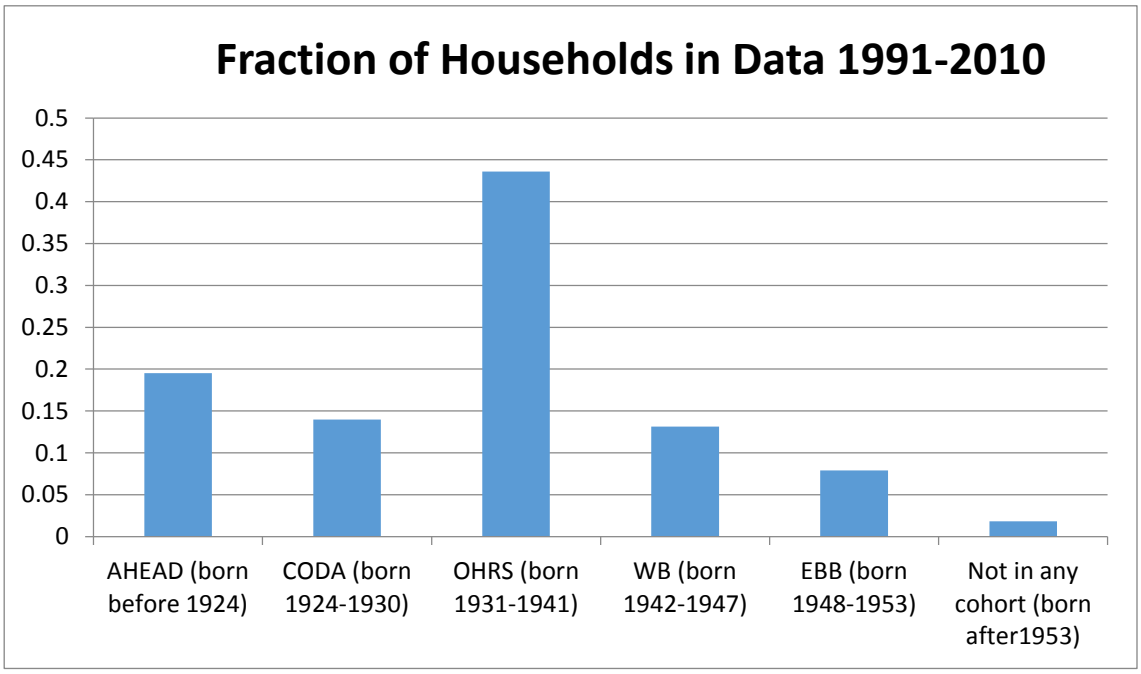


Figure 1.5: Labor Behaviors of Full-time, Part-time and Not Work by Age Group.

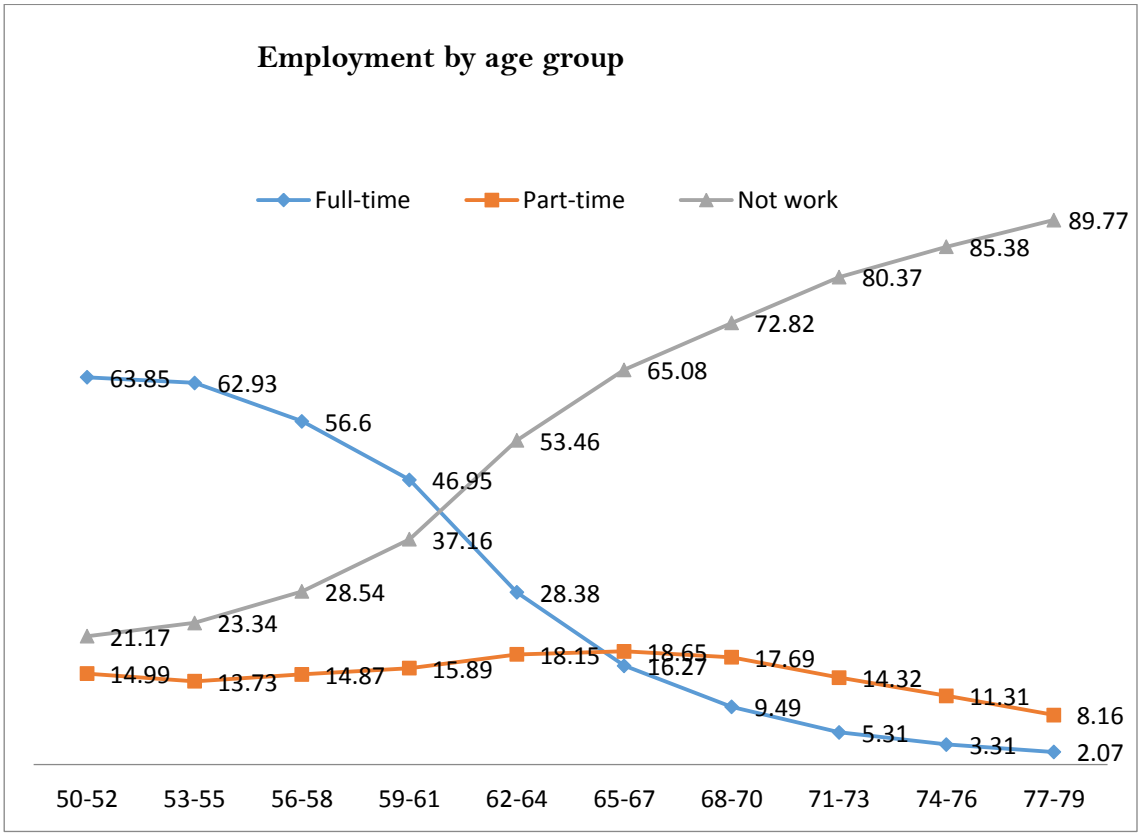


Figure 1.6.1: Assets Allocation of Elderly Households within Our Analysis 1991-2010.

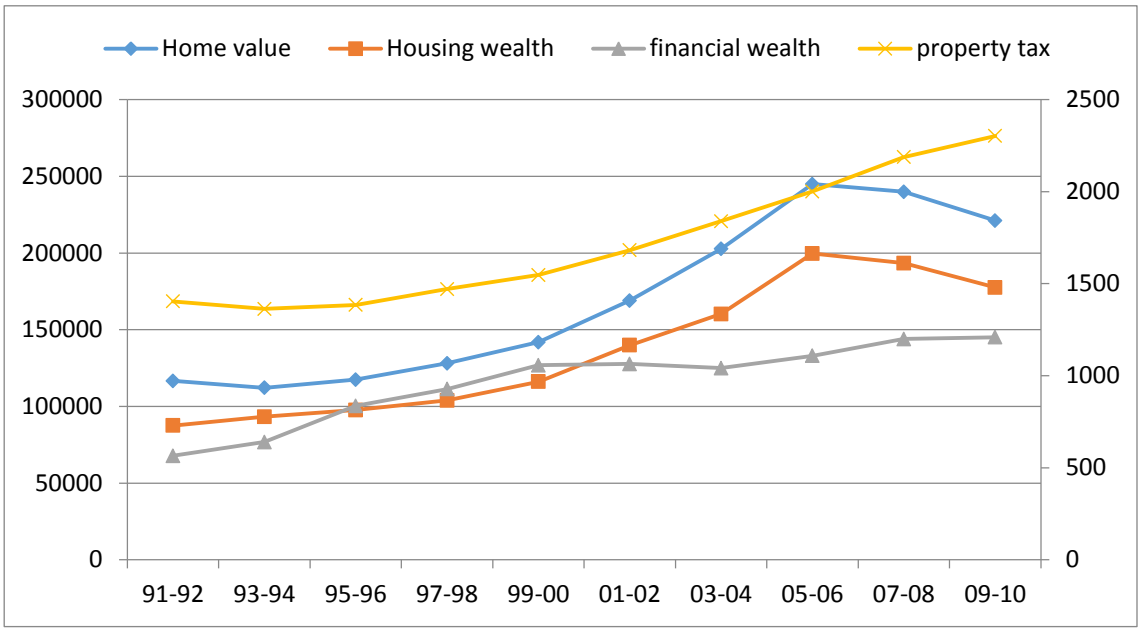
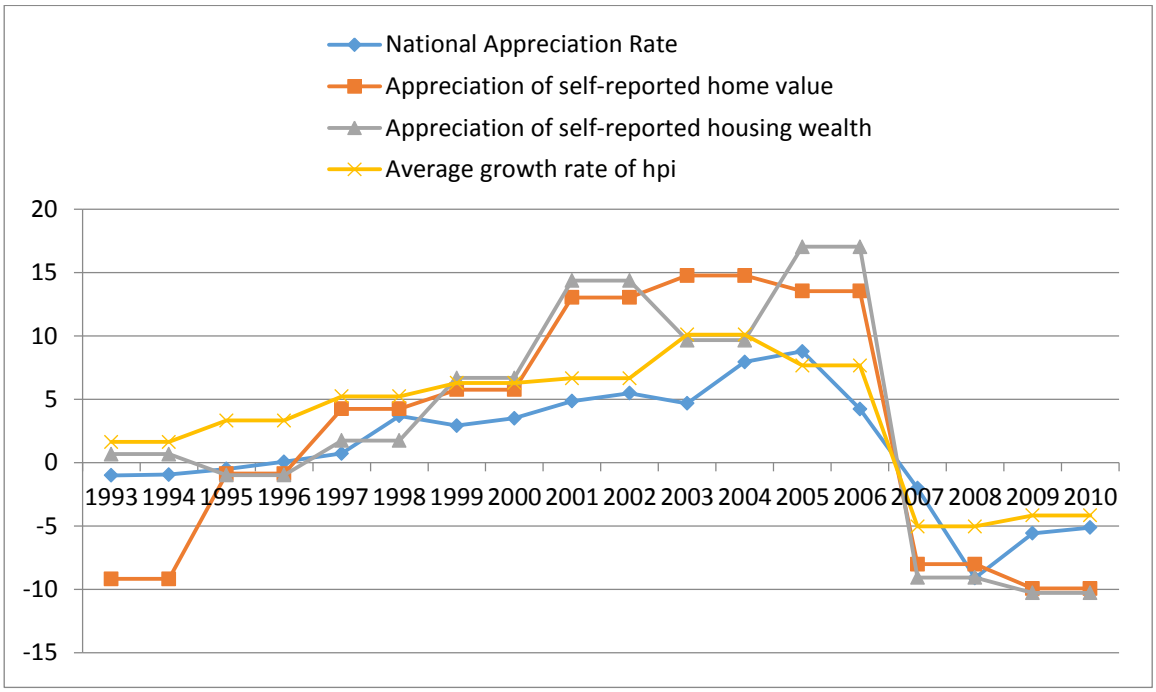


Figure 1.6.2: Real Growth Rate of Home Value and HPI Appreciation.



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 1.7.1 Interaction Effect of Housing Price Index Growth and Homeowner Status as a Function of the Predicted Probability of Labor Participation.

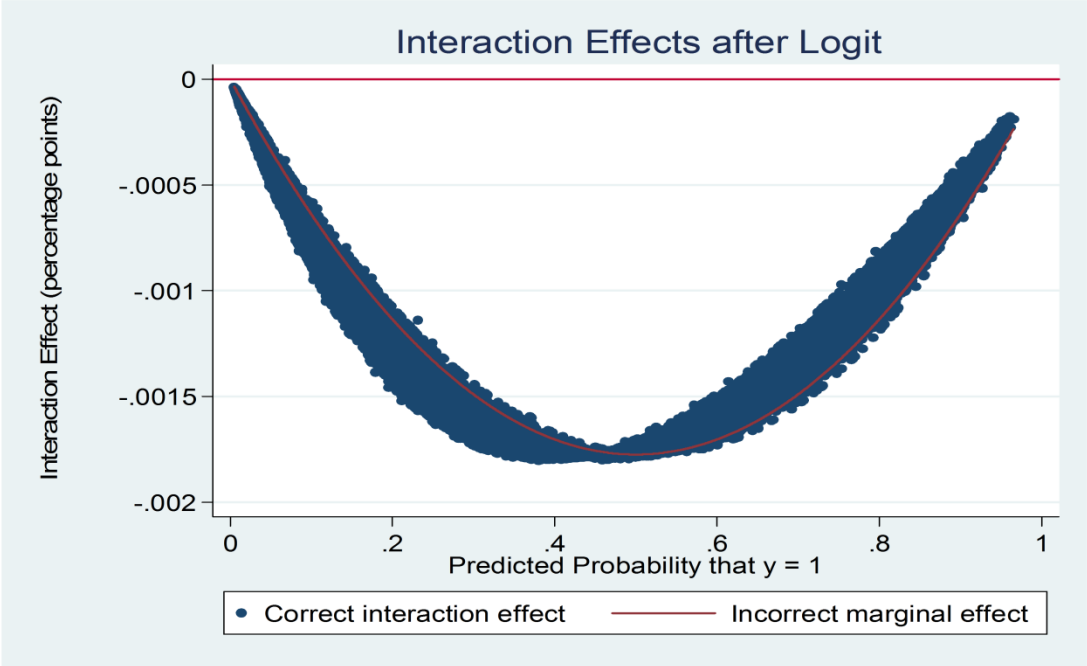


Figure 1.7.2: Z-statistics as a Function of the Predicted Probability of Labor Participation.

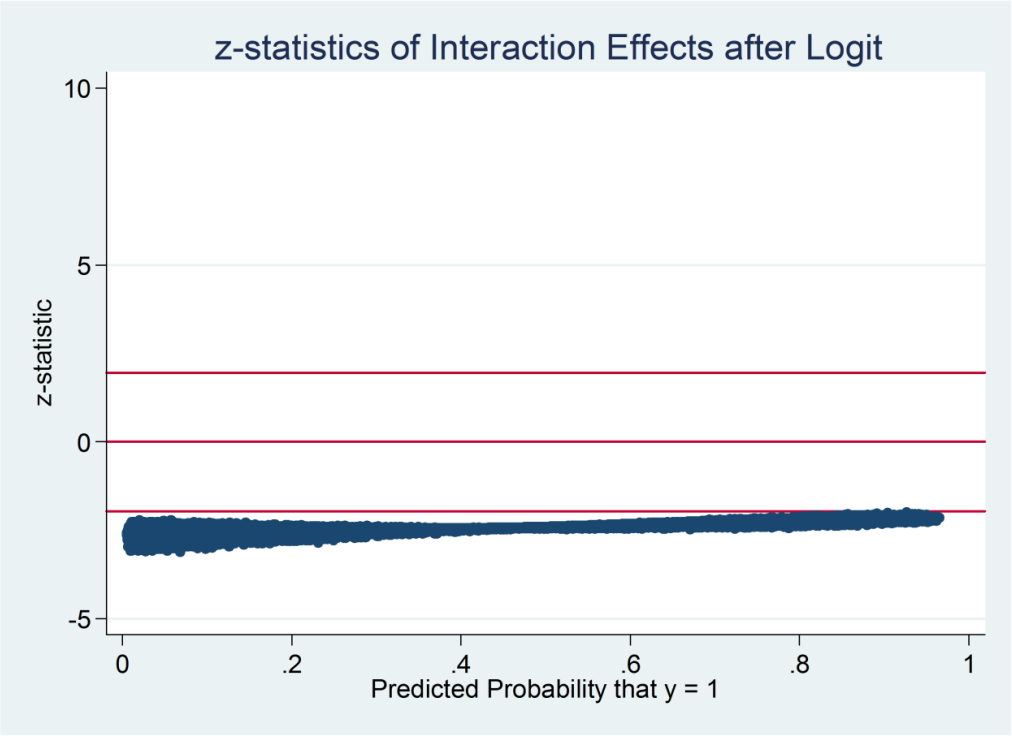
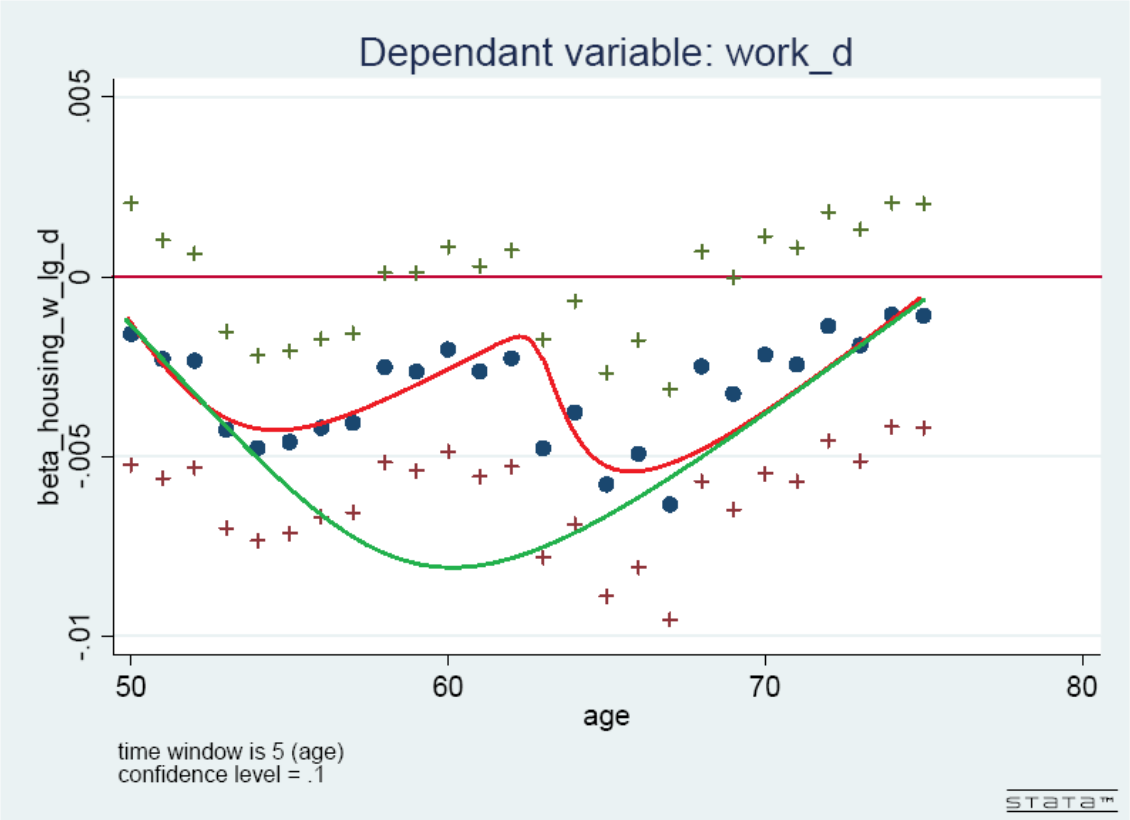


Figure 1.8: Heterogeneous Effect of Housing Wealth across Age Groups.



Chapter 2: Retirement and Unretirement during the Recent Housing Crisis

2.1 Introduction

Over the recent boom/bust cycle in the housing market, the unusual volatility of prices surprised many homeowners. Importantly, studies established that older households have relatively greater wealth accumulated in the housing sector, while simultaneously experience more limited current or perspective income (Lusardi & Michell, 2007). Hence, older workers have strong incentives to closely monitor fluctuating housing market conditions over this period of turbulence. The unanticipated and prolonged nature of the housing market bubble provides a valuable opportunity to investigate the effects of housing wealth on older households' behaviors. Zhao and Burge (2015) provide evidence supportive to the idea that housing wealth and property taxes both influence current elderly labor supply in the predicted opposing directions. They also find heterogeneous responses by gender and across age groups, and that these informative patterns relate to marital status and the traditional retirement age range (mid 60's). In this essay, I extend by evaluating the effects of housing wealth and property taxes on additional behaviors, including early retirement expectations, actual retirement timing, and potential post-retirement reentry (or unretirement).

If retirement planning is sensitive to gains/losses in housing wealth and property tax liabilities, it could have major implications for accurately evaluating the consequences of financial crises and understanding how to best apply government corrective fiscal policy. Despite its likely importance however, the role of housing wealth and property taxes on elderly labor supply has not received much attention in the

literature. Given the large aging population in the US (and abroad), and the fact that lower income elderly households have retirement portfolios that are highly skewed towards housing wealth, this is concerning. The existing work examining the influence of housing wealth on older workers' retirement behaviors focuses almost exclusively on retirement timing, finding mixed results (Sevak 2002; Farnham and Sevak 2007; Disney, Ratcliffe, and Smith 2010; Zhao 2011). Our study adds to the literature by exploring the dynamic aspects of retirement planning and subsequent retirement, as well as partial or complete reversal of the retirement at a later point in time. Importantly, we also employ restricted access Health and Retirement Study data that carries rich information and facilitates our estimation strategies, including hazard duration model, multinomial model and first difference model.

Most workers follow a traditional pattern of labor force participation by working full-time for several decades, and retiring in their mid 60's. However, in many other cases, traditional paths are not followed. In the extreme, older individuals may even reverse the initial retirement decision. Unretirement can be viewed as one stage of a gradual retirement process, possibly planned or caused by unanticipated poor wealth or income shocks. Prior research has found that early subjective expectations provide a strong prediction of eventual realizations of retirement behaviors (Bernheim 1989; Loughran et al. 2001; Disney and Tanner 1999). We take advantage of a unique subjective measure of expectations regarding retirement in the HRS to examine not only how housing wealth and property taxes influence retirement expectations, as well as unexpected deviations from these expectations in retirement behaviors.

Specifically, we seek to extend the literature considering retirement behaviors in four ways. To our knowledge we are the first study to examine the effect of the liquidity constraints associated with property taxes on the retirement decision. Recent work has found evidence that property tax burdens during the recent housing boom affected elderly mobility (Shan, 2010) and labor force participation (Zhao and Burge, 2015). No previous research however, has addressed whether or not this liquidity constraint influences the timing of full retirement, one of the most important decisions among older households.

Second, most studies that investigate the effect of housing wealth on retirement decisions rely solely on quasi-experimental variation across regions and over time. While we also use variation of this nature for identification, we additionally use self-reported home value estimates, adding another source of valuable information across individuals. By adding self-reported household measures, we can compare estimates investigating the determinants of retirement timing using alternative variables reflecting housing wealth.

Third, I explore early retirement expectations, actual retirement timing and potential post-retirement labor force reentry. Models of realized retirement decisions likely register the effect of housing wealth and property taxes on leisure. Our alternative model which focuses on early retirement expectations, allows us to examine how actual retirement outcomes deviate from previous expectations for individuals experiencing the boom/bust cycle of the housing market.

Finally, the post-retirement labor force reentry model extends beyond the traditional hazard models used in most studies by investigating whether volatility in the housing market influences elder households during their post-retirement years.

The following section of our paper documents historical housing price dynamics that highlight the potential for an impact on retirement planning that is economically important, and describes the survey data used in this. We outline our empirical approach, focusing on the hazard realized retirement in Section III. Section IV presents a multinomial approach to investigate other aspects of unretirement behaviors. Section V discusses expectations and realizations of employment after age 62. Finally, Section VI concludes and discusses future directions.

2.2 Data

We rely primarily on the restricted access RAND version of the Health and Retirement Study (HRS) data set in this paper. The data set focuses on individuals over age 50 and their spouses, allowing us to focus on several retirement-related transitions. Also, the HRS survey asks questions about retirement-related expectations, providing a subjective measure of retirement expectations. In addition, the data contains comprehensive information regarding socio-economic and demographic variables, health status, financial and housing wealth, income, benefits, social security, pensions, and employment history. The HRS is an ongoing biennial longitudinal survey covering ten waves from 1991 through 2010. We use RAND and the restricted version of all the ten waves in the paper, containing five cohorts including the original HRS cohort (born in 1924), the Assets and Health Dynamics cohort (born in 1924 or earlier), the Children of Depression cohort (born between 1924 and 1930), the War Baby cohort (born

between 1942 and 1947), and the Early Baby Boomer cohort (born between 1948 and 1953).

HRS asks several detailed employment questions that are consistent across waves. This allows us to construct rich dependent variables regarding the employment patterns of older workers. These include actual retirement, unretirement transitions (i.e. reentering the workforce after the first retirement decision.) actual working status, and early expectations of being employed after age 62.

We define retirement based on self-reported retirement status, including those who are completely retired and partly retired. Figure 2.1 plots the proportions of homeowners undergoing retirement transitions during the ages of 50s and 60s, revealing similar trends across genders. [Insert Figure 2.1 about here] The key tendencies in the data, most notably the spikes on retirement at 62/63, are quite similar for females and males. There is a monotonically increasing trend before the spikes other than the age 65/66 bump decline after the spikes.

Although direct movement from working to eventual retirement is more probable, we see significant proportions either turned partly retired or reversing retirement. In this paper we construct several variables to reflect various elderly postretirement paths and define unretirement transactions based on these categories. Table 2.1 lists postretirement paths, along with the number of observations and the percentage share. [Insert Table 2.1 about here] These transitions are identified on the basis of wave-to-wave changes in self-reported retirement status. We find that almost two thirds of our observations remain completely retired, while twelve percent remain partly retired. Observations following the modal retirement path, (such as from being not retired to

being partly retired / completely retired, and from being partly retired to being completely retired), account for another eleven percent. Unretirement path is defined as three specific transitions categorized in Table 2.1: completely retired to partly retired, completely retired to not retired, and partly retired to not retired. While somewhat unusual, unretirement transitions represent about 7.5 percent of our data.

In Figure 2.2.1, we use aggregate statistics of the data to demonstrate the relationship between actual retirement rate (around age 62) and expected retirement rates during different waves. [Insert Figure 2.2.1 about here] Two intuitive patterns emerge from Figure 2.2.1. First, actual retirement rates share similar trends with subjective expected retirement rates for most HRS waves, with the sole exception of the 2009-2010 wave. Second, the retirement rates expected from the first survey lag wave are closer to the realized retirement rates than those from the third survey lag. This is consistent with the reasonable assumption that the accuracy of expectations gets stronger as respondents approach their actual retirement. Figure 2.2.2 and 2.2.3 illustrate the trends for females and males respectively, displaying both similarities and differences across genders. Actual retirement rates correspond to subjective expectations for both women and men, except for the turbulent last wave 2009-2010. However, while the most recent expectations are strong predictors of actual retirement for females, they are surprisingly poor signals for males.

Housing wealth, financial wealth and property taxes are our major independent variables of interest. HRS asks questions about home ownership, self-assessed home value, mortgage liability, property tax liabilities, checking accounts, saving accounts, stocks, and other investments. Following Zhao and Burge (2015), we use the net value

of home equity to capture changes in accumulated housing wealth. Figure 3 displays the asset allocations of elderly homeowners in terms of these four variables. [Insert Figure 3 about here] A prolonged housing boom since the late 1990s and the striking bust starting in 2007 surface in the figure. Financial wealth and property taxes also appear to share a similar trend, consistent with the overall housing market fluctuations. However, there is a potential validity issue associated with using the self-reported housing wealth since that value only reflects perceived price variations as opposed to actual market conditions. We acknowledge this particular concern and extend our data by merging MSA-specific home value indexes with the household survey data.

Our two alternative measures each carry certain advantages and disadvantages over the other. The HPIs are exogenous to households' individual shocks, but they show limited variation in housing wealth. Thus, this fails to fully reflect changes in housing wealth due to absent indebtedness and heterogeneity at the neighborhood level. Self-reported measure is more direct in reflecting rich variation in housing wealth, but it has a common critique of present measurement error.

Table 2.2 lists all the variables relavant and data sources. [Insert Table 2.2 about here] Table 2.3 displays summary statistics for the 103,593 observations analyzed in our paper, along with subsample statistics for female homeowners and male homeowners. [Insert Table 2.3 about here] These observations are greater than those in later regressions either because of the estimation method (i.e. hazard model) or because certain models only focus on specific subgroups (i.e. respondents who reverse the retirement decision after the initial retirement or reported expectations associated with retirement).

The 103,593 examined observations remain after creating several intuitive filters. Among the observations eliminated are:

- Respondents who are younger than 44. The survey target must be 50 or older, but they may have a younger spouse. We drop observations younger than 44. This restriction reduced the sample by less than 1 percent.
- Extremely wealthy and extremely poor households, since we think they systematically display different behaviors in the labor market. We acknowledge our models may fail to characterize this group. We drop cases where households reported large negative values (i.e., less than -50,000 for housing wealth or for financial wealth, accounting for less than 1 percent of the sample) and where they reported large positive values (i.e., greater than 1,000,000 for housing wealth or 2,000,000 for financial wealth, accounting for less than 1 percent as well).
- Respondents that fail to report any of these financial assets as well as reporting omissions (i.e., the true values are not zero, but the respondent skipped the questions) or non-banking households (where households' true financial wealth cannot be fully reflected). This restriction causes 15% reduction of the sample.
- Observations with self-reported property taxes that are unrealistically high (i.e., over ten percent of home value).

2.3 Actual Retirement Decisions

Estimating a series of hazard models, we examine the effects of housing wealth, property taxes, and financial wealth on retirement transitions, controlling for various

demographic factors, education, local economic conditions and other important worker characteristics.

We model retirement decisions following a standard duration hazard specification. In our analysis, *survival* occurs if a respondent has not yet retired. The hazard model assumes the event of interest only occurs once, when the surveyed individual initially reports his/her status as retired. Since they have no pre-retirement measures, we exclude the individuals who were already retired at their initial appearance in the survey, accounting for about 17% of the sample.

During the housing boom, greater wealth accumulated through home equity should speed up the actual retirement decision, while the heavier burden of rising property taxes as a result of rising home equity should slow down retirement decisions through the current liquidity constraint.

We specify an individual's initial transition to retirement as a discrete time Cox proportional hazard model (Cox, 1972). Here the status of being retired includes both being partially retired and completely retired. We also explore using full retirement for later robustness checks. The retirement hazard function, $\theta(t|X_i)$, gives the probability that respondent *i* retires in period *t* conditional on not having already retired:

$$(1)\ \theta(t|X_i) = \frac{f(t|X_i)}{1 - F(t|X_i)}$$

We specify a proportional hazards model of retirement as

$$(2)\ \theta(t|X_i) = \theta_0 \exp\{X_i'\beta\}$$

in which age in years, *t* is the relevant duration. $\theta_0(t)$ is the baseline hazard function common to all individuals at time *t*, and is estimated non-parametrically. The baseline hazard function cancels out once a proportion is formed by separate hazards in the same time period. Hence, we have:

$$(3)\ \frac{\theta(t|X_i)}{\theta(t|X_j)} = \frac{e^{(X_i'\beta)}}{e^{(X_j'\beta)}} = e^{(X_i'-X_j')\beta} \qquad \text{where}$$

$$(4)\ \beta X = \beta_0 + \beta_1 \text{housing wealth}_{it} + \beta_2 \text{property taxes}_{it} + \beta_3 \text{financial wealth}_{it} +$$

$$\beta_4 \text{health}_{it} + \beta_5 \text{demographics}_{it} + \beta_6 \text{unemployment rate}_{mt} + \beta_7 \text{local tax burden}_{st} + \beta_8 \text{wave}_t + \varepsilon_{it}$$

The right hand side variables include logged values of self-reported housing wealth, property taxes, financial wealth, a health status indicator, the local unemployment rate, and local tax burden, demographic characteristics including gender, race, education, and marital status, and wave specific dummies. Note that the specification of the model allows for flexible age effects. We use a series of age group dummies, reflecting not only a pure age effect, but also capturing the effects of relevant retirement policies such as Social Security and Medicare. Again, we note that in the hazard model a positive (negative) coefficient implies that large and positive values of the factor lead to later (earlier) retirement.

One concern in estimating the hazard model with self-reported housing wealth is a potential endogeneity issue. This occurs since households endogenously choose both housing consumption and mortgage indebtedness. To mitigate this concern, we use aggregated MSA specific housing price change instead of personal wealth changes, to capture quasi-experimental variation in housing wealth. This approach has been used previously (e.g. Farnham and Sevak 2007; Lovenheim 2011, Lovenheim and Mumford

2013; Lovenheim and Reynolds 2013; Zhao and Burge 2015) and is useful in our data context covering nearly the entire housing boom-bust cycle. Thus, alternatively we have:

$$(5)\ \beta X = \beta_0 + \beta_1 hpi\_growth_{mt} + \beta_2 \text{property taxes}_{it} + \beta_3 \text{financial wealth}_{it} +$$

$$\beta_4 \text{health}_{it} + \beta_5 \text{demographics}_{it} + \beta_6 \text{unemployment rate}_{mt} + \beta_7 \text{local tax burden}_{st} + \beta_8 \text{wave}_t + \varepsilon_{it}$$

However, retirement is not a completely irreversible event like birth or death. Out of our analysis sample, about six percent of retirement lapses as some respondents reverse retirement following their retirement decisions. These occasions of unretirement transitions will be revisited in the next section.

Table 2.4 presents the results of our hazard model for elerly homeowners' retirement. [Insert Table 2.4 about here] We find evidence that individuals retire earlier if they experience significant gains in their home equity and financial assets. Conversely, the retirement decision is delayed if property taxes increase. The evidence remains robust across the two alternative measures of housing wealth. Also, consistent with prior studies of retirement, we find evidence that health is one of the strongest factors influencing retirement decision. Older homeowners retire earlier if their health detoriates. The results also suggest how local unemployment and tax burden would affect older homeowners' retirement behaviors. Homeowners are predicted to experience earlier retirement with higher unemployment rates and higer local tax burdens.[12] Although demographics are not a main focus of our study, we do find that Black, Hispanic, and Asian workers all retire at older ages than Whites. More highly

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

educated respondents and married individuals also retire later, and having children has the same effect. Females retire earlier than males.

Since effect of the gender variable was significant and many of the studies in the literature focus on reactions to changes in wealth explore the role of gender, we consider the possibility that males and females in our data may adjust retirement subject to different underlying behavioral models. Therefore, we report estimated results for males and femaes seperately in columns 3 to 6. Overall, reactions across genders to wealth shocks retain the same direction, and the magnitudes of effects are similar for both genders. By measuring housing wealth with self-reported data, we find that the coefficient among females is only slightly bigger than that among males. When using housing price index alternatively, the significantly negative coefficient estimate remains for females, nearly doubling in size while the estimate turns insignificant for males. The effects of changes in property taxes are also significant and similar, again with females slightly more influenced. Changes in financial wealth are found to influence males with a bigger magnitude of effect.

We also use an alternative measure of retirement with a narrower definition that excludes partial retirement from being retirement status. The results remain qualatatively similar.

We also use a difference-in-difference approach as a robustness check to identify the effect of housing wealth by comparing retirement behaviors of otherwise similar homeowners (treatment group) and renters (control group) during the period with dramatic movement of home prices. This quasi-experimental analysis relies on our regional housing price index. Evidence is found to suggest significant housing wealth

effects in the expected direction. From Column (1) of Table 2.5, our interaction term of interest shows elderly homeowners residing in the areas experiencing housing value appreciation are more likely to retire than otherwise similar renters. The estimated effects of interaction term are found to be positive as well, but not significant when splitting the sample to females and males respectively.

2.4 Unretirement Transition

Here we focus on the non-traditional outcome of unretirement, investigating whether or not it is influenced by housing wealth and property taxes. Nearly six percent of retirees reversed their retirement decisions and went back to work. There are two possibilities when we try to explain the phenomenon of retirement. If the decision of being unretired is planned, that means the respondents perceived their future unretirement prior to their being retired. In this case, no factors during the postretirement period could contribute to an explanation of this untraditional retirement path. However, if the transition is not anticipated, that implies retirement reversal is driven by unexpected shocks to the various conditions affecting the household.

Modifying Maestas (2010) with some modifications relevant to our case, we use a multinomial logit specification to estimate unretirement. It is difficult for one to fully predict the evolution of his/her housing wealth, future property tax burdens and financial assets during our study period. The last two decades witnessed a volatile housing market and frequent macroeconomic fluctuations, causing a tremendous amount of uncertainty in terms of housing prices and housing wealth accumulation.

Also, it is unlikely that individuals accurately forecast all of the relevant changes in their health. As such, we assume unretirement transitions are primarily unanticipated,

and that postretirement information of respondents' changes in health, wealth, local economic conditions and individual characteristics may influence the likelihood of making this transition.

The multinomial logit model in our analysis describes as

$$(6)\ P(y_{i,r+t} = k \mid X_{i,r+t}) = \frac{\exp^{x_i'_{r+t},\beta_{k,r+t}}}{\sum_{j=1}^{k} \exp^{x_i'_{r+t},\beta_{k,r+t}}}$$

where *r* denotes the individual i's retirement date, and *r+t* denote the survey wave after retirement. The multinomial logit model over the choices after the initial retirement decision is defined by complete retirement, partial retirement and unretirement. Thus, *k* ranges from 1 to 3.

The benchmark specification is

$$(7)\ \beta X = \beta_0 + \beta_1 \text{housing wealth}_{it} + \beta_2 \text{property taxes}_{it} + \beta_3 \text{financial wealth}_{it} +$$

$$\beta_4 \text{health}_{it} + \beta_5 \text{demographics}_{it} + \beta_6 \text{unemployment rate}_{mt} + \beta_7 \text{local tax burden}_{st} + \beta_8 \text{wave}_t + \varepsilon_{it}$$

The benchmark regression results reported in Table 2.6 use HRS self-reported measures of housing wealth. [Insert Table 2.6 about here] The probabilities of choosing partial retirement or being not retired are stated relative to the baseline category of full retirement. If unretirement arises because of negative wealth shocks, higher levels of housing wealth and financial wealth should decrease the probability of unretirement. Columns (1) and (2) report the results for regressions including both genders. The estimated coefficients for housing wealth are -0.02481 and -0.05277 respectively for partial retirement and unretirement, suggesting higher housing wealth is associated with greater likelihood of experiencing both partial retirement and unretirement, and the

negative effect appears stronger on unretirement than that on partial retirement. We also see the significant negative effect of financial assets, with coefficient estimates of -0.05491 and -0.09899 on partial retirement and unretirement, somewhat bigger than the coefficients on housing wealth. Touching briefly on the other explanatory variables in our multinomial models, we find evidence that:

- Better health status is a strong factor that increases the likelihood of reversing their previous retirement.
- Elderly workers facing higher local tax burdens are more likely to turn unretired.
- Facing worsening local employment conditions, elderly individuals are more likely to reverse their initial retirement decision.
- Aging brings decreasingly likelihoods of transiting from retired to unretired.
- Married individuals are less likely to transit to unretired, while having children make retirement reversal more likely.
- Black workers are more likely to transit from full retirement to partial retirement or being unretired than white workers. Hispanic status only increases the likelihood of being partly retired.
- More highly educated individuals are more likely to turn partially retired, but education is not found to influence the transition of being not retired.

Columns 3 through 6 report the results from multinomial models run separately for males and females. Careful examination of the coefficient estimates reveals qualitatively similar effects for most cases. The slightly bigger magnitudes for some coefficient estimates in the last two columns suggest male workers may be more responsive to property taxes, aging and health status.

2.5 Expectations and Realizations of Postponing Retirement at Age 62

From the analysis discussed in the previous section, it is difficult to identify whether adjustments regarding retirement status is anticipated or unanticipated by respondents. In the following analysis, we take advantage of the unique subjective measure of expectations regarding retirement in the HRS to investigate two mainquestions regarding expectations. First, we explore how housing wealth shocks impact expectations of postponing retirement beyond the modal retirement age. Second, we consider the relationship between expectations and realizations regarding retirement.

2.5.1 Longitudinal Analysis of Retirement Expectations

The underlying nature of the cross-sectional variation in housing wealth may well present an endogeneity issue. Specifically, elderly households may initially decide among their housing related options that form plans of supplying specific amounts of future labor. This leads a situation where cross-sectional correlation between the two suffers from reverse causality bias. We use first differenced measures to mitigate potential bias associated with this concern. Thus, expectations regarding retirement decisions are modeled as:

$$(9)\ expectation_{it} = \beta_0 + \beta_1 \Delta \text{housing wealth}_{it} + \beta_2 \Delta \text{property taxes}_{it} + \beta_3 \Delta \text{financial wealth}_{it} + \beta_4 \Delta \text{health}_{it} + \beta_5 \Delta \text{age}_{it} + \beta_6 \Delta \text{unemployment rate}_{mt} + \beta_7 \Delta \text{local tax burden}_{st} + \beta_8 \text{wave}_t + \varepsilon_{it}$$

The dependent variable $expectation_{it}$ indicates updating self-reported probability of working full-time after age 62, and all the explanatory variables are all first differenced.

Table 2.8.1 reports the results of the above first difference model and the original OLS results with two alternative measures of housing wealth. [Insert Table 2.8.1 about here] The coeffcient estimates in both models provide evidence that financial wealth,

health, and age are the only major factors explaining elderly homeowners' updating expectations of postponing retirement beyond the age of 62. Table 2.8.2 displays the first difference model results across gender groups. Although none of the relationships show statistically significant differences (i.e., as tested through insignificant gender interactions), there is some weak evidence suggesting female retirement expectations may be influenced by changes in financial wealth more intensively than males.

2.5.2 Expectations regarding Retirement and Realizations

Perhaps the most interesting aspect of the HRS data in terms of our application is that we can precisely identify households whose retirement expectations and actual realizations differ. The interesting research question is what factors are correlated with these differences. Specifically, we estimate a model explaining retirement status after age 62 that includes the individuals' previous expectation over this outcome, along with all our other variables. Hence, we have:

$$(10)\ \text{work\_62}_i = \beta_0 + \beta_1 \text{ex\_work}_i + \beta_2 X_i + \varepsilon_i$$

Unsurprisingly, a comparison of estimation results that use expectations at different waves reveals the superiority of selecting the most recent expectations. Table 8 presents the results of estimating equation (10) with these alternative expectations of respondents at different points in time. [Insert Table 2.9 about here] Panels A, B, and C report the results using retirement expectations from one wave ago, two waves ago, and three waves ago respectively. As anticipated, the pattern emerging from the results supports the idea that the accuracy of the anticipations is stronger when expectations are made at waves closer to the actual behavior.

Table 2.10 displays the estimation results associated with actual employment around age 62. [Insert Table 2.10 about here] Three panels of results for both genders, females and males are reported. The first column in each panel excludes the variable of the most recent expectations regarding employment status after age 62. From the first column of panel (1), we find that older households' employment decisions around 62 are impacted by all the wealth shocks, including housing wealth, property taxes and financial wealth. In response to a doubling of housing wealth, participation for older respondents drops by 1.3 percentage points. The coefficients on the property taxes and financial wealth are also significant and positive as we expected. The second column includes the variable of respondents' most recent expectation. The coefficient for financial wealth turns insignificant with an almost zero magnitude while housing wealth and property taxes stay robust. The pattern is consistent with the findings from Section IV: only financial wealth out of three interest variables impacts expectations. Here we find financial wealth influences employment near the retirement age through the mechanism of individual anticipations, while housing wealth and property taxes mainly impact unexpected decisions regarding employment choices at the modal retirement age. One of the possible explanations could be that older households do not fully take housing wealth into account until it is urgent to make the employment decision (or postpone the retirement). The failure to find evidence for housing wealth effect upon expectations could be due to the data limitation: we can only explore wave-to-wave changes. Also, we find females more commonly work beyond retirement date than males. Panels (2) and (3) display results for females and males respectively. The pattern of effects remains similar for females, while no evidence of a wealth effect is found for

males when controlling for the most recent expectations. Overall, all these results indicate that the expectations variable is a meaningful predictor of the subsequent decision of continuing to work after age 62, and housing wealth and property taxes only impact unexpected employment outcome around 62 in the context of our data.

2.6 Conclusion

Recent decades witnessed unprecedented volatility in the housing market. As such, older households experienced dramatic fluctuations in their accumulated wealth in home equity. In this paper, we use restricted version HRS data spanning this time period to explore how housing wealth and property tax liabilities influence employment paths near the modal retirement age. The retirement-related behaviors we examine include actual decisions of both retirement and unretirement, as well as expectations of employment near the retirement age. In addition, two alternative measures of housing wealth - self-reported values and housing price indexes are used, since each carries certain advantages and disadvantages over one another.

The empirical results are both intuitive and robust. We find that housing wealth and property taxes play an important role in explaining the employment patterns of older population in the final stages of their working lives, supportive to older homeowners' strategic response to losses and gains in housing wealth, property taxes and financial wealth during the boom/bust cycle. Overall, we find that elderly workers retire earlier when experiencing positive shocks in housing wealth and financial wealth, whereas they postpone retirement due to increased property taxes. We also find unretirement is an alternative when older households experience wealth losses. Also, we find financial shocks, together with changes in health, helps explain longitudinal

variation in retirement expectations prior to the actual retirement, and serves as major mechanisms through which expectations affect retirement behaviors. Lastly, changes in retirement decisions are driven by housing wealth shocks and property taxes, but not financial wealth.

We follow traditional approaches by defining retirement status according to respondents' self-classification of "retired", "partly retired", or "not retired". Future work should strive to examine more objective measures of retirement status. The objective definition could supplement these subjective measures with working hour requirements for three categories of retirement status. Comparisons with the present results could then test whether or not there are disparities between the self-reported and objective retirement classification, and whether the major findings remain robust to the choice of definitions. In addition, prior studies (Ruhm 1990) show that partial retirement almost always involves a change of employment sector, and that women maintain attachment to their prior industry more often. These and many other interesting questions relating to labor supply among older workers remain to be answered.

Table 2.1: Postretirement Paths.

	Defined as unretirement	Obs.	Percent
1. Completely retired —> completely retired		21,775	64.41%
2. Completely retired —> partly retired	√	1,257	3.72%
3. Completely retired —> not retired	√	310	0.92%
4. Partly retired —> completely retired		2,237	6.62%
5. Partly retired —> partly retired		4,106	12.15%
6. Partly retired —> not retired	√	959	2.84%
7. Not retired —> completely retired		583	1.72%
8. Not retired —> partly retired		1,087	3.22%
9. Not retired —> not retired		1,493	4.42%
Total		33,807	

Table 2.2: Description of Variables.

Variable	Description	Data source
Retirement-related:		
Retired	Dummy equals one if the respondent is currently retired (either completely or partly).	RAND HRS
Postretirement type	Categorical variable that equals one if being completely retired, one if partly retired, and three if not retired.	RAND HRS
Unretired	Dummy equals one if the respondent does an unretirement transition, which include three possibilities: 1) completely retired to partly retired; 2) completely retired to not retired; 3) partly retired to not retired.	RAND HRS
Regarding the work status age 62		
Actual work status	Dummy equals one if the respondent is currently working at age 62.	RAND HRS
Updating expectations	Updating self-reported probability of working full-time after age 62.	RAND HRS
Expectations one wave ago	Probability of working full-time after age 62 reported one wave ago.	RAND HRS
Expectations two waves ago	Probability of working full-time after age 62 reported two waves ago.	RAND HRS
Expectations three waves ago	Probability of working full-time after age 62 reported three waves ago.	RAND HRS
Wealth-related:		
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: HRS, AHEAD, CODA, WB and EBB.	RAND HRS
Age	Age in years.	RAND HRS
Squared age	Squared value of age.	
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	Four race dummies of white, black, hispanic and other racial group.	RAND HRS
Education years	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
Housing price index	MSA specific housing price index	Federal Housing Finance Agency
Local tax burden rate	State specific local tax burden rate.	Tax Foundation
Unemployment rate	MSA specific unemployment rate aggregated from counties.	Bureau of Labor Statistics

Table 2.3: Summary Statistics of Observations in the Analysis.

	Homeowners			Female Homeowners			Male Homeowners		
	Obs.	Mean	Std.	Obs.	Mean	Std.	Obs.	Mean	Std.
Retirement-related:									
Retired	82,356	0.5867	0.4924	43,254	0.5506	0.4974	39,102	0.6267	0.4837
Postretirement type	48,951	1.3630	0.6283	24,412	1.3717	0.6535	24,539	1.3524	0.6021
Unretired	33,807	0.0748	0.2629	16,280	0.0746	0.2628	17,527	0.0748	0.2631
Regarding the work status at age 62									
Actual work status	6,704	0.3371	0.4728	3,632	0.3283	0.4697	3,073	0.3475	0.4763
Retirement expectations (in%)	30,715	46.08	38.82	17,473	41.63	37.99	13,242	51.96	39.13
Expectations one wave ago (in%)	26,997	45.62	38.80	15,378	41.43	37.95	11,619	51.16	39.22
Expectations two waves ago (in%)	22,859	45.09	38.76	12,976	40.76	37.86	9,883	50.78	39.20
Expectations three waves ago (in%)	18,945	45.62	38.96	10,694	41.36	38.03	8,251	51.14	39.45
Wealth-related:									
Home assets	103,593	167,619	156,257	57,216	163,918	154,152	46,377	172,185.7	158,699
Housing wealth	103,593	135,872	135,139	57,216	133,799	133,830	46,377	138,114.8	137,045
△log(Housing wealth)	83,045	0.2992	2.1349	46,100	0.3057	2.1411	36,945	0.2911	2.1271
Property tax	103.593	1,700.78	1,810.06	57,216	1,659.99	188.15	46,377	1,751.102	1,820.98
△log(property tax)	75,781	0.1734	1.4507	41.869	0.1753	1.4584	33,912	0.1709	1.4411
Financial assets	103,593	115,769	221,919	57,216	111,308.9	216,990	46,377	121,271.4	227,735
△log(Financial assets)	78,863	0.0847	1.6635	43,663	0.0808	1.6966	35,200	0.0897	1.6216
Demographics:									
Age (in years)	103,593	65.827	10.15	57,216	65.29	10.51	46,377	66.49	9.66
Health (in a 5-point scale)	103,593	3.3491	1.0909	57,216	3.3775	1.0821	46,377	3.3139	1.1008
Female	103,593	0.5523	0.4973						
Number of children	103,593	3.1075	1.9826	57,216	3.0829	1.9780	46,377	3.1378	1.9877
Married	103,593	0.7750	0.4176	57,216	0.6940	0.4608	46,377	0.8750	0.3307
Race dummies									
White	103,593	0.8533	0.3538	57,216	0.8475	0.3595	46,377	0.8606	0.3464
Black	103,593	0.0811	0.2730	57,216	0.0863	0.2807	46,377	0.0747	0.2629
Hispanic	103,593	0.0485	0.2148	57,216	0.0493	0.2164	46,377	0.0475	0.2127
Other race	103,593	0.0171	0.1296	57,216	0.0170	0.1292	46,377	0.0172	0.1300
Education (in years)	103,315	12.7792	2.8276	57,100	12.7161	2.6185	46,215	12.8572	3.0646
Education degree dummies									
No degree	103,593	0.1771	0.3818	57,216	0.1666	0.3726	46,377	0.1901	0.3924
High school	103,593	0.6039	0.4891	57,216	0.6500	0.4770	46,377	0.5471	0.4978
College & above	103,593	0.2179	0.4128	57,216	0.1829	0.3866	46,377	0.2609	0.4392
Other degree	103,593	0.0011	0.0302	57,216	0.0005	0.0229	46,377	0.0018	0.0425
Year	103,593	2000.86	5.5349	57,216	2000.9	5.5217	46,377	2000.76	5.5496
MSA level housing price index growth (in%)	98,267	3.7997	6.5218	54,308	3.7910	6.5659	43,959	3.8104	6.4670
MSA level unemployment rate (in%)	103,342	5.8720	2.3756	57,082	5.8693	2.3733	46,260	5.8753	2.3784
State level local tax burden (in%)	103,354	9.5789	1.1747	57,089	9.5737	1.1714	46,265	9.5853	1.1787

Table 2.4: Hazard Model of Retirement.

Variable	(1) Homeowners		(2) The female homeowners		(3) The male homeowners	
Housing wealth	-0.03288***		-0.03383***		-0.03009***	
	(0.0043)		(0.0060)		(0.0063)	
Hpi_growth		-0.00218*		-0.00415***		0.00013
		(0.0012)		(0.0016)		(0.0017)
Property tax	0.03505***	0.02748***	0.03753***	0.03018***	0.02903***	0.02124***
	(0.0036)	(0.0035)	(0.0048)	(0.0046)	(0.0055)	(0.0053)
Financial wealth	-0.06026***	-0.06465***	-0.05459***	-0.05887***	-0.07187***	-0.07623***
	(0.0029)	(0.0028)	(0.0038)	(0.0038)	(0.0043)	(0.0042)
Health	0.12693***	0.12627***	0.12174***	0.12182***	0.13376***	0.13265***
	(0.0053)	(0.0054)	(0.0075)	(0.0075)	(0.0076)	(0.0077)
Unemployment rate	-0.01690***	-0.01725***	-0.01932***	-0.02085***	-0.01430***	-0.01312***
	(0.0033)	(0.0035)	(0.0046)	(0.0048)	(0.0049)	(0.0051)
Local tax burden	-0.01218**	-0.01587***	-0.02229***	-0.02516***	-0.00413	-0.00860
	(0.0051)	(0.0051)	(0.0070)	(0.0071)	(0.0073)	(0.0074)
N of children	0.02205***	0.02066***	0.02809***	0.02666***	0.01564***	0.01415***
	(0.0027)	(0.0028)	(0.0038)	(0.0038)	(0.0040)	(0.0040)
Married	0.60207***	0.59395***	0.67529***	0.66561***	0.42242***	0.41775***
	(0.0137)	(0.0138)	(0.0170)	(0.0171)	(0.0228)	(0.0228)
Female	-0.03109***	-0.03476***				
	(0.0118)	(0.0119)				
Hispanic	0.12021***	0.11277***	0.07972*	0.07130*	0.16912***	0.16280***
	(0.0296)	(0.0298)	(0.0414)	(0.0417)	(0.0424)	(0.0426)
Black	0.28158***	0.28721***	0.32573***	0.32802***	0.21122***	0.22025***
	(0.0213)	(0.0214)	(0.0281)	(0.0282)	(0.0328)	(0.0328)
Other race	0.19626***	0.19479***	0.36078***	0.35875***	0.03071	0.02967
	0.0471	0.0473	(0.0655)	(0.0659)	(0.0679)	(0.0681)
High school	0.44111***	0.43946***	0.41551***	0.41310***	0.48208***	0.48184***
	(0.0158)	(0.0159)	(0.0225)	(0.0227)	(0.0223)	(0.0224)
College	0.57570***	0.57112***	0.69187***	0.69200***	0.49825***	0.49101***
	0.0195	0.0196	(0.0282)	(0.0284)	(0.0271)	(0.0273)
Other degree	0.07320	0.07541	0.28129	0.29909	0.08025	0.08144
	(0.1697)	(0.1697)	(0.7085)	(0.7086)	(0.1752)	(0.1753)
N of obs	85060	80758	48968	46480	36092	34278

*Significance at the 10% level. **Significance at the 5% level. ***Significance at the 1% level.

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

Table 2.5: Difference-in-Difference Estimation of Housing Price Index Growth Effect.

Variable	Both Genders	Females	Males
	(1)	(2)	(3)
Hpi_growth	-0.00173***	-0.00177***	-0.00154**
	(0.0004)	(0.0006)	(0.0007)
Homeowner	0.06729***	0.04105***	0.10258***
	(0.0069)	(0.0092)	(0.0104)
Hpi_growth*homeowner	0.00097**	0.00086	0.00082
	(0.0004)	(0.0006)	(0.0007)
Property tax	-0.00926***	-0.00707***	-0.01171***
	(0.0009)	(0.0012)	(0.0013)
Financial wealth	-0.00821***	0.00907***	0.00619***
	(0.0006)	(0.0008)	(0.0009)
Health	-0.04671***	-0.04676***	-0.04609***
	(0.0012)	(0.0016)	(0.0017)
Unemployment rate	0.00206***	0.00228**	0.00131
	(0.0007)	(0.0010)	(0.0010)
Local tax burden	0.00023	-0.00362**	0.00476***
	(0.0011)	(0.0015)	(0.0016)
Female	0.00967***		
	(0.0025)		
Number of children	0.00056	0.00117	-0.00020
	(0.0006)	(0.0008)	(0.0009)
Married	0.03171***	0.04594***	-0.00319
	(0.0030)	(0.0039)	(0.0049)
Hispanic	-0.05555***	-0.06005***	-0.05054***
	(0.0056)	(0.0077)	(0.0082)
Black	0.00622	0.00315	0.00990
	(0.0041)	(0.0054)	(0.0064)
Otherrace	-0.04340***	-0.03996***	-0.04676***
	(0.0085)	(0.0116)	(0.0124)
High school	-0.00713**	-0.01900***	0.01063**
	(0.0035)	(0.0049)	(0.0050)
College	-0.03543***	-0.02141***	-0.04103***
	(0.0043)	(0.0062)	(0.0060)
Other degree	0.05122	0.14226*	0.01632
	(0.0423)	(0.0828)	(0.0488)
R^2	0.4338	0.4396	0.1663
N	95,656	51,776	47,008

*Significance at the 10% level. **Significance at the 5% level. ***Significance at the 1% level.

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

Table 2.6: Multinomial Model of Unretirement.

Variable	Homeowners		The female homeowners		The male homeowners	
	partly retired	not retired	partly retired	not retired	partly retired	not retired
Housing wealth	-0.02481***	-0.05277***	-0.02527*	-0.05075***	-0.02683**	-0.05488***
	(0.0091)	(0.0118)	(0.0134)	(0.0161)	(0.0124)	(0.0175)
Property tax	0.05690***	0.07246***	0.04907***	0.05411***	0.06468***	0.09551***
	(0.0086)	(0.0131)	(0.0124)	(0.0170)	(0.0120)	(0.0206)
Financial wealth	-0.05491***	-0.09899***	-0.06480***	-0.10002***	-0.04265***	-0.09551***
	(0.0063)	(0.0090)	(0.0090)	(0.0118)	(0.0087)	(0.0139)
Health	0.30931***	0.37742***	0.30824***	0.34426***	0.31490***	0.42264***
	(0.0120)	(0.0177)	(0.0180)	(0.0236)	(0.0162)	(0.0271)
Unemployment rate	-0.02123***	-0.01619	-0.03312***	-0.03108**	-0.0117	-0.00056
	(0.0072)	(0.0106)	(0.0110)	(0.0147)	(0.0093)	(0.0155)
Local tax burden	-0.06331***	-0.07366***	-0.00903	-0.01254	-0.10699***	-0.14547***
	(0.0111)	(0.0165)	(0.0164)	(0.0219)	(0.0151)	(0.0252)
Age	-0.06494***	-0.29675***	-0.05519*	-0.24079***	-0.06070**	-0.36756***
	(0.0210)	(0.0304)	(0.0302)	(0.0398)	(0.0307)	(0.0490)
Age^2	-0.00009	0.00123***	-0.00022	0.00079***	-0.00009	0.00176***
	(0.0001)	(0.0002)	(0.0002)	(0.0003)	(0.0002)	(0.0004)
N of children	0.02592***	0.03310***	0.03466***	0.02563**	-0.01561*	0.04059***
	(0.0061)	(0.0091)	(0.0089)	(0.0121)	(0.0084)	(0.0137)
Married	-0.06908**	-0.10801**	-0.16589***	-0.19183***	0.06558	0.02162
	(0.0316)	(0.0466)	(0.0414)	(0.0574)	(0.0513)	(0.0844)
Female	-0.35677***	0.08763**				
	(0.0252)	(0.0371)				
Hispanic	-0.21418***	0.02761	-0.09620	-0.02668	-0.30153***	0.11105
	(0.0688)	(0.0912)	(0.1023)	(0.1278)	(0.0931)	(0.1309)
Black	0.15916***	0.09350***	0.30185***	-0.02443	0.00820	0.26369***
	(0.0436)	(0.0625)	(0.0598)	(0.0843)	(0.0645)	(0.0940)
Other race	0.12554	0.35927***	0.2396*	0.35355**	0.01473	0.32687
	(0.0983)	(0.1304)	(0.1413)	(0.1735)	(0.1370)	(0.1992)
High school	0.12911***	-0.05692	0.22297***	-0.04955	0.04146	-0.05658
	(0.0364)	(0.0524)	(0.0561)	(0.0698)	(0.0483)	(0.0806)
College	0.31618***	0.10268	0.22436***	-0.04538	0.33443***	0.25962***
	(0.0432)	(0.0639)	(0.0687)	(0.0885)	(0.0562)	(0.0946)
Other degree	0.64356	1.53861***	1.0740	1.79017	0.59051	1.49360***
	(0.3921)	(0.4029)	(1.2340)	(1.1081)	(0.4207)	(0.0946)
N of obs	48857	48857	24366	24366	24491	24491

*Significance at the 10% level. **Significance at the 5% level. ***Significance at the 1% level.

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

Table 2.7: Estimating the Transition of Unretirement.

Variable	(1) Homeowners	(2) Female Homeowners	(3) Male Homeowners
Housing wealth	-0.00278**	-0.00369**	-0.00197
	(0.0011)	(0.0016)	(0.0016)
Property tax	0.00215**	0.00252*	0.00175
	(0.0009)	(0.0013)	(0.0013)
Financial wealth	-0.00432***	-0.00436***	-0.00416***
	(0.0007)	(0.0010)	(0.0011)
Health	0.01483***	0.01561***	0.01414***
	(0.0014)	(0.0020)	(0.0019)
Unemployment rate	-0.00047	-0.00094	-0.00002
	(0.0009)	(0.0013)	(0.0012)
Local tax burden	-0.00391***	-0.00318*	-0.00461**
	(0.0013)	(0.0018)	(0.0018)
Age	-0.0201***	-0.01937***	-0.02099***
	(0.0023)	(0.0032)	(0.0034)
Age^2	0.0001***	0.00011***	0.00012***
	(0.0000)	(0.0000)	(0.0000)
Female	-0.01005***		
	(0.0030)		
Married	-0.00639*	-0.01343***	0.00376
	(0.0036)	(0.0046)	(0.0058)
N of children	0.00210***	0.00283***	0.00139
	(0.0007)	(0.0010)	(0.0010)
Hispanic	0.00569	0.00545	0.00605
	(0.0079)	(0.0118)	(0.0107)
Black	0.01746***	0.01419**	0.02053***
	(0.0053)	(0.0072)	(0.0078)
Other race	0.01611	0.01008	0.02160
	(0.0119)	(0.0171)	(0.01667)
High school	-0.00243	0.00055	-0.00503
	(0.0041)	(0.0061)	(0.0056)
College	-0.00285	-0.00006	-0.00549
	(0.0050)	(0.0076)	(0.0067)
Other degree	0.04810	0.06864	0.0422
	(0.0501)	(0.1297)	(0.0546)
R^2	0.0268	0.0319	0.0234
N of obs	33759	16254	17505

*Significance at the 10% level. **Significance at the 5% level. ***Significance at the 1% level.

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

Table 2.8.1: Expectations of Postponing Retirement.

Variable	OLS		1st Diff	
Housing wealth	-0.80464***		0.04939	
	(0.1315)		(0.1318)	
hpi growth		-0.02136		-0.04012
		(0.0517)		(0.0599)
Property tax	0.95425***	0.68184***	-0.24873	-0.22619
	(0.1781)	(0.1782)	(0.2150)	(0.1853)
Financial wealth	-2.18506***	-2.31289***	-0.33011**	-0.34143**
	(0.1184)	(0.1203)	(0.1603)	(0.1629)
Health	3.5514***	3.41195***	0.89818***	0.97542***
	(0.2314)	(0.2413)	(0.3230)	(0.3306)
Unemployment rate	0.04910	0.05671	-0.47430	-0.47054
	(0.1170)	(0.1272)	(0.2999)	(0.3139)
Local tax burden	-0.93591***	-0.99407***	0.15606	0.00130
	(0.1998)	(0.2097)	(0.8807)	(0.8986)
Age	-7.92000***	-7.93318***	-3.38483*	-3.8164**
	(1.1400)	(1.1860)	(1.7383)	(1.7815)
Age^2	0.07971***	0.07959***	0.03328**	0.03729**
	(0.0204)	(0.0108)	(0.0157)	(0.01607)
Female	-10.3858***	-10.54614***		
	(0.4516)	(0.4695)		
Married	-8.18838***	-7.95792***		
	(0.6231)	(0.6426)		
N of children	0.24526**	0.27024**		
	(0.1242)	(0.1299)		
Hispanic	-0.91699	-0.96996		
	(0.9821)	(1.0118)		
Black	-7.35771***	-7.23218***		
	(0.7790)	(0.7985)		
Other race	1.96668	2.23689		
	(1.4787)	(1.5046)		
High school	2.86513***	2.65464***		
	(0.7775)	(0.8304)		
College	8.16386***	8.18244***		
	(0.8854)	(0.9362)		
Other degree	1.61111	1.80336		
	(8.4251)	(8.4397)		
R^2	0.0676	0.0659	0.0065	0.0069
N of obs	30657	28353	17614	16799

*Significance at the 10% level. **Significance at the 5% level. ***Significance at the 1% level.

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

Table 2.8.2: Expectations of Postponing Retirement (First Difference Model)

Variable	First Difference Homeowners	First Difference Female Homeowners	First Difference Male Homeowners
Housing wealth	0.04939	0.03244	0.08866
	(0.1318)	(0.1766)	(0.1980)
Property tax	-0.24873	-0.25840	-0.23275
	(0.2150)	(0.2861)	(0.3264)
Financial wealth	-0.33011**	-0.37432*	-0.26745
	(0.1603)	(0.2101)	(0.2481)
Health	0.89818***	0.80827*	0.98884**
	(0.3230)	(0.4381)	(0.4780)
Unemployment rate	-0.47430	-0.65758	-0.22002
	(0.2999)	(0.4033)	(0.4485)
Local tax burden	0.15606	0.11128	0.19529
	(0.8807)	(1.2118)	(1.2808)
Age	-3.38483*	-1.90106	-4.08527
	(1.7383)	(2.0916)	(3.6836)
Age^2	0.03328**	0.01973	0.04060
	(0.0157)	(0.0190)	(0.0326)
R^2	0.0065	0.0059	0.0093
N of obs	17614	10143	7471

*Significance at the 10% level. **Significance at the 5% level. ***Significance at the 1% level.

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

Table 2.9: Expectations of Postponing Retirement.

	(1) Homeowners	(3) Female Homeowners	(3) Male Homeowners
A. Using the most recent expectation.			
Coefficient on the Expectation	0.56925***	0.53124***	0.60496***
	(0.0164)	(0.0237)	(0.0228)
R-squared	0.2600	0.2475	0.2871
N	4226	2137	2089
B. Using 1 wave before the most recent expectation.			
Coefficient on the Expectation	0.49760***	0.47843***	0.50891***
	(0.0195)	(0.0280)	(0.0276)
R-squared	0.1869	0.1853	0.2005
N	3769	1937	1832
C. Using 2 waves before the most recent expectation.			
Coefficient on the Expectation	0.45839***	0.40747***	0.50124***
	(0.0214)	(0.0311)	(0.0296)
R-squared	0.1670	0.1447	0.2070
N	3278	1698	1580

*Significance at the 10% level. **Significance at the 5% level. ***Significance at the 1% level.

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

Table 2.10: Estimating Full-time Employment after Age 62 Using Expectations.

Variable	(1) Homeowners		(2) Female Homeowners		(3) Male Homeowners	
The most recent expectation		0.56924***		0.53125***		0.60496***
		(0.0164)		(0.0237)		(0.0228)
Housing wealth	-0.01314***	-0.00942**	-0.01951***	-0.01543**	-0.00814	-0.00415
	(0.0037)	(0.0071)	(0.0053)	(0.0063)	(0.0053)	(0.0058)
Property tax	0.02273***	0.01565***	0.02145***	0.02243***	0.02444***	0.00798
	(0.0040)	(0.0050)	(0.0054)	(0.0067)	(0.0061)	(0.0074)
Financial wealth	-0.01292***	-0.00041	-0.01446***	-0.00227	-0.00892*	0.00123
	(0.0030)	(0.0037)	(0.0040)	(0.0052)	(0.0046)	(0.0054)
Health	0.06640***	0.02572***	0.07428***	0.04312***	0.05861***	0.00826
	(0.0058)	(0.0071)	(0.0078)	(0.0102)	(0.0085)	(0.0099)
Unemployment rate	-0.00707**	-0.00534	-0.00642	-0.00536	-0.00766	-0.00569
	(0.0033)	(0.0040)	(0.0045)	(0.0059)	(0.0048)	(0.0054)
Local tax burden	-0.00173	0.00338	-0.00468	-0.00124	0.00111	0.00806
	0.0052	(0.0062)	(0.0070)	(0.0089)	(0.0078)	(0.0085)
Age	-3.93379***	-6.3871***	-2.26924	-5.8229***	-6.3023***	-6.68274***
	(1.1948)	(1.4108)	(1.6199)	(2.0001)	(1.7745)	(2.0008)
Age^2	0.03116***	0.05062***	0.01785	0.04602***	0.05011***	0.05307***
	(0.0096)	(0.0113)	(0.0130)	(0.0160)	(0.0142)	(0.01603)
Female	-0.02982***	0.07361***				
	(0.0116)	(0.0139)				
Married	-0.10835***	-0.02725	-0.14099***	-0.03950*	-0.03015	-0.01141
	(0.0154)	(0.0178)	(0.0185)	0.0223	(0.0284)	(0.0309)
N of children	-0.00065	-0.00540	-0.00420	-0.01123**	0.00182	-0.00030
	(0.0030)	(0.0036)	(0.0041)	0.0053	(0.0045)	(0.0050)
Hispanic	0.05588**	0.03136	0.02008	-0.02129	0.10518***	0.09608**
	(0.0269)	(0.0335)	(0.0360)	0.0473	(0.0407)	(0.0477)
Black	-0.00730	-0.00129	-0.02272	-0.02900	0.01918	0.04153
	(0.0206)	(0.0244)	(0.0275)	0.0336	(0.0312)	(0.0358)
Otherrace	0.03103	0.33111	-0.00299	-0.06529	0.07064	0.13656*
	(0.0441)	(0.2174)	(0.0590)	(0.0750)	(0.0666)	(0.0700)
High school	0.03263*	-0.04023*	0.01976	-0.09540***	0.04439*	0.00888
	(0.0172)	(0.0222)	(0.0234)	(0.0324)	(0.0255)	(0.0305)
College	0.10416***	-0.00939	0.03872	-0.11237***	0.15906***	0.08026**
	(0.0212)	(0.0259)	(0.0297)	(0.0383)	(0.0307)	(0.0353)
Otherdegree	-0.22381	-0.33111	-0.38973*	-0.42299***	-0.12590	-0.30196
	(0.1468)	(0.2174)	(0.2307)	(0.3126)	(0.1917)	(0.3043)
R^2	0.0547	0.2600	0.0624	0.2475	0.0585	0.2871
N of obs.	6695	4226	3623	2137	3072	2089

*Significance at the 10% level. **Significance at the 5% level. ***Significance at the 1% level.

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

Figure 2.1: Proportion of Retirement Transitions.

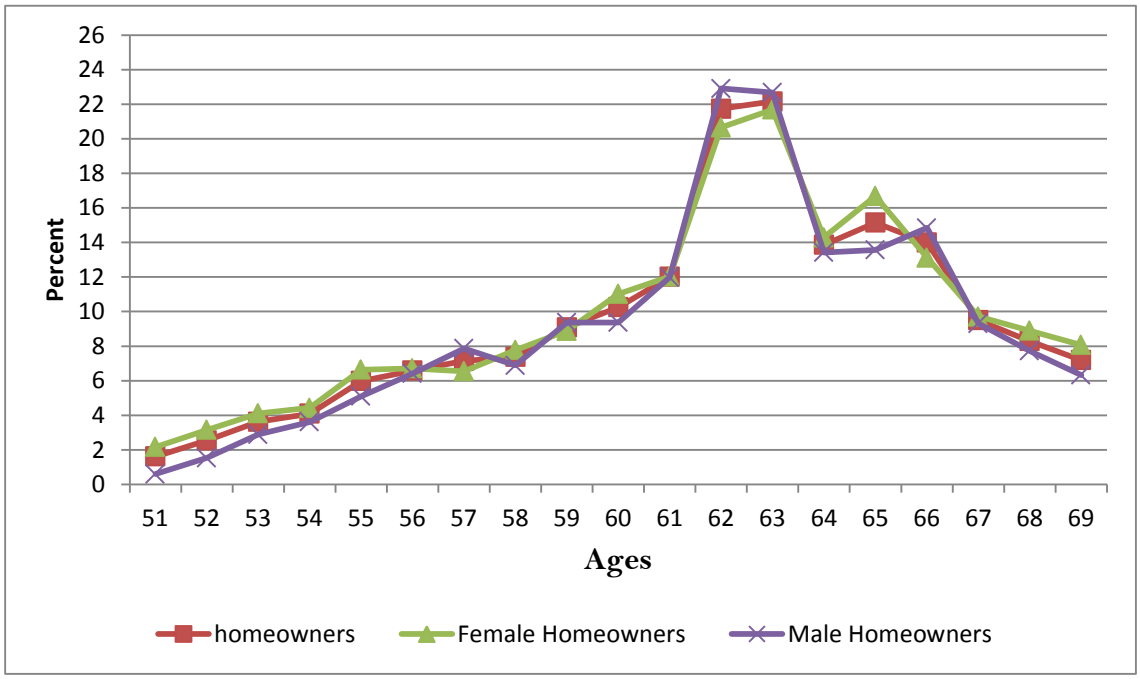
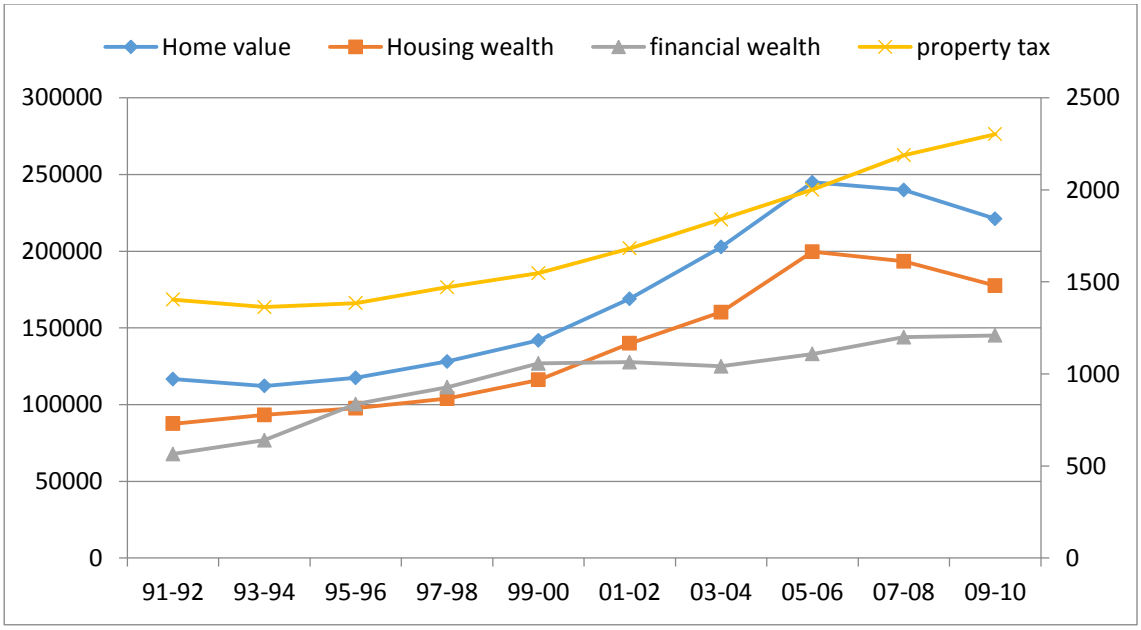


Figure 2.2.1: Actual vs. Expected Retirement Rates

Figure 2.2.2: Actual vs. Expected Retirement Rates (Females)

Figure 2.2.3: Actual vs. Expected Retirement Rates (Males)

Figure 2.3: Assets Allocation of Elderly Households within Our Analysis 1991-2010.



Chapter 3: Trends in Reverse Mortgages during the Recent Boom-Bust Housing Cycle

3.1 Introduction

In the United States, the federal reverse mortgage program allows elderly homeowners aged at 62 or older to withdraw some or all of the equity they have accumulated in their homes at younger ages. The purpose is to enhance current levels of consumption. By waiving their rights to future resources that pay out when the property is eventually sold, older homeowners are able to supplement their current consumption. Conceptually then, the decision operates much like an annuity, but is 'purchased' using wealth stored in the form of housing equity rather than cash.

The Home Equity Conversion Mortgage (HECM) is a specific type of reverse mortgage that is insured by the federal government. As such, homeowners have traditionally viewed it as a safe plan that can provide greater financial security. To be eligible for a HECM, the individual must be 62 or older. Also, they must own their home with no outstanding mortgage, or must be able to pay off the entire existing mortgage through the reverse mortgage they will qualify for. As such, the program is designed for, and actively markets itself towards, "house-rich, cash-poor" residents by helping them finance their retirement.

Although the Federal legislation enabling the current program was passed in the late 1980s, the HECM program was scarcely utilized among elderly homeowners until the early 2000s. At that time, the market for reverse mortgages began to grow substantially and has rapidly accelerated since. [Insert Figure 3.1 about here] This

makes it one of several major options based on home equity available to the retired including downsizing, migrating to low cost regions, home equity withdrawal, and simply leaving the homeownership.

Over the last two decades, the U.S. experienced a significant boom-bust cycle in the housing market. During this horizon there were several striking changes in the long run trends of the reverse mortgage landscape. First, there was an accelerated upward trend in originations of HECMs that coincided with the timing of large gains in house prices during the early to mid 2000s. Existing studies examine the demand side of reverse mortgages in the early years of the program that preceded this explosive growth. Case and Schnare (1994) evaluate the demand for reverse mortgages by considering the attributes of borrowers, their properties, and the types of payment options. Unsurprisingly, they find the strongest demand for reverse mortgages among "house-rich, cash-poor" elderly homeowners. More recent work by Shan (2011) explored the reasons why the reverse mortgage market experienced substantial growth in the early and mid-2000s, attributing much of the growth in demand to higher housing prices rather than changes in other demographic factors. Specifically, she estimates that about one-third of all reverse mortgage originations during 2003-2007 can be attributed to house price growth.

However, there is another notable phenomenon that, surprisingly, has not been examined by these studies or the other relatively few papers that have taken up the topic of reverse mortgages: namely, the idea that a predictable gap (e.g., lag structure) exists between the co-movement of housing wealth shocks and HECM originations. Recall from Figure 3.1 that the peak number of HECM originations is observed in 2009.

Paradoxically then, one would have to explain why this peak value occurred two full years *after* the beginning of the housing market bust (which is generally accepted to be sometime in the late 2006 to early 2007 time frame, depending on regional factors). During the years 2007 to 2009, the housing market experienced turbulence and declining prices, yet the number of HECM loans still grew steadily. One of the main contributions of this paper is that we stress the importance of the idea that the structural characteristics of the Federal HECM program and the *expectation* of future housing prices played a large role in explaining why HECM origination became more attractive to homeowners during this period (i.e., 2007-2009) than it was in the mid 2000s, even though housing prices were already past their peak values.

To further illustrate this point, Figure 3.2 displays the comparison of growth rates between reverse mortgages and housing prices in the U.S., generated from the data that we eventually use to conduct the present analyses. [Insert Figure 3.2 about here] Importantly, the figure motivates a discussion of the Federal HECM program and empirical investigation of the effects of housing prices on reverse mortgage originations in a manner that allows for potentially asymmetric and lagged effects.

There are several possibilities that could be driving the lag structure between housing prices and reverse mortgage originations. We argue that one potential factor is the institutional mechanism of the reverse mortgage instrument itself, and the extent to which the timing and dollar level of HECM appraisals may differ from those generated for homes being sold through traditional mortgages. Another concern has to do with the "buyer" of the home. In the private market during the initial portions of the housing crisis, the average length of time on the market for homes grew considerably, as sellers

believed their homes were worth more than buyers did (Genesove and Han, 2012). However, the HECM transaction does not follow this market based approach. Rather, the "buyer" of a HECM was the government, making an immediate purchase each time a qualified home owner applied. This motivates empirical analysis examining the potentially asymmetric effect of housing prices on the reverse mortgage market.

In addition, the gender and marital composition of HECM borrowers has been changing persistently since the early 2000s. Figure 3.3 presents the fractions of each type of borrowers by gender and marital status. [Insert Figure 3.3 about here] Prior to 2000 the composition of HECM users was quite stable, with single females playing a clearly dominant role. However, rapid gains in the number of originations from the other two categories, but most notably the massive increase in the frequency of married couples, led to a reversal of this dominance. By 2012 married couples took out nearly as many reverse mortgages as single females. Importantly, this striking narrowing of the gap was quite persistent even during and after the harshest portions of the housing market crisis. The increasingly important role played by single males and married couples may relate to modifications of traditional gender roles and specialization in home/work production. Additionally, Zhao and Burge (2015) find that female labor force participation is more responsive to housing wealth shocks than male labor supply. In this study, we further explore roles of gender and family composition in originating reverse mortgages.

While a full description of the federal HEMC program lies beyond the scope of this essay, several important aspects of the program are worth highlighting.[13] Policy changes to the terms of home value limits and maximum loan amounts made by HUD actually coincided with the bust period of housing market, and likely influenced the pronounced variation in the frequency and composition of HECMs. In 2006, the national loan limit of $417,000 was established. It was raised to $625,500 with a legislation being passed in 2009. These changes made HECM program more attractive and thus decreased proprietary loans at the same time the total number of originating reverse mortgage rose. Proprietary reverse mortgages are loans structured and backed by private companies, and designed for high value homes that are usually above the $600,000 level. Concurrent with raising the loan limit maximums, however, HUD made downward adjustments in the percentages of home value that could be borrowed. For example, in 2009 the percentage was adjusted from 62% to 56%. The policy changes of raising the loan value limit and lowering percentage limit allowed the HECM program to apply to more homeowners in need, because of a new wider range of targeted property values. [Insert Table 3.1 about here] Also, another new variation occurred to the HECM program at the same time. In 2009, the Federal Housing Administration introduced a new function of HECM allowing older Americans to buy a new home by putting a reverse mortgage on it, while it has been little used.

In this study, we seek to extend the current literature by examining factors that influenced changes in the landscape of the reverse mortgage market and consider potentially asymmetric effects of housing prices on this outcome. We will do so in two

[13] For more detailed discussion of the institutional framework of the HECM program, interested readers should see Case & Schnare (1994) or Shan (2011).

specific ways. First, to our knowledge our study is the first to examine the asymmetric effect of house price shocks on the demand for reverse mortgages with respect to time lags. In this paper, we use loan level data on reverse mortgages originated from 1995 to 2011. Our goal is to detect potential rent-seeking behaviors on the part of homeowners, taking advantage of the relative late downturned appraisal value of property to the actual market, and the "government as an always willing buyer" phenomenon.

Second, while prior studies have described the characteristics of reverse mortgage borrowers, we examine factors previously ignored. Davidoff (2004) argued that single women are the main users of reverse mortgages, citing that they often wish to take out the remaining equity out of homes more urgently than other households. Shan (2011) shows the significant changes in borrower characteristics, and find that single females, still with the largest proportion, constitute a declining fraction as of 2007. In this paper, we will further explain the trend of narrowing down the gap among three groups of borrowers in terms of the needs for cashing out their housing wealth, in particular during the recent boom-bust cycle of housing market. In addition to demographic factors, we take the county-specific labor market condition into account as well. Prior research investigate the influence of housing wealth on retirement behaviors (Sevak 2002; Farnham and Sevak 2007; Disney, Ratcliffe, and Smith 2010.) Farnham and Sevak (2007) find that a 10% increase in housing wealth is associated with a reduction in expected retirement age of between 3.5 and 5 months. Also, Zhao and Burge (2015) find that older households adjust their current labor supply decisions to changes in housing wealth and financial wealth.

The remaining portions of the paper are organized as follows. Section II describes the data we use for our analysis. Our methodology is outlined in Section III, while Section IV reports our empirical results. Section V concludes and lays out future directions.

3.2 Data

The analysis mainly relies on the public HECM dataset that contains FHA loan-level origination and performance data spanning the 17 years from 1995 to 2011. We exclude loans from 1989 to 1994 since reverse mortgages were so rarely used during this initial period. Further, some important variables, such as non-metropolitan housing price index and median household income, are not available over these early years. The dataset includes the number of originations, appraisal property value and location (at state, MSA and zip-code levels), payment plan, interest rate, lender information, and borrower information such as age, gender and marital status. Through a unique county level identifier, we merge the HECM data with local economic information, such as housing price index, unemployment rate and median household income. Our annual MSA level housing price indexes are taken from the FHFA. Annual county level unemployment rates are taken from the BLS. Finally, county-specific estimates of median household income come from the Census Bureau.

A few strategies are used during data processing and cleaning. The loan-level administrative HECM data provided by HUD includes a total of 949,171 raw mortgage records. Since our research explores the growth of reverse mortgage demand within counties, we aggregate loan level data to the county-year level, constructing the annual percentage change of originations made at county level as our main dependent variable.

We have 30,873 county-year observations. Second, we lose 6,393 observations since growth of originations made in some counties are not observed through all the years we analyze. Eventually, our baseline sample has 21,981 county-year observations. (When we later we impose the requirement that a county has to originate at least 30 loans, our sample becomes 4080 county-year observations. The estimate results for this restricted sample are reported as a robustness check in the Section III.) The summary statistics are presented in Table 3.2. [Insert Table 3.2 about here]

3.3 Estimations and Preliminary Results

3.3.1 Factors Influencing the Demand for Reverse Mortgages

Modifying Shan (2011), the following model is adopted to examine the factors explaining growth of reverse mortgage originations:

(1) $$\text{originations\_growth}_{c,t} = \beta_0 + \beta_1 \text{housing price growth}_{m,t} + \beta_2 \Delta\text{unemployment rate}_{c,t} + \beta_3 \text{median income}_{c,t} + \gamma_c + \theta_t + \varepsilon_{c,t}$$

where *originations_growth* is the percentage change of MSA level housing price indexes. The variable of key interest is *Housing price growth* , the appreciation rate of home values. The coefficient β_1 captures the effects of changes in housing prices on reverse mortgage demand, reflecting elderly homeowners' incentive to take advantage of booming home values to finance their retirement. Δ*unemployment rate* is the first differenced unemployment rate within counties. β_2 reflects how the constraint of local employment condition would impact older homeowners' behaviors of tapping out their home equity since labor supply is an alternative that helps finance retirement. *median income* is county-specific median household income. β_3 captures the effect of being

wealthier or poorer in demanding the mortgages. γ_c and θ_t respectively represent county fixed effects and year fixed effects.

The estimated results are displayed in Table 3.3. [Insert Table 3.3 about here] Column (1) provides the results from the baseline model. The coefficient estimate for housing price growth is positive and significant, indicating counties with higher home value appreciation experienced great increases in reverse mortgage originations. The magnitude of 4.3 means that 1 percentage point increase in the regional housing price index is associated with a 4.3 percentage point increase in the originations of reverse mortgages. The estimated effect of changes in unemployment rate is found to be positive and significant, suggesting severe unemployment problems would also raise residents' demand for reverse mortgages. The estimated effect of local household income appears negative and significant. As expected, richer households are displaying the tendency to demand fewer reverse mortgages, perhaps due to more advanced retirement asset accumulation.

Column (2) displays the results with one year lagged housing price growth added. The specification considers the possible impact of lagged housing price appreciation. Results show a smaller effect of current housing price growth and a much larger effect of lagged housing price appreciation, although both are positive and significant. The coefficient for unemployment loses its significance in this estimation. Through columns (3) to (6), county fixed effects and year fixed effects are introduced sequentially and together. All the coefficient estimates for housing price growth and its one year lagged value are positive and significant, and the effects of other factors are not found to have

robust impact on demand of reverse mortgages. The standard errors increase substantially.

3.3.2 Asymmetric Effect of Housing Price during the Recent Boom-Bust Cycle

While the previous specifications follow the literature, the occurrence of gaps in time between housing prices and reverse mortgage demand is explored by allowing for asymmetric effects of housing prices during the upturns and downturns of the housing market. During the housing boom, elderly homeowners perceived the rising trend of the home values and seemed to have found it more beneficial to tap into their home equity. However, when the housing bust took hold in 2007, housing price movements may have asymmetric impacts on reverse mortgage growth. On the one hand, decreasing home values make homeowners hesitate to use reverse mortgages because their assets are worth less. On the other hand, because of the lagged nature of the property appraisal process, and the government as an "always willing buyer" phenomenon, homeowners believe their homes can be tapped out for more cash than the house is worth. This rent-seeking incentive weakens, and may even overwhelm, the positive impact of housing prices, and slows down the pace of declining reverse mortgage market. To consider this potential asymmetric effect, we estimate the model as:

$$
\begin{aligned}
(2)\ \ &\text{originations\_growth}_{c,t} \\
&= \beta_0 + \beta_1 \text{housing price growth}_{m,t} + \beta_2 \text{housing price growth}_{m,t} * \text{Bust} \\
&+ \beta_3 \Delta\text{unemployment rate}_{c,t} + \beta_4 \text{median income}_{c,t} + \gamma_c + \theta_t + \varepsilon_{c,t}
\end{aligned}
$$

The specification expands to now include our key variable of interest, *housing price growth*bust*. This interaction term accounts for the potentially differential effects of housing price changes during the bust period. We define the status of bust at the county-

specific level. Bust equals one only if the county experiences housing depreciation of over ten percent, and zero otherwise. The coefficient, β_2 , captures the differential effect of housing price percentage change over the course of housing boom-bust cycle. β_2 is expected to be negative and ($\beta_1+\beta_2$) accounts for the effect of housing price movements on reverse mortgage demand over the housing bust.

Column (1) of Table 3.4 provides estimation results for the specification described in equation (2). [Insert Table 3.4 about here] The estimated coefficient for housing price growth is 4.48, and the effect remains positive and significant. The coefficient estimate of the interaction term between housing price and bust dummy is -1.31, negative and significant. This suggests when the county experiences ten percentage point of depreciation/appreciation during the recession, its originations of reverse mortgages decrease/increase by (4.48-1.31) percentage point. Column (2) adds 1-year lagged housing price growth to take lagged effect into account, and use the interaction term to further explore the asymmetric effect. The estimated differential effect remains negatively significant and reflects an asymmetric effect of housing price during the bust. The coefficient for housing price growth remains positive and significant, but it is of a much smaller magnitude. Column (3) displays the results when controlling for county fixed effect. The estimated effects of housing price and interaction term appear essentially similar. Column (4) includes the results with both county fixed effects and year fixed effects controlled for. The standard errors of all variables get bigger, and the coefficient estimate for the interaction term keep a negative sign but it turns insignificant due to a much smaller magnitude.

3.4 Conclusion

In this article, we use loan level reverse mortgage data spanning both boom-bust cycle of housing market to construct analysis to better understand the development course of reverse mortgage market. We first examine the factors affecting growth of the reverse mortgage market, and then further identify potential asymmetric effect of housing price during the economic downturn. Due to the lagged property appraisal, homeowners may believe their homes can be tapped out for cash more than buyers actually assess. The rent-seeking incentive leads to a differential impact of housing prices and slows down the pace of declining reverse mortgage market. Our findings are consistent with our earlier expectations. They suggest housing price change function as the strongest and the most robust factor in explaining the expansion and shrinkage of the reverse mortgage market. Also, evidence is found to indicate asymmetric effect of housing price during the housing bust period in the expected direction.

The presented results are only preliminary and the work is still in progress. My main plan to expand the analysis to investigate how type of borrower (e.g. married, single males and single females) influence this process and whether there is a gendered pattern related to expansion of the reverse mortgage market over the last two decades.

Table 3.1: Recent Major Changes in the HECM Program.

Year	Maximum Loan	Maximum Percent to Claim	Range of Targeted Property Values
2006-2008	$ 417,000	62%	$ 672,580
2009-2014	$ 625,000	56%	$ 1,116,964

Table 3.2: Summary Statistics of Observations in the Analysis.

Variables	Obs.	Mean	Std.
County HECM originations	21,981	35.16	145.17
County HECM originations (single females)	21,982	13.91	61.01
County HECM originations (single males)	21,983	5.97	27.41
County HECM originations (couples)	21,984	11.35	45.10
County HECM originations growth	21,985	47.50	128.05
County HECM originations growth (single females)	21,986	13.91	61.01
County HECM originations growth (single males)	21,987	5.97	27.41
County HECM originations growth (couples)	21,988	11.35	45.10
MSA housing price growth (%)	21,981	2.777	5.899
Bust period dummies	21,982	0.0171	0.1295
County unemployment rate change (%)	21,982	0.4333	1.4349
County median household income (in thousand dollars)	21,982	43.579	11.271

Table 3.3: Effect of Housing Price on Reverse Mortgage Growth.

	(1)	(2)	(3)	(4)	(5)	(6)
Housing price growth (%)	4.3335***	1.2961***	4.8937***	2.9864***	3.1534***	2.2284***
	(0.1562)	(0.2572)	(0.1765)	(0.2147)	(0.2360)	(0.3462)
Housing price growth with 1 lag (%)		3.8703***				1.2405***
		(0.2611)				(0.3398)
County unemployment rate change (%)	1.3307***	0.5581	0.2391	1.0361	-0.3084	-0.6319
	(0.6395)	(0.6385)	(0.6889)	(1.0514)	(1.1608)	(1.1639)
County median household income	-0.2797***	-0.3399***	0.7573***	-0.3127	0.7088	0.4852
(in thousand $)	(0.0755)	(0.0752)	(0.2264)	(0.0752)	(0.4114)	(0.4158)
County FE	N	N	Y	N	Y	Y
Year FE	N	N	N	Y	Y	Y
Obs.	21,980	21,980	21,980	21,980	21,980	21,980

*Significance at the 10% level. **Significance at the 5% level. ***Significance at the 1% level.

Table 3.4: Asymmetric Effect of Housing Price on Reverse Mortgage Growth.

	(1)	(2)	(3)	(4)
Housing price growth (%)	4.4792***	1.4419***	5.1539***	2.2315***
	(0.1657)	(0.2630)	(0.1904)	(0.3610)
Housing price growth* Bust	-1.3094***	-1.3109***	-2.1284***	-0.0187
	(0.4972)	(0.4948)	(0.5844)	(0.6101)
Housing price growth with 1 lag (%)		3.8704***		1.2415***
		(0.2611)		(0.3414)
County unemployment rate change (%)	1.2617**	0.4889	0.1078	-0.6349
	(0.6399)	(0.6389)	(0.6897)	(1.1680)
County median household income (in thousand dollars)	-0.2880***	-0.3485***	0.7518	0.4850
	(0.0755)	(0.0753)	(0.2266)	(0.4159)
County FE	N	N	Y	Y
Year FE	N	N	N	Y
Obs.	21,980	21,980	21,980	21,980

*Significance at the 10% level. **Significance at the 5% level. ***Significance at the 1% level.

Figure 3.1: HECM Originations and National Housing Prices, 1995-2011.

Source: National Case-Shiller home price indexes and originations of HECM loans from HUD.

Figure 3.2: Originations of Reverse Mortgages vs. Home Values, 2004-2011.

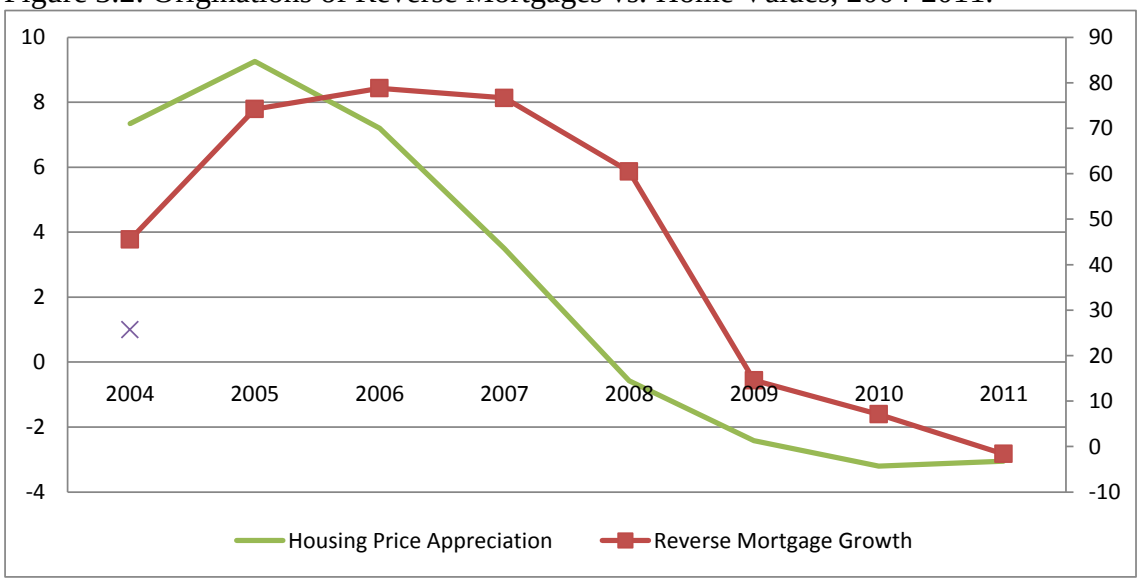
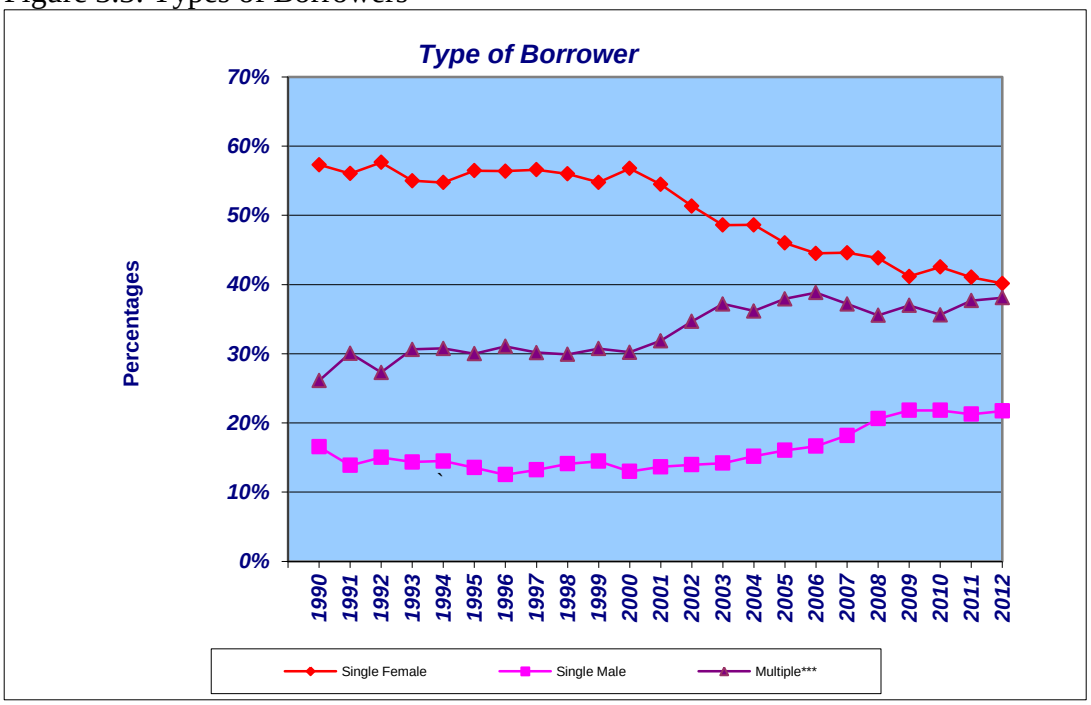


Figure 3.3: Types of Borrowers



Source: HUD.

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