Housing Wealth, Property Taxes, and Labor Supply among the Elderly

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We investigate the relationship between housing wealth, property taxes, and elderly labor supply using longitudinal data from the Health and Retirement Survey spanning the recent boom/bust housing cycle. When combined with MSA-specific house price indexes, the data provide plausibly exogenous variation in housing wealth, identified through within-MSA renter/homeowner comparisons. Our findings suggest that elderly households 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 by gender and age.

I. Introduction

Over recent decades, striking changes in the demographic composition of the US labor force and the nature of elderly labor supply have taken place concurrently. Unprecedented growth in the number of elderly-headed households has complemented the only upswing in elderly labor force participation rates seen in modern history. In 2012, more than one out of every five work-

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ers in the United States 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-World War II environment (Haider and Loughran 2001). Figure 1 shows Current Population Survey (CPS) estimated labor force participation rates for various age groups over the period 1948–2010. 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 today over 60% of Americans between the ages of 55 and 64 are employed. Figure 2 shows that the ratio of part-time to full-time employment among workers ages 65 and up has actually been declining since the mid-1990s, due to a persisting increase in rates of full-time employment. These striking changes motivate careful investigation of the factors influencing the labor decisions of older workers.

During the same period, the value of residential homes varied dramatically, with a particularly strong boom/bust cycle characterizing the last 15 years. Given the fact that housing wealth is the primary component of retirement asset portfolios for so many aging US 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 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), few systematically relate housing wealth to current elderly labor supply. Surprisingly, these papers all ignore the potential effect of property taxes, an important factor that is directly linked to home values and that may affect labor decisions through current liquidity constraints.

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 alternative measures of housing wealth: self-reported values and MSA housing price indexes. Since each carries 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 versus 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

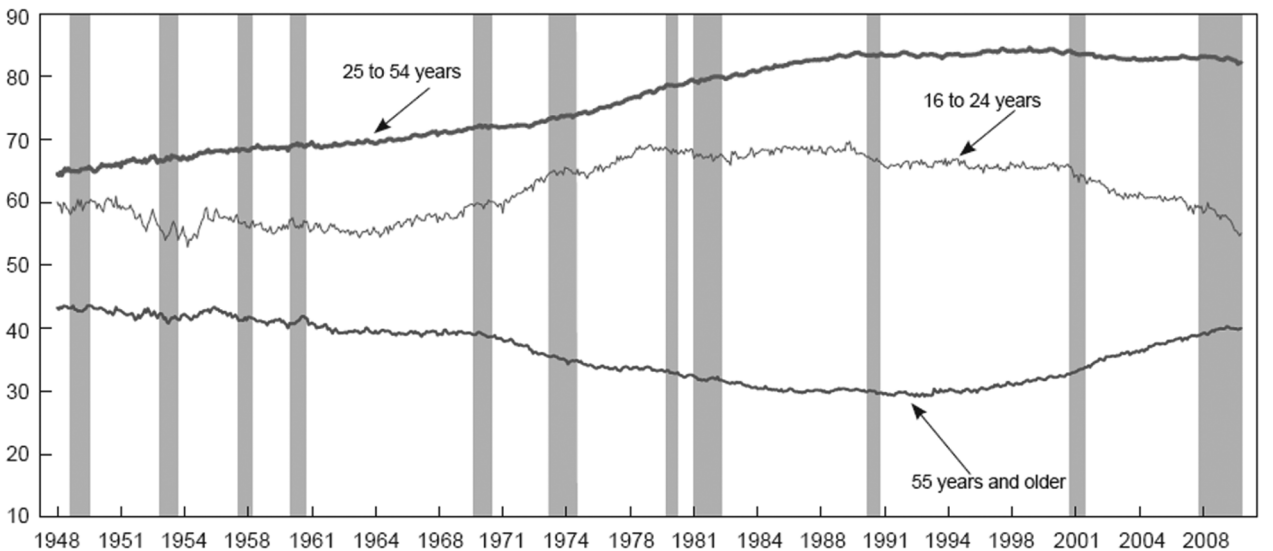

FIG. 1.—Labor force participation rates for civilian workers, by age, seasonally adjusted, 1948–2010. Source: Bureau of Labor Statistics, Current Population Survey, various years. Shaded areas represent recessions, as determined by the National Bureau of Economic Research (NBER). A color version of this figure is available online.

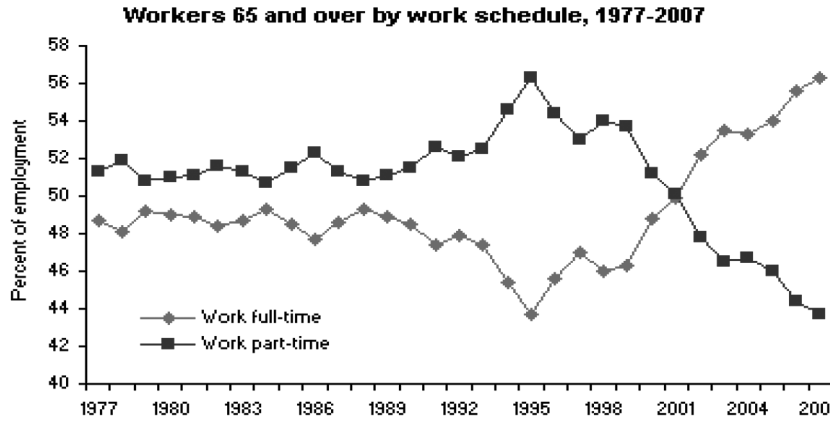

FIG. 2.—Fraction of elderly workers in full-time and part-time employment, 1977–2007. Source: Bureau of Labor Statistics, Current Population Survey, various years. A color version of this figure is available online.

labor supply. When focusing on the extensive margin, the magnitude of effect is roughly twice as large for females. Third, changes in property tax liabilities offset a portion of the effect otherwise associated with gains/losses in housing wealth. Fourth, changes in housing wealth exert stronger effects on workers in their middle to late fifties and their middle to late sixties than they do on younger workers (less than age 55) and workers approaching traditional Social Security thresholds (ages 62–65). Finally, while the effects of housing wealth are found to be significant across two different estimation strategies, the magnitude of their effect is small compared to factors like health or marital status. Our difference-in-difference results suggest that when compared to otherwise equivalent renters, homeowners were about 5% more likely to stay in the labor force during the housing bust. Results from longitudinal models considering only homeowners indicate that doubling of housing wealth is associated with a 3.3% decline in labor force participation, while a halving of housing wealth is associated with a 4.1% increase in the likelihood of working.

II. Background and Theory

A. Determinants of Elderly Labor Supply

Within the considerable literature examining labor supply among older workers, there is a 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 2014). Life cycle theory predicts that unexpected gains in wealth should boost the consumption of normal goods, including leisure. Many papers try to understand this relation-

ship by focusing on the effects of inheritances and lottery winnings that serve quite naturally as unexpected wealth shocks. For example, Imbens, Rubin, and Saerdote (2001) find that lottery winners in Massachusetts significantly reduce their labor supply. Similarly, evidence suggests that the recipients of unanticipated financial wealth obtained through inheritances are also likely to reduce labor supply (e.g., Joulfaian and Wilhelm 1994; Brown, Coile, and Weisbenner 2010). To examine the effect of financial wealth on labor decisions among the elderly, other plausibly unexpected shocks in wealth have been used. For example, Coronado and Perozek (2003) find that workers holding corporate equity immediately prior to the bull market of the 1990s retired, on average, 7 months earlier than otherwise similar individuals who did not. While comparisons are complicated by differences in considered labor outcomes, the magnitude of effect we later present falls plausibly in line with the existing literature.

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; Gruber and Orszag 2003; Liebman, Luttmer, and Seif 2009; Coile and Levine 2011b; Vere 2011), pension and Medicare eligibility (Ruhm 1996; French 2005; French and Jones 2011; Kaushal 2014), and Disability Insurance benefits (Kostol and Mogstad 2014). Besides the life cycle framework, forward-looking models and option value models have also established the effects of policy-related benefits; they generally find that these factors help explain current labor supply and retirement decisions. Additionally, some conditions within the macroeconomic environment, such as labor market tightness and the performance of the stock market, have consistently been shown to have an impact on people's retirement behaviors (e.g., Coile and Levine 2006, 2007, 2011a; Gustman, Steinmeier and Tabatabai 2010; Goda, Shoven, and Slavov 2011, 2012; Disney, Ratcliffe, and Smith 2015). Coile and Levine (2011a) show that workers aged 62–69 respond to local unemployment rates and long-term fluctuations in stock market returns and that the impact of the unemployment rate is nearly 50% larger than the effect of the stock market crash. Unsurprisingly, health limitations have also been widely verified as causing older workers to exit the labor force (e.g., Hanoch and Honig 1983; Coile and Levine 2007; Hurd and Rohwedder 2008).

Our analysis accounts for the established determinants of elderly labor supply while adding our two key variables of interest: housing wealth and property taxes. Although it serves as the dominant component of retirement asset portfolios for most elderly households, housing equity has been given very little attention in the literature. In fact, since households endogenously choose housing consumption and make subsequent decisions regarding mortgage indebtedness, previous work has little to say about how elderly labor supply responds to exogenous housing wealth shocks.

B. The Role of Housing Wealth

Housing wealth has recently attracted attention from a literature focusing on the link between consumption and housing wealth (e.g., Bhatia 1987; Benjamin et al. 2004; Lettau and Ludvigson 2004; Case et al. 2005; Campbell and Cocco 2007; Kishor 2007; Bostic, Gabriel, and Painter 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 is frequently cited as an important component of the consumption portfolio of elderly households, our study adds to this emerging literature.

Most work examining the influence of housing wealth on elderly labor supply focuses on the timing of retirement (Sevak 2002; Farnham and Sevak 2007; Zhao 2011; Disney et al. 2015), generally finding evidence to support the idea that wealth effects are present. Farnham and Sevak (2007) find that a 10% increase in housing wealth is associated with a reduction in expected retirement age of 3.5–5 months. Zhao (2011) finds relatively 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 et al. (2015) analyze British data and find no 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 labor supply.

A broadening of scope to incorporate housing wealth is past due. We show that around 80% of households above age 50 are homeowners and that, for the majority of these households, housing wealth accounts for over half of their aggregate wealth. Combined with limited sources of liquid assets and current income, this concentration makes elderly households particularly vulnerable to unexpected housing wealth shocks. As predicted by the life cycle framework, households smooth consumption by saving during working years to maintain future consumption during retirement and/or periods of reduced labor supply. Studies in this area consistently find that accumulated preretirement wealth influences the level of expected retirement spending (e.g., Bernheim, Skinner, and Weinberg 2001; Hurd and Rohwedder 2008).

However, even accounting for the importance of this relationship, it is easy to explain the dearth of research on the topic. Specifically, an endogeneity problem poses a threat to identification. Housing wealth is the value of one's property less any associated financial obligations (i.e., mortgages and loans). Households make dynamic utility-maximizing decisions regarding both components. While decisions like moving into a higher-/lower-cost region or into a bigger/smaller home are the most obvious of these choices, control over housing wealth becomes even more nuanced once behaviors like home upkeep/renovation, prepaying down mortgage principle, and taking

out home equity loans are accounted for. We follow recent studies examining the effect of housing wealth on other outcomes and argue that geographic variation in the recent boom/bust housing cycle generated variation in wealth that is plausibly exogenous at the household level—particularly when focusing on otherwise similar renters and homeowners who live in the same Metropolitan Statistical Area (MSA).

Figure 3 summarizes the 120-year historical trend of aggregate home values in the United States, based on the Case-Schiller price index. Save minor fluctuations, prices have moved predictably, showing little change in real value between the 1950s and the mid-1990s. However, since then, the housing market boomed until 2006 and then experienced a crisis in 2007. Between 1996 and 2006, nominal home values nearly doubled, and then they abruptly fell back to their late-1990s level by the end of 2011. Figure 4 shows the national housing price index and appreciation rate of home equity since 1991, based on Federal Housing Finance Agency (FHFA) data. We argue that this boom/bust cycle provides sufficient exogenous variation for examining the effects of housing wealth. Figure 5 shows frequencies of Home Equity Conversion Mortgage (HECM) loans and their average property values from 1990 to 2010. Each displays the boom/bust pattern, verifying the idea that housing wealth serves as a precautionary buffer that can be cashed out in the event of pressing financial need (Skinner 1996).

Several studies have compared the effects of housing wealth and financial wealth, reaching a consensus that housing wealth shocks have a greater effect on current consumption (e.g., Benjamin et al. 2004; Lettau and Ludvigson 2004; Case et al. 2005; Campbell and Cocco 2007; Kishor 2007). The typical explanation is that unanticipated shocks to stock prices are likely perceived as transitory, whereas shocks to housing prices are more likely to be perceived as permanent. Given these findings, it is possible that housing wealth shocks also have a greater effect on elderly labor supply than similarly sized changes in financial wealth or that the two effects are similar in magnitude. Our eventual findings lend support to the latter conclusion.

C. The Role of Property Taxes

Property taxes should also influence elderly labor supply. As equity increases (decreases) due to unexpected positive (negative) shocks to home values, the property tax payment the homeowner must cover rises (falls).[1] 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 would have driven an increase

[1] An owner holding the majority stake in his/her property sees these increases directly through higher property tax bills, whereas an owner holding a minority stake experiences higher mortgage payments.

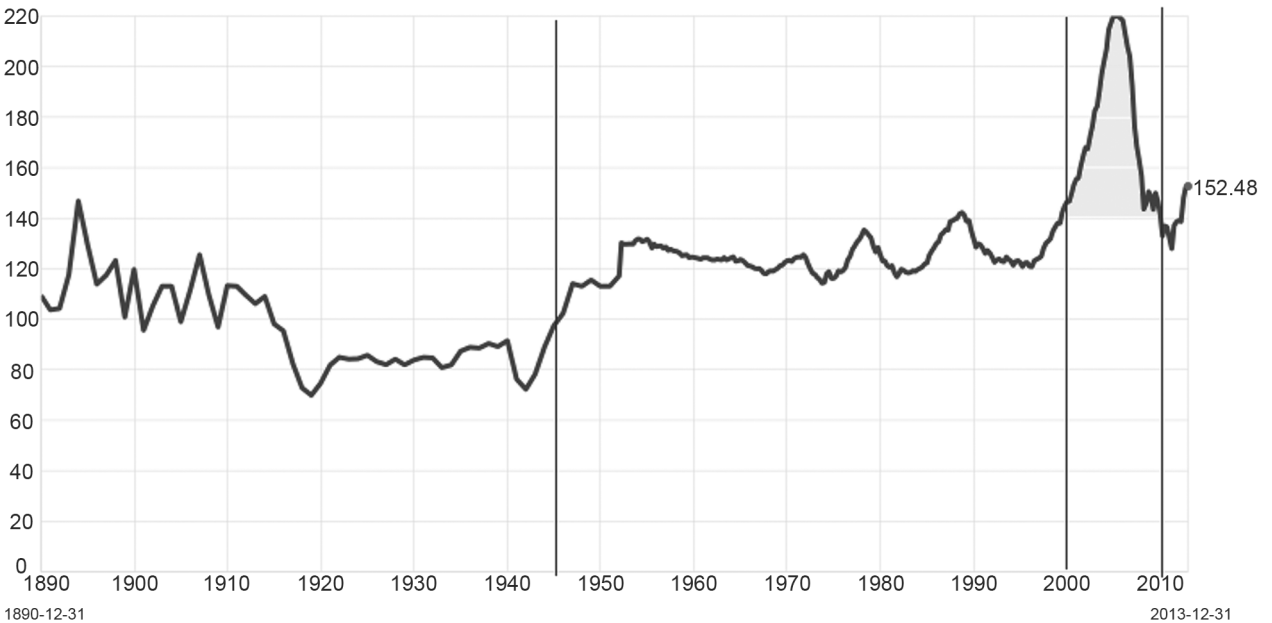

FIG. 3.—Historical trends in Case-Schiller US Housing Price Index, 1890–2013. Source: Case-Schiller nonseasonal national index levels. Prices are inflation adjusted using February 2014 dollars. A color version of this figure is available online.

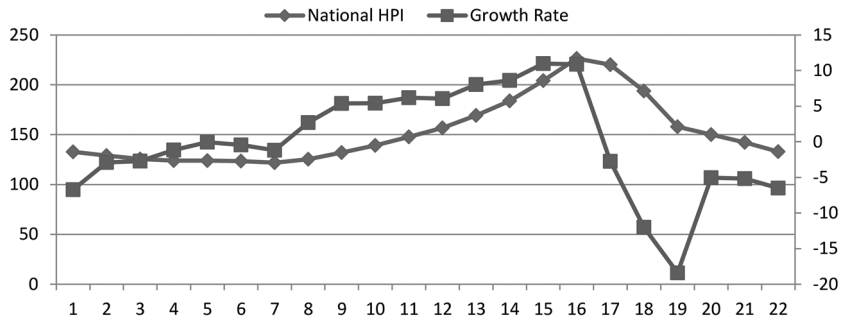

FIG. 4.—Home values and appreciation rates in the United States, 1990–2011. Source: Federal Housing and Finance Agency, national inflation-adjusted index. A color version of this figure is available online.

in labor supply. Without controlling for property tax liabilities, the estimated effect of housing wealth would be biased toward zero, since it then reflects the *total net effect* (i.e., combines the expected negative effect of housing wealth and the expected positive effect of property taxes). To our knowledge, Shan (2008) is the only study that considers the effects of property taxes on elderly labor supply. However, Shan did not directly test for the effects of housing wealth. Hence, there is a need for research that accounts for the role of both countervailing factors.

D. Contributions and Extensions

While our study is not the first to consider the effect of housing wealth on elderly labor supply, we extend the literature in four ways. First, most previous work focuses on the timing of retirement rather than on current labor supply, generally finding that greater housing wealth leads to earlier

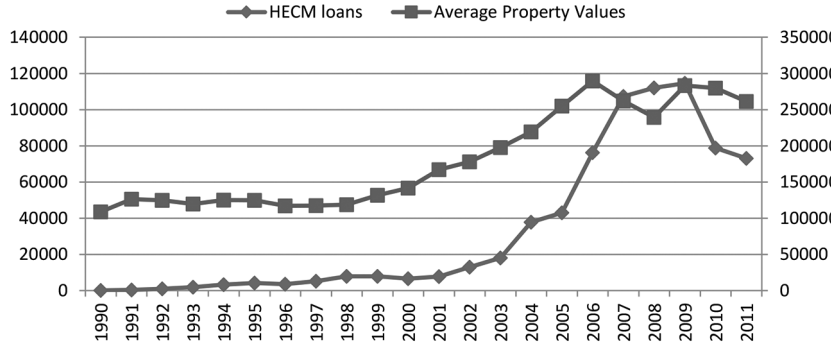

FIG. 5.—Frequency and magnitude of HECM loans, 1990–2011. Source: US Department of Housing and Urban Development (HUD). A color version of this figure is available online.

retirement. Second, previous studies have not examined the recent recession and the plausibly exogenous variation in housing wealth that the boom/bust cycle in the housing marker created. For example, elderly homeowners in Texas experienced dramatically different housing wealth shocks than otherwise similar households residing in Florida during a time period where their financial portfolios likely behaved similarly. This plausibly exogenous difference in wealth experiences allows precise identification through difference-in-difference estimation that compares renters and homeowners living in the same cities. Third, to our knowledge we offer the first study in this literature to consider two distinct measures of housing wealth—each with their own advantages/disadvantages over the other. While the renter versus homeowner difference-in-difference offers the clearest identification strategy, it suffers from the critique that it does not directly measure the variable of interest—households' actual perceptions over their own individual housing equity. We reach similar conclusions using both measures. Finally, prior studies have not simultaneously included housing wealth and property taxes in regressions exploring elderly labor outcomes.

The remaining portions of the paper are organized as follows. Section III describes our HRS data. Section IV outlines the two distinct empirical methodologies. Section V presents our main estimation results along with robustness checks. Section VI concludes and discusses future directions.

III. 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 socioeconomic and demographic variables, health status, financial and housing wealth, income, benefits, social security, pensions, and employment history. The data we use are the 10 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 6 shows that around 40% of our data come from the OHRS cohort, while the AHEAD cohort represents another fifth.

Table 1 provides the specific timing of the survey for each cohort. The OHRS cohort, born from 1931 to 1941, was first interviewed in 1992 and subsequently every 2 years thereafter. The AHEAD cohort, born in 1924 or earlier, was first interviewed in 1993. With the exception of a 3-year gap between 1995 and 1998, they also follow the biannual survey pattern. The CD and WB cohorts were added to the HRS survey in 1998, and they consist of individuals born between 1924 and 1930 and between 1942 and 1947, respectively. The EBB cohort, born between 1948 and 1953, was first inter-

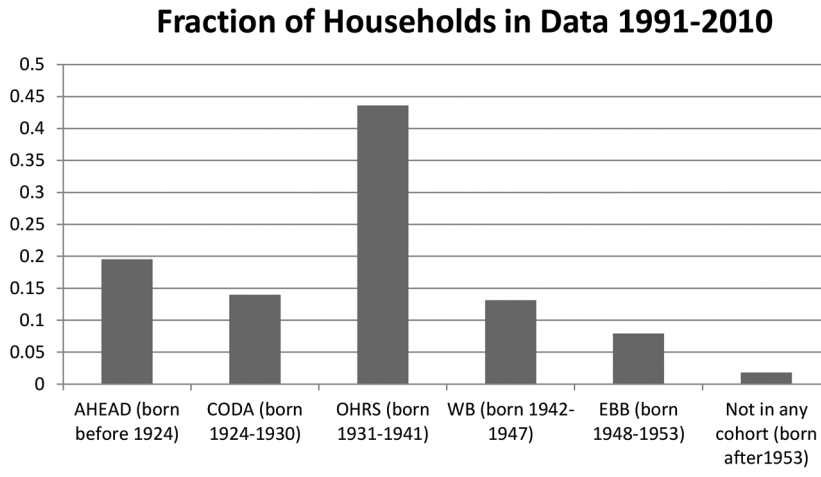

FIG. 6.—Percentage breakdown, by cohort, Health and Retirement Study (HRS) data sample, 1991–2010. A color version of this figure is available online.

viewed in 2004, and subsequently every 2 years. Since cohorts entered the survey at different times, it is unlikely that our results are driven by the economic experiences of a particular cohort. Still, we explored robustness checks that included various cohort groupings and found that 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 var-

Table 1
The Composition of Health and Retirement Study Entry Cohorts, by Wave

	Entry Cohorts				
Wave	OHRS	AHEAD	CODA	WB	EBB
1	1992	1992	NA	NA	NA
2	1994	1993	NA	NA	NA
3	1996	1995	NA	NA	NA
4	1998	1998	1998	1998	NA
5	2000	2000	2000	2000	NA
6	2002	2002	2002	2002	NA
7	2004	2004	2004	2004	2004
8	2006	2006	2006	2006	2006
9	2008	2008	2008	2008	2008
10	2010	2010	2010	2010	2010
Individual-wave observations	55,544	24,869	17,802	16,719	10,072

NOTE.—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).

iables measuring elderly labor supply reflecting both the extensive margin and the intensive margin. These include labor force participation, full-time or part-time working status, and hours worked per year. Figure 7 illustrates the working status shares of respondents by age, including working full-time, working part-time, and not working. 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-1960s. Whereas over half the sample works full-time prior to reaching age 60, by age 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 65–67 years old, which suggests that part-time employment serves as an alternative form of labor supply post-retirement or for workers preparing to retire soon.

The HRS survey asks questions about home ownership, self-assessed home value, size of monthly mortgage payments, and the details of households' first and second mortgages. While it is common to use home value as a proxy for housing wealth, home value reflects the amount of housing services consumed but 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 actual housing wealth. In our analysis, the net value of home equity is used to reflect housing wealth. Figure 8 displays the asset allocations of elderly households that we analyze in this study over the period

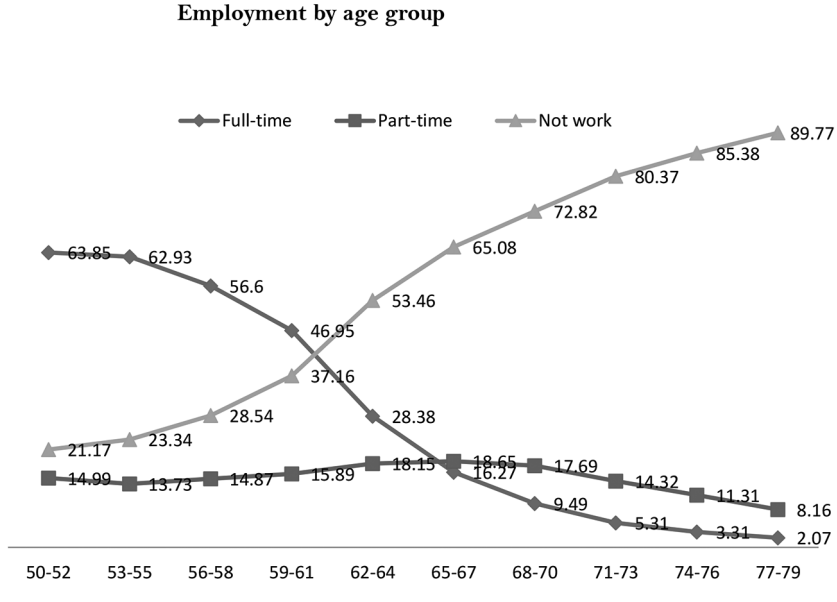

FIG. 7.—Labor supply, by age group, Health and Retirement Study (HRS) data sample, 1991–2010. A color version of this figure is available online.

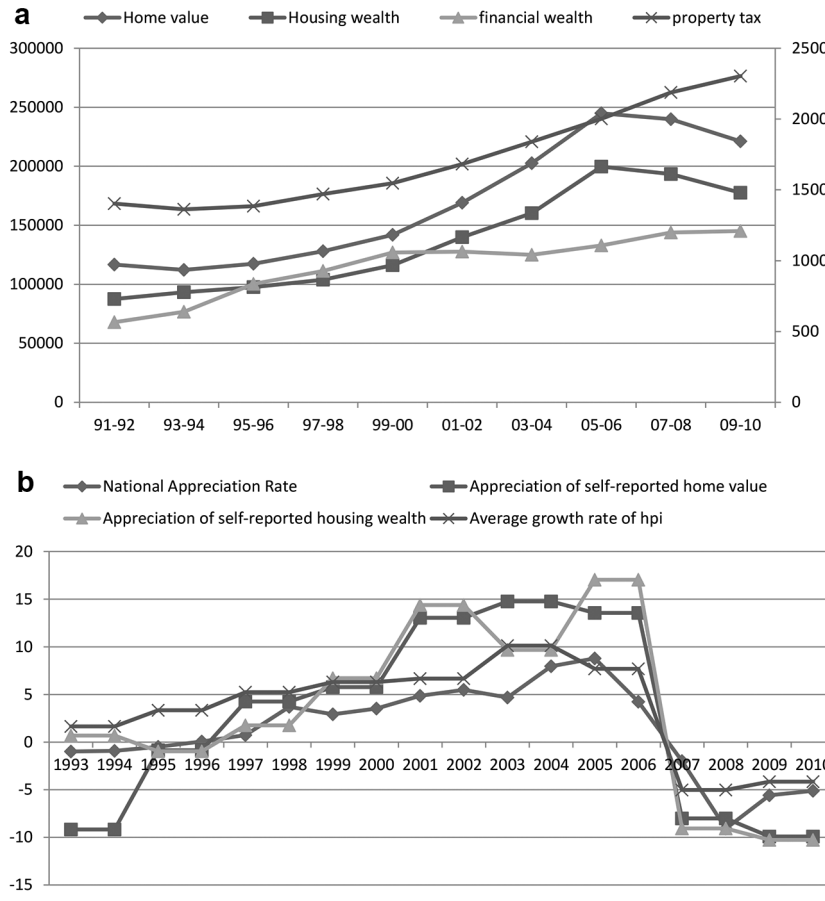

FIG. 8.—*a*, Asset allocation, by time period, Health and Retirement Study (HRS) data sample, 1991–2010; *b*, self-reported Health and Retirement Study (HRS) and National (FHFA) Price Appreciation, 1993–2010. The National Index was constructed using FHFA estimated MSA-specific indexes for 1992–2010, weighted by MSA population. The series was deflated using the Consumer Price Index. A color version of this figure is available online.

1991–2010. 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 illustrated in the same chart and appear to be on a trend consistent with the housing market fluctuation. We observe that financial wealth typically falls below housing wealth, which once again emphasizes the increasing importance of understanding the influence of housing wealth on the behavior of older American households.

Since the housing measures in the HRS are self-reported, a potential criticism is that respondents report based on perceived prices as opposed to actual market values. Figure 8*b* compares real growth rates of self-reported home value and housing wealth with the national real appreciation of home equity derived from an MSA-specific home price index, each deflated by the national consumer price index. While the measures show clear co-movement, greater volatility is seen in the self-reported values. The figure illustrates overly optimistic prospects on home values during the boom and slightly pessimistic expectations during the housing market collapse. However, perceptions of housing wealth should directly influence our outcome of interest, providing a strong argument for using self-reported values. However, additionally merging MSA-specific house price indexes with our household-level data allows our study to be the first to compare the effect of perceptions versus reality when it comes to elderly homeowners' labor decisions and gives us additional confidence in our eventual findings. Hence, we match MSA-level house price indexes from the FHFA, along with MSA-level unemployment rates from the Bureau of Labor Statistics (BLS) and state-level tax burdens from the Tax Foundation to our household-level survey data through state-county identifiers available in the restricted access HRS data.[2]

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

[2] All merging was conducted at the University of Michigan's Health and Retirement Study data center.

Table 2
Labor Participation Rate, by Age and Housing Wealth, Health and Retirement Study Data Sample, 1991–2010

	Housing Wealth Percentile			
Age	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

NOTE.—The table shows the labor participation rates of particular age ranges of those situated in specific housing wealth percentiles. For example, of those who were in the 25%–50% housing wealth percentile and who were in the 50–52 age range, 66.13% of them were participating in the labor market.

the causal effect of housing wealth and property taxes on elderly labor supply requires further empirical examination.

Table 3 lists all our variables, along with their descriptions and data sources. Table 4 displays summary statistics for the 127,336 observations used in our analysis, along with subsample statistics for homeowners and renters. While the majority of our data comes from the HRS, our annual MSA-level housing price indexes are taken from the FHFA. Annual unemployment rates are taken from the BLS. While we initially observe county-level unemployment rates, our other key variables are measured at the MSA level. Hence, we construct an aggregate weighted MSA-level unemployment rate from the underlying county rates. This aggregation also better aligns our measure with prospective labor market opportunities, which likely extend beyond the county of residence. Finally, estimates of the local tax burden come from the Tax Foundation. The measure registers all state and local taxes (e.g., income taxes, sales taxes).

A few filters are used. First, while the HRS only targets individuals older than 50, spouses can be younger. Importantly, young respondents are not representative of their cohorts. For example, a 42-year-old respondent is not drawn from 42-years-olds; they are drawn from 42-year-olds married to someone at least 8 years older. Also, we seek to examine the labor supply of older households. For both reasons, we drop respondents who are younger than 44. This trims the sample by less than 1%, and we verified that our findings remain under alternative cut-offs. Next, procedures are used to clean the data based on housing and financial wealth. Respondents with mortgage debt that far exceeds the value of their home have the option of foreclosure, while households with considerable negative financial wealth may choose bankruptcy. In both cases, it is unreasonable to allow large

Table 3
Description of Variables

Variable	Description	Data Source
Labor-related:		
Labor force participation	Dummy equal to 1 if the respondent is currently work	RAND HRS
Working status	Categorical variable (2 = full-time, 1 = part-time, 0 = not working)	RAND HRS
Annual hours worked	Hours worked per week times weeks worked per year	RAND HRS
Wealth-related:		
Homeownership	Dummy equal to 1 for homeowners	RAND HRS
Home assets	Reported value of primary residence	RAND HRS
Housing wealth	Reported value of primary residence less mortgage liability	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 nonhousing financial wealth, calculated by substracting nonmortgage debts from the sum of stocks, mutual funds, investment trusts, checking, savings, money market accounts, saving bonds, and other bonds/savings	RAND HRS
Demographics:		
Cohort	Cohort dummies: OHRS, AHEAD, CODA, WB, and EBB	RAND HRS
Age	Age in years	RAND HRS
Age group	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 1 if self-report health is poor, 2 if fair, 3 if good, 4 if very good, and 5 if excellent	RAND HRS
Female	Dummy equal to 1 if the respondent is female	RAND HRS
Number of children	Number of children within the household	RAND HRS
Married	Dummy equal to 1 if the respondent is married	RAND HRS
Race	White, black, Hispanic, and other racial status	RAND HRS
Education year	Number of years spent in school	RAND HRS

Table 3 (*Continued*)

Variable	Description	Data Source
Education degree	Four education degree dummies of no degree, high school, college and above, and other degree	RAND HRS
Location and wave:		
Wave	10 wave dummies; 1991–2010	RAND HRS
Census region	Census region dummies; Northeast, Midwest, West, and South	RAND HRS
Housing price index	MSA-specific housing price index	FHFA
Local tax burden rate	State-specific local tax burden rate	Tax Foundation

NOTE.—Health and Retirement Study (HRS); Federal Housing Finance Agency (FHFA); HRS cohort (OHRS); the Assets and Health Dynamics cohort (AHEAD); the Children of Depression cohort (CD); the War Baby cohort (WB); Early Baby Boomer cohort (EBB); MSA = Metropolitan Statistical Area.

negative values to enter the estimations. These filters also trim the data by less than 1%. Also, extremely rich respondents may exhibit systematically different labor supply. We acknowledge that our estimated models fail to capture this, and we drop observations when wealth is exceedingly high (over $1,000,000 for housing wealth and $2,000,000 for financial wealth). This also represents less than 1% of the original data. Financial wealth is calculated as the amount of stocks, bonds, mutual funds, investment trusts, checking, savings, and money market accounts. We drop observations that fail to report these variables, as pervasive zeros represent two distinct cases: reporting omissions (i.e., actual values are nonzero but the respondent skips the questions) or nonbanking households without assets (perhaps driven by a lack of access). These cases represent 15% of the observations left after the other filters. Finally, we ensure self-reported property taxes are not unrealistically high; we remove cases where the reported property taxes are over 10% of house values from the analysis. This accounts for less than one-tenth of 1% of the data.[3]

After applying the filters, the data contain 127,336 distinct observations, 103,593 from homeowners and 23,743 from renters. Summary statistics for the first-differenced variables are also reported.

IV. Empirical Methodology

Households are expected to respond to unexpected increases (decreases) in housing wealth by supplying less (more) labor. At the same time, property tax liabilities should have an opposing 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)

[3] According to taxfoundation.org, no US state had effective property tax rates over 2% during our sample.

Table 4
Summary Statistics, Health and Retirement Study (HRS) Data Sample, 1991–2010

	Total			Homeowners		Renters	
	Observations	Mean	SD	Mean	SD	Mean	SD
Labor-related:							
Labor force participation:	127,336	.406	.4910	.43	.4950	.301	.459
Boom	68,653	.3860	.4868	.4121	.4922	.2751	.4466
Bust	20,063	.3446	.4752	.3693	.4826	.2400	.4272
Working status	127,336	.6765	.8722	.7144	.8795	.5114	.8192
Boom	68,653	.6343	.8537	.6759	.8641	.4581	.7836
Bust	20,063	.5487	.8099	.5855	.8217	.3928	.7376
Annual hours worked	50,065	1,826.75	821.18	1,816.45	823.45	1,891.66	803.70
Boom	25,554	1,797.10	841.78	1,787.40	842.89	1,859.58	831.97
Bust	6,657	1,678.67	837.98	1,663.99	834.58	1,775.23	854.16
Wealth-related:							
Homeownership	127,336	.8135	.3895				
Home assets	127,336	136,365	155,324	167,619	156,257	0	0
Housing wealth	127,336	110,538	132,882	135,872	135,139	0	0
Δlog(Housing wealth)	102,158	−1.1719	2.8941	.2992	2.1349	−2.2189	4.4512
Property tax	127,336	1,383.65	1,761.88	1,700.78	1,810.06	0	0
Δlog(property tax)	93,833	−.0524	1.7494	.1734	1.4507	−1	2.4415
Financial assets	127,336	104,524	212,880	115,769	221,919	55,460	158,783
Δlog(Financial assets)	95,122	.0676	1.7358	.0847	1.6635	−.0153	2.0487

Demographics:							
Age (in years)	127,336	66.68	10.8	65.827	10.15	70.38	12.60
Health (on a 5-point scale)	127,336	3.2646	1.1191	3.3491	1.0909	2.8962	1.1650
Female	127,336	.5703	.4950	.5523	.4973	.6489	.4773
Number of children	127,336	3.0995	2.0532	3.1075	1.9826	3.0647	2.3363
Married	127,336	.7015	.4576	.7750	.4176	.3805	.4855
Race dummies:							
White	127,336	.8288	.3767	.8533	.3538	.7217	.4482
Black	127,336	.0964	.2951	.0811	.2730	.1630	.3694
Hispanic	127,336	.0555	.2289	.0485	.2148	.0860	.2803
Other race	127,336	.0194	.1378	.0171	.1296	.0293	.1686
Education (in years)	127,336	12.585	2.9288	12.779	2.8276	11.738	3.1996
Education degree dummies:							
No degree	127,336	.2026	.4019	.1771	.3818	.3136	.4640
High school	127,336	.5949	.4909	.6039	.4891	.5557	.4969
College and above	127,336	.2015	.4011	.2179	.4128	.1301	.3364
Other degree	127,336	.0010	.0318	.0011	.0302	.0006	.0251
Year	127,337	2000.9	5.5245	2000.9	5.5349	2001.2	5.4686
MSA-level housing price index growth (%)	121,226	3.8331	6.6041	3.7997	6.5218	3.9762	6.9439
MSA-level unemployment rate (%)	127,003	5.8791	2.3697	5.8720	2.3756	5.9102	2.3437
State-level local tax burden (%)	127,020	9.6221	1.2026	9.5789	1.1747	9.8109	1.3008

shocks to housing prices. We estimate several empirical models that seek to disentangle the dual nature of these effects, while we still control for other factors that have been shown to influence elderly labor supply.

A. Alternative Measures of Housing Wealth

We use two measures of housing wealth—self-reported values and MSA house price indexes (HPIs)—each carrying distinct advantages and disadvantages over the other. Using renter-homeowner comparisons, the HPIs capture quasi-experimental variation in housing wealth, exogenous to households' individual shocks. This technique has been used to great success in the context of the recent boom/bust cycle in the housing market. However, we acknowledge two limitations of these measures. First, although HPIs show wide variation in price trends across metropolitan areas, they do not reflect important heterogeneity at the neighborhood level. Ferreira and Gyourko (2012) provide several stylized facts related to local heterogeneity in the length and amplitude of the housing boom, even finding that local socioeconomic characteristics pay a role. Second, HPIs only reflect the movement of home prices at the MSA level, and thus they imperfectly measure actual changes in housing wealth (i.e., that are additionally affected by changes in mortgage liabilities).

Conversely, self-reported measures carry their own advantages/disadvantages. The clearest advantage is that housing wealth (as opposed to price) is measured directly. Additionally, self-reported housing wealth captures relevant heterogeneity at the very local (neighborhood) level. Finally, and perhaps most important, it most directly measures the variable that should influence behavior: perceived housing wealth. In fact, a common critique of self-reported data is that there may be measurement error (i.e., respondents do not know their precise home value). However, the econometric issue is whether estimation errors are biased and/or whether the true market value of the home is actually the preferred variable in the estimation. We readily acknowledge that people may not know their home value precisely, and even that they may inaccurately report mortgage liabilities. However, we seek to understand how people react to perceived changes in housing wealth, and we see no reason why reported mortgage liability would contain systematic bias. The second concern regarding the self-reported data relates to the main 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 decide among their housing options having already formed expectations over supplying labor in the future. Fortunately, the longitudinal nature of the HRS data provides a mechanism for mitigating potential reverse causality bias associated with this threat. Since each measure holds certain advantages over the other, we use both in our analyses, finding qualitatively similar effects of housing wealth on labor supply in both cases.

B. Difference-in-Difference Estimations

In this subsection, 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.[4] 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 decisions 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 identification strategy makes 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: $(\text{labor}_{\text{bust}}^{\text{homeowners}} - \text{labor}_{\text{bust}}^{\text{renters}}) - (\text{labor}_{\text{boom}}^{\text{homeowners}} - \text{labor}_{\text{boom}}^{\text{renters}})$. As seen in figure 8*b*, 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 difference-in-difference models of labor supply are estimated using a pooled cross section of respondents from the control and treatment group between 1997 and 2010.

$$\begin{aligned}\text{labor outcome}_{it} = {} & \beta_0 + \beta_1 \text{bust}_t + \beta_2 \text{homeowner}_{it} + \beta_3 \text{bust} \times \text{homeowner}_{it} \\ & + \beta_4 \text{property taxes}_{it} + \beta_5 \text{financial assets}_{it} + \beta_6 \text{health}_{it} \\ & + \beta_7 \text{demographics}_{it} + \beta_8 \text{unemployment rate}_{mt} \\ & + \beta_9 \text{local tax burden}_{st} + \varepsilon_{it},\end{aligned} \tag{1}$$

[4] We follow previous studies by characterizing the boom/bust cycle as a shock to housing wealth. Homeowners also face higher mobility costs that may constrain their reactions to bad labor market conditions. This effect should work against our eventual findings, which motivates a view of our difference-in-difference estimates as a lower bound.

where labor outcome contains three outcomes: (i) a dummy variable for labor force participation, (ii) a categorical variable for working status indicating full-time, part-time, or no work, and (iii) a continuous variable reflecting naturally logged annual working hours. In our initial model, bust equals 1 if the respondent was surveyed between 2007 and 2010 and 0 if surveyed between 1997 and 2006. For a simple robustness check, we also estimate models where the bust variable is defined individually for each MSA, taking the value of 1 if housing prices dropped more than 2% in nominal terms for that year. The coefficient β_1 captures the effects of the housing cycle that were 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 $\times$ 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, as well as 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 of 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:

$$\begin{aligned} \text{labor outcome}_{it} = {} & \beta_0 + \beta_1 \text{hpi\_g}_{mt} + \beta_2 \text{homeowner}_{it} + \beta_3 \text{hpi\_g} \\ & \times \text{homeowner}_{imt} + \beta_4 \text{property taxes}_{it} \\ & + \beta_5 \text{financial assets}_{it} + \beta_6 \text{health}_{it} \\ & + \beta_7 \text{demographics}_{it} + \beta_8 \text{unemployment rate}_{mt} \\ & + \beta_9 \text{local tax burden}_{st} + \beta_{10} \text{wave}_t + \varepsilon_{it}. \end{aligned} \tag{2}$$

Again, β_3 is the coefficient of interest, capturing the estimated 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 is influenced by the magnitude of housing price changes in that MSA.[5]

[5] For ease of interpretation and to avoid the issues noted by Ai and Norton (2003) that complicate interaction effects between a continuous variable (housing wealth) and

C. Longitudinal Estimations

In addition to our difference-in-difference models, we estimate first-differenced longitudinal models using self-reported housing wealth. We previously argued it would be hard to claim 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, both housing wealth and labor supply are affected by social, economic, and demographic factors, as well as other housing variables (including the decision to own, choice over mortgage instrument, the extent to which equity is withdrawn through refinancing or additional mortgages, and early pay-down of mortgage principle), making them poor instruments. Since our analysis examines the impact of housing wealth without the benefit of an uncontaminated instrument, we adopt various strategies to mitigate potential endogeneity bias, taking advantage of the volatile conditions that led to shocks that were plausibly unexpected. 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).

For this application, however, there are two concerns associated with self-reported housing wealth. One is that even although 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 a specific amount of future labor. As such, cross-sectional correlations between the two may suffer from reverse causality bias. Fortunately, first-differencing the measures and then running longitudinal models substantially mitigates both concerns.

Comparing the difference-in-difference and first-differenced models, two clear advantages of the first-differenced models 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, this bias is mitigated.

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. After first-differencing the

an indicator variable (gender) in nonlinear models, we use linear probability models. Results of multinomial and ordered logit/probit models lead to similar conclusions.

data for each observation,[6] we estimate the following regression model for elderly homeowners:

$$\begin{aligned}\Delta\text{labor outcome}_{it} = {} & \beta_0 + \beta_1\Delta\text{housing wealth}_{mt} + \beta_2\Delta\text{property taxes}_{it} \\ & + \beta_3\Delta\text{financial assets}_{it} + \beta_4\Delta\text{health}_{it} \\ & + \beta_5\Delta\text{unemployment rate}_{mt} + \beta_6\Delta\text{local tax burden}_{mt} \\ & + \beta_7\Delta\text{age}_{it} + \beta_8\text{wave}_t + \varepsilon_{it},\end{aligned} \tag{3}$$

where $\Delta\text{labor outcome}_{it}$ 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 definitions discussed previously. Since the dependent variables are first-differenced and logged, β_1, β_2, and β_3 each represent intertemporal labor supply elasticities (i.e., they estimate the change in labor supply resulting from a percentage change in the variable of interest). Similarly, β_4 captures the effect of respondent's time-varying health status and is expected to show that degraded health causes elderly individuals to reduce their labor supply. Most of our demographic control variables are time invariant; thus they drop out after first-differencing.[7] The exceptions are changes in age, which we include. In addition, β_5 and β_6 control for effects of the local unemployment rate and local tax burden, respectively. Age group and wave dummies are still included, but they are now best interpreted as controlling for their respective transitions.

V. Results

A. Difference-in-Difference Estimations

The regression results, presented in tables 5, 6, and 7, all come from our difference-in-difference models, each measuring the housing boom/bust in a different way. We see evidence of significant housing wealth effects in the expected direction. From column 1 of table 5, our interaction term of interest suggests that elderly homeowners suffering through the housing bust period were 2.3 percentage points more likely to work than otherwise similar renters, which translates to a 5% increase given their mean labor force participation rate. The coefficient for homeowner status also supports the importance of time-invariant housing wealth effects. Holding other factors constant, homeowners are 3.3 percentage points less likely to work than

[6] First-differencing means subtracting the value of the same variable reported 2 years earlier for the majority of cases. For a small number of observations, the gap between survey waves is 3 years.

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

Table 5
Difference-in-Difference Estimation of Bust Effect (Boom, 1997–2006; Bust, 2007–10)

Variable	Participation (1)	Working Status (2)	Working Hours (3)
Bust	.00674	.01521	−.09492
	(.0082)	(.0138)	(.0706)
Homeowner	−.03312***	−.06059***	−.06585*
	(.0072)	(.0120)	(.0257)
Bust × homeowner	.02291***	.03444***	.03477
	(.0081)	(.0135)	(.0309)
Property tax	.00855***	.01333***	.00180
	(.0009)	(.0015)	(.0032)
Financial wealth	−.00490***	−.00872***	−.01238***
	(.0006)	(.0011)	(.0022)
Health	.06810***	.11141***	.02515***
	(.0013)	(.0022)	(.0046)
Unemployment rate	−.00622***	−.01027***	−.00118
	(.0008)	(.0014)	(.0027)
Local tax burden	−.00502***	−.00796***	.00196
	(.0012)	(.0020)	(.0039)
Female	−.10166***	−.21409***	−.23889***
	(.0028)	(.0047)	(.0090)
Number of children	.00122*	.0009	.00427*
	(.0007)	(.0011)	(.0023)
Married	−.03669***	−.08040***	−.11547***
	(.0033)	(.0056)	(.0112)
Hispanic	.00433	.02354**	−.01976
	(.0060)	(.0101)	(.0189)
Black	.01003**	.01740**	−.02327
	(.0048)	(.0080)	(.0149)
Other race	.02575***	.05889***	.08310***
	(.0095)	(.0159)	(.0267)
High school	.03343***	.05892***	−.00295***
	(.0038)	(.0063)	(.0146)
College	.09233***	.14981***	−.08507***
	(.0048)	(.0080)	(.0166)
Other degree	.00609	−.01320	−.17002
	(.0400)	(.0670)	(.1207)
R^2	.3312	.3820	.1707
N	88,619	88,619	32,045

NOTE.—Housing wealth, property taxes, and financial assets are naturally logged. Covariates not shown include survey wave dummies and the set of age group dummies. The omitted age category is < 50. Other than 50–54, all age groups are significant, negative, and increase in absolute value with age. Standard errors are in parentheses.

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

Table 6
Difference-in-Difference Estimation of Bust Effect (Area-Specific Boom/Bust Designations)

Variable	Participation (1)	Working Status (2)	Working Hours (3)
Bust	−.02382***	−.04217***	−.07122**
	(.0087)	(.0146)	(.0327)
Homeowner	−.03201***	−.05980***	−.06806***
	(.0072)	(.0120)	(.0258)
Bust × homeowner	.02048***	.033–2**	.03128
	(.0078)	(.0130)	(.0299)
Property tax	.00845***	.01323***	.00213
	(.0009)	(.0015)	(.0032)
Financial wealth	−.00497***	−.00886***	−.01246***
	(.0006)	(.0011)	(.0022)
Health	.06807***	.11137***	.02514***
	(.0013)	(.0022)	(.0046)
Unemployment rate	−.00608***	−.00999***	−.00045
	(.0009)	(.0014)	(.0028)
Local tax burden	−.00491***	−.00766***	.00244
	(.0012)	(.0020)	(.0039)
Female	−.10147***	−.21381***	−.23906***
	(.0028)	(.0047)	(.0090)
Number of children	.00113*	.00075	.00443*
	(.0007)	(.0011)	(.0023)
Married	−.03662***	−.08023***	−.11559***
	(.0033)	(.0056)	(.0112)
Hispanic	.00433	.02332**	−.02173
	(.0061)	(.0101)	(.0189)
Black	.00922*	.01578**	−.02497*
	(.0048)	(.0080)	(.0149)
Other race	.02700***	.06191***	.08129***
	(.0095)	(.0159)	(.0268)
High school	.03347***	.05900***	−.00266
	(.0038)	(.0063)	(.0147)
College	.09239***	.15001***	−.08499***
	(.0048)	(.0080)	(.0167)
Other degree	.00347	−.02018	−.17627
	(.0402)	(.0673)	(.1222)
R^2	.3313	.3821	.1707
N	88,634	88,634	32,050

NOTE.—Housing wealth, property taxes, and financial assets are naturally logged. Covariates not shown include survey wave dummies and the set of age group dummies. The omitted age category is < 50. Other than 50–54, all age groups are significant, negative, and increase in absolute value with age. Standard errors are in parentheses.

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

Table 7
Difference-in-Difference Estimation of Bust Effect (Housing Price Index Values)

Variable	Participation (1)	Working Status (2)	Working Hours (3)
Hpi_growth	.00123***	.00230***	.00357***
	(.0004)	(.0007)	(.0014)
Homeowner	−.02807***	−.05042***	−.05905***
	(.0064)	(.0109)	(.0219)
Hpi_growth × homeowner	−.00085**	−.00136*	−.0009
	(.0004)	(.0007)	(.0015)
Property tax	.00862***	.01302***	.00284
	(.0008)	(.0014)	(.0027)
Financial wealth	−.00510***	−.00954***	−.01222***
	(.0006)	(.0010)	(.0018)
Health	.07047***	.11722***	.02173***
	(.0011)	(.0019)	(.0036)
Unemployment rate	−.00420***	−.0074***	.00137
	(.0007)	(.0011)	(.0020)
Local tax burden	−.00345***	−.00548***	−.00080
	(.0010)	(.0017)	(.0031)
Female	−.10996***	−.23786***	−.24736***
	(.0024)	(.0041)	(.0072)
Number of children	.00109*	.00034	.00306*
	(.0006)	(.0010)	(.0018)
Married	−.0410***	−.09082***	−.10358***
	(.0029)	(.0049)	(.0091)
Hispanic	.01102**	.03233***	−.0279*
	(.0052)	(.0089)	(.0152)
Black	.01863***	.03155***	−.01507
	(.0040)	(.0069)	(.0115)
Other race	.02163***	.05614***	.07669***
	(.0082)	(.0141)	(.0219)
High school	.03357***	.05947***	−.00065
	(.0032)	(.0054)	(.0111)
College	.09257***	.15387***	−.06890***
	(.0040)	(.0069)	(.0128)
Other degree	.02544	.02990	−.06276
	(.0360)	(.0615)	(.0991)
R^2	.3466	.3917	.1663
N	121,358	121,358	47,008

NOTE.—Housing wealth, property taxes, and financial assets are naturally logged. Covariates not shown include survey wave dummies and the set of age group dummies. The omitted age category is < 50. Other than 50–54, all age groups are significant, negative, and increase in absolute value with age. Standard errors are in parentheses.

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

renters. We also find that property tax burdens have the expected countervailing (positive) effect on labor supply, while financial wealth affects 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. The main results from the participation model all carry over. However, there is weaker evidence of the effect of housing wealth from the model explaining hours worked, found in column 3.[8] While the homeowner variable retains significance, statistical significance is lost on the interaction term due to a larger standard error. One possibility is that the housing bust period negatively correlates with demand for labor on the intensive margin and thus downwardly biases the potential effect of loss in home equity during the bust period. Another relevant consideration is that these results apply to a limited subset of workers (e.g., considering those in the workforce while ignoring information from those who could potentially be in the workforce) and that the sample size is less than half as large as the others.

Tables 6 and 7 report the results of similar estimations that use the MSA-specific boom/bust designations and a continuous variable approach to measuring the effect of housing wealth. Both robustness checks generally confirm all the main conclusions from the initial model. One interesting difference is that although the coefficients and standard errors on homeowner, bust × homeowner, property tax, and financial wealth all remain stable, the sign of the bust dummy variable flips and becomes significant. This likely reflects the strong correlation between regional labor market conditions and the timing of the regional boom/bust cycle.

Although they are not our main focus, a brief discussion of the estimated effects of our other explanatory variables is merited. Poor health appears to be a strong factor restraining the elderly from working; the estimates are consistently statistically and economically significant. Also, both our labor force participation and work status models suggest that respondents from regions with higher unemployment rates and higher local burdens are less likely to be employed, whereas they are not found to influence hours worked. Demographics are found to influence elderly work decisions in a manner consistent with other relevant studies. Females are less likely to work than males, and we see that, along with health status, gender carries the strongest effect of any of our variables. Additional explorations of the role of gender are later presented in the context of our longitudinal models. Married individuals are less likely to work than single individuals, while having children makes working more likely.

As expected, aging brings monotonically decreasing likelihoods of working as well as reductions in hours worked. In general, we find that black, Hispanic, and Asian workers all participate in the labor market at higher rates

[8] To enter these regressions, workers had to report a value of at least 1 for hours worked in a typical week.

Table 8
Longitudinal Model of Labor Force Participation for Homeowners

Variable	Both Genders (1)	Female (2)	Male (3)
ΔHousing wealth	−.00260***	−.00346***	−.00162
	(.0007)	(.0009)	(.0011)
ΔProperty tax	.00448***	.00513***	.00369**
	(.0010)	(.0013)	(.0015)
ΔFinancial wealth	−.00190**	−.00296***	−.00038
	(.0008)	(.0010)	(.0012)
ΔHealth	.01253***	.01215***	.01245***
	(.0015)	(.0020)	(.0022)
ΔUnemployment rate	−.00254*	−.00033	−.00607***
	(.0014)	(.0018)	(.0021)
ΔLocal tax burden	.02530***	.02188***	.02921***
	(.0039)	(.0052)	(.0059)
R^2	.0103	.0089	.0130
N	72,713	40,069	32,644

NOTE.—Housing wealth, property taxes, and financial assets are naturally logged. Covariates not shown include survey wave dummies and the set of age group dummies. The omitted age category is < 50. Other than 50–54, all age groups are significant, negative, and increase in absolute value with age. Standard errors are in parentheses.

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

than whites, but statistical significance is not uniform across models and racial categories. Finally, more highly educated respondents are more likely to work, but they are also less likely to work long hours. Both results 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).

In moving from our difference-in-difference models to our first-differenced models 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 that gender plays a role in determining labor outcomes, we also present the results of models that separately consider male and female labor supply, and we find interesting gender-related patterns in responses to housing wealth.

B. Longitudinal Results

Table 8 displays the estimation results for our first-differenced regression models on homeowners' labor supply. These models narrow the focus to homeowners since reported changes in housing wealth and property taxes—our two main variables of interest—rarely change for renters.[9] Column 1 re-

[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 too rare to consider in our analysis.

ports the results concerning labor force participation for regressions including both genders. The estimated baseline coefficient for housing wealth is −0.0026, suggesting that a doubling of housing wealth reduces elderly homeowners' likelihood of being in the labor force by roughly 3.3% (0.0026/0.0786), where the denominator reflects the baseline likelihood of transition). Considering the reverse direction (i.e., a halving of housing wealth), the homeowner would become roughly 4.1% more likely to work. Additionally, note that in our data a doubling of housing wealth and a one standard deviation increase in housing wealth are very similar in magnitude. The coefficient on the property tax variable is significant and positive, as we expected. Since a doubling of housing wealth would typically be associated with far less than a doubling of property taxes (i.e., housing wealth and the value of the home are quite different), it is difficult to directly compare the magnitudes of these effects. A cautious interpretation would simply note that the corresponding impact of higher property taxes offsets a small portion, but not all, of the influence exerted by housing wealth. We also see the significant negative effect of financial assets. While the coefficient of −0.0019 is slightly smaller than the coefficient on housing wealth, the size of their effects cannot be distinguished from one another at conventional levels of certainly. That is to say, we would fail to reject a null hypothesis that variation in housing wealth exerts the same effect as variation in financial wealth.

Recall that most of our control variables drop out of these models since they do not change over time. We do find evidence that elderly workers facing higher local tax burdens are more likely to stay in the labor force, while those facing worsening local employment conditions are less likely to stay in the labor force. One interpretation of the sign reversal on local tax burden is that, having first-differenced the variable, initial variation in the fraction contributed by sales taxes, income taxes, and property taxes is largely removed. That is, the previous results highlight the disincentive to work when income/sales taxes make up a large fraction of the overall tax burden (i.e., the substitution effect from workers retaining less of their pay), whereas the longitudinal models likely highlight the role of the relevant income effect. Poor health status remains a major depressing factor influencing elderly labor decision, and aging still brings monotonically decreasingly likelihoods of working.

Table 9 reports the results of a similar model, changing only the dependent variable to work status (full-time/part-time/no work) rather than participation. Unsurprisingly, these results largely reinforce our other findings, save a few interesting differences related to gender that we discuss presently.

1. Heterogeneous Responses by Gender

For a number of reasons we are interested in the possibility that males and females in our HRS sample may not supply labor subject to the same under-

Table 9
Longitudinal Model of Work Status for Homeowners (Full-Time/Part-Time/No Work)

Variable	Both Genders (1)	Female (2)	Male (3)
ΔHousing wealth	−.00414***	−.00396***	−.00456**
	(.0011)	(.0015)	(.0018)
ΔProperty tax	.00695***	.00687***	.00715***
	(.0017)	(.0021)	(.0026)
ΔFinancial wealth	−.00374***	−.00520***	−.00160
	(.0013)	(.0016)	(.0021)
ΔHealth	.02202***	.02099***	.022801***
	(.0024)	(.0032)	(.0037)
ΔUnemployment rate	−.00564**	−.00142	−.01084***
	(.0023)	(.0029)	(.0035)
ΔLocal tax burden	.04691***	.04122***	.05303***
	(.0065)	(.0085)	(.0100)
R^2	.0173	.0128	.0234
N	72,713	40,069	32,644

NOTE.—Housing wealth, property taxes, and financial assets are naturally logged. Covariates not shown include survey wave dummies and the set of age group dummies. The omitted age category is < 50. Other than 50–54, all age groups are significant, negative, and increase in absolute value with age. Standard errors are in parentheses.
** Significant at the 5% level.
*** Significant at the 1% level.

lying behavioral model. First, recall that the gender variable was significant in all our difference-in-difference estimations. Additionally, gender interaction terms with housing wealth and financial wealth are generally, thought not uniformly, significant in most of the models we explored using the first-differenced approach. Finally, many of the studies in the literature focusing on reactions to changes in financial wealth explore the role of gender. Hence, the second and third columns of table 8 model labor force participation separately for females and males. Focusing on the estimates coefficients from the second and third columns, we find that in response to a doubling of housing wealth, participation rates for females are more than twice as responsive as those for males. The effects of changes in financial wealth are also highly significant for women and similar in magnitude to the housing wealth result. Men on the other hand, seem less influenced by changes in housing and financial wealth, but are more influenced by changes in local unemployment rates. Property taxes are found to influence both groups with a similar magnitude of effect. As such, reactions to wealth shocks seem subject to gender interactions, but reactions to changes in current budgetary liabilities (property taxes), do not.

One interesting difference between the gender-specific models of labor force participation and those considering work status is that the male coefficient for housing wealth resurfaces as statistically significant in the work

status model shown in column 3 of table 9. Our data show that males are far more likely to transition directly from full-time work to no work than are females, who more commonly than males experience a full-time work to part-time work transition. This phenomenon influences the work status models, but it does not influence the labor force participation models. The effect of financial wealth still differs by gender in the work status model, as does the retained differential influence of local unemployment rates.

Recall that our difference-in-difference analysis suggested that the effect of housing wealth on labor supply was subject to an interactive relationship with age. To further investigate that possibility, our longitudinal analysis also included several unreported regressions using age-restricted subsamples. A similar pattern—that younger individuals (less than age 55) and individuals who are very near traditional retirement and Social Security eligibility (ages 62–65) are less affected than other workers—generally surfaced. However, the data do not allow precise estimates of any potential differences.[10] Similarly, we conducted further explorations of how gender may potentially influence the intensive margin reaction by running several unreported regressions explaining hours worked. The presence of gender-related differences in effects was not as precisely seen here as it was in some other explorations.

2. Robustness Checks

Several robustness checks were estimated but are not reported. (All are available upon request.) To explore potentially asymmetric effects regarding the working-to-exited versus exited-to-working transitions, we also estimated multinomial and ordered logit models. The results indicated that housing wealth significantly influences 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 transitions significantly. These results are not surprising given that our data contain far more workers exiting the labor force than the reverse.

We also examined nonmovers as another robustness check. Since households may reduce (increase) their consumption of housing in response to losses (gains) in housing wealth, restricting the sample to nonmovers mitigates concerns associated with reverse causality. Our access to restricted geographic information from the HRS data allows us to identify household mobility status—verifying that 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

[10] Specifically, we ran separate analyses using various combinations of age ranges to form subsamples and a comprehensive set of regressions using rolling 5-year age ranges (e.g., the estimation for age 63 uses respondents ages 59–63). These results are available upon request.

similar effects. Furthermore, in the nonmover regressions, gender-related and age-related effects also still surface. In a final robustness check, we find that our results are also retained when we include/exclude various HRS cohort groupings.

V. Conclusion

Over the past 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 that most elderly households carry a large fraction of their asset portfolios in the form of home equity, while at the same time they face 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 elasticities with respect to housing wealth and property taxes are both statistically and economically significant and of the nature predicted by the life cycle model. Our findings suggest that elderly homeowners, when viewed collectively as one group, are about 5% less likely to work if they experience a doubling of housing wealth, which was not an uncommon experience during the housing boom. 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 related variables. Elderly female labor force participation seems 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 fifties and late sixties is found to be more responsive to changes in housing wealth than labor outcomes for workers still in their early fifties and workers approaching significant Social Security thresholds. Workers well beyond traditional retirement ages (i.e., 73+) are found to be unresponsive to changes in either housing wealth or property taxes—responding only to changes in health.

While our study provides evidence that informs the discussion of several important questions relating to elderly labor supply, it leaves others un-

addressed. For example, while we find no evidence that changes in housing wealth influence the behavior of workers younger than age 55, it would be interesting to see if those changes influence younger workers in other ways that we are not measuring in this study. Similarly, as time passes and new cohorts—potentially cohorts with gender ideology that differs on average from previous generations—age into their fifties and sixties, it would be interesting to see if the intervening role played by gender is retained or becomes less noticeable.

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