Do Elderly Individuals Delay Claiming Social Security and Cash-out Home Equity When House Prices Appreciate?

Naqun Huang
Institute of Urban Development
Nanjing Audit University
86 West Yushan Road
Nanjing, Jiangsu, China, 211815
Phone: (86) 188-6096-5090
Email: naqun.huang.2012@phdecons.smu.edu.sg

Jing Li
School of Economics
Singapore Management University
90 Stamford Road
Singapore, 178903
Phone: (65) 6808-5454
Email: lijing@smu.edu.sg

Amanda Ross
Department of Economics, Finance, and Legal Studies
The University of Alabama
Box 870224
Tuscaloosa, AL 35487
Phone: (205) 348-6313
Email: aross@cba.ua.edu

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Abstract

This paper examines the extent to which changes in house prices affect when eligible individuals start receiving Social Security benefits. When a household starts to receive Social Security is important because the timing of the claiming decision affects the monthly benefit amount. We argue that if house prices increase, financially constrained households may draw upon the additional home equity to finance expenses and delay receipt of Social Security for larger monthly benefits. Since changes in house prices and the claiming of Social Security are likely to be correlated with unobserved local demand shocks, we employ a control function approach to address endogeneity concerns. We use two independent sets of instrumental variables to identify these effects, drawing on exogenous variations in Saiz (2010) supply elasticity of an MSA and Guren et al. (2019)'s CBSA price sensitivity measure. We find that elderly individuals delay Social Security claiming when house prices increase during the housing boom period, but not during the bust. We also find that financially constrained households are more likely to delay claiming Social Security if house prices appreciate and they do so by remaining in their current residences but increasing the amount of their home loans.

Keywords: Social Security; home equity; housing wealth shock; land supply elasticity
JEL Codes: D12, D14, J14, J26, R20

1. Introduction

Elderly individuals in many countries face an important decision regarding when to claim their retirement benefits. The trade-off in this decision resides in similar designs of the systems that individuals who claim later face increased monthly benefits, even though they receive the benefits for a shorter period of time.[1] For example, in the United Kingdom, working an additional year past the state pension age increases benefits by 10.4%, which in 2019 translates to an additional 142.64 pounds a year. The pension system in France and the Social Security scheme in the United States (U.S.) also allow monthly benefits to increase if an individual delays receipt after initially becoming eligible. Despite its prevalence, early literature modelling life cycle financial decisions fails to incorporate the complicated financial options involving the specifics of this trade-off.[2] However, as emphasized in more recent studies, when to exercise the option to claim is one of the most crucial financial decisions for the elderly.[3]

One vital aspect of the elderly's claiming decisions that still has not received much consideration in the literature is the role of a housing wealth shock and its interaction with retirement benefits claiming.[4] Housing wealth often comprises a significant portion of an elderly's total net worth. In the U. S., for example, among various financial assets, Social Security benefits and home equity are typically the two largest components of an elderly individual's balance sheet (Poterba, 2014). Figure 1 illustrates the ratio of home equity to household net worth by age groups

[1] For information on retirement programs across the world, see https://www.ssa.gov/policy/docs/progdesc/ssptw/index.html.
[2] See, for example, Merton (1969), Bodie et al. (1992), Campbell and Viceira (2001), Cocco et al. (2005), Farhi and Panageas (2007), Gomes et al. (2008), Horneff et al. (2008), Love (2010), Chai et al. (2011), Inkmann et al. (2011) and Hubener et al. (2014).
3 For example in the U.S., the timing of when to claim determines the return of the Social Security benefits which comprise a large portion of family assets and hinge greatly upon optimal life cycle financial and retirement choices (Coile et al, 2002; Gustman, et al. 2010; Shoven and Slavov, 2014; Hubener et al., 2016).
4 Cocoo (2005) considered the role of housing in a portfolio choice model but did not model specifically the Social Security claiming decisions.

based on the 2005 Survey of Income and Program Participation. Home equity comprises about 38–45% of the total net worth for households in the top two senior age groups. Given the importance of home equity, studying the role of housing wealth in Social Security claiming decisions is essential for understanding life cycle saving and investment decisions. The high fluctuations in house prices that occurred recently in the U.S also provides significant variations to address this key question.

This paper examines how changes in house value affect when elderly individuals in the U.S. start receiving Social Security. In this context, it is worth emphasizing the extent to which the timing of receiving Social Security affects individuals' retirement benefits. Social Security rules in the U.S. are such that once the Primary Insurance Amount (PIA) has been determined based on the earnings history, the amount received varies based on when an individual starts receiving benefits.[5] For example, Figure 2 illustrates that an eligible individual in the cohort born between 1943 and 1954 will face on average a reduction of 6.25–6.67% per year if he or she claims before the Full Retirement Age (FRA), but will receive an additional 8% per year for deferring claiming past the FRA. This variation in benefits translates into an increase in monthly Social Security benefits of 76% if this individual claimed Social Security at age 70 versus at 62.

Given the potentially large benefits associated with delaying, elderly individuals may have an incentive to draw upon their assets to finance consumption and delay claiming Social Security. This is especially so if a financially constraint household experiences an unexpected positive wealth shock, including a change in housing wealth. The tendency to rely on home equity to finance consumption has been established in the previous literature (Bostic et al., 2009; Mian

[5] The PIA is calculated by applying a non-linear formula to the Average Indexed Monthly Earnings (AIME) which takes the top 35 highest earning years up to age 60 and indexes it for wage growth, and then averages it to get a monthly amount. The AIME approximates earnings over the beneficiary's lifetime at today's wages.

and Sufi, 2011, Mian et al., 2013, Cooper, 2013, and Aladangady, 2017). Studying this issue in the context of *the aging population* with regards to the timing of when to claim Social Security allows us to better understand the substitutability of these two assets as a source of income for the aged population.

We begin by arguing for the existence of a substitution between the two assets based on the potential benefit from a delay in receiving Social Security in the U.S., as documented in Coile et al., (2002) and Shoven and Slavov (2014). Following the framework of Mariger (1987), Feldstein (1990), and Mirer (1998), we show that the realization of the benefits from delaying could be compromised by the lack of initial wealth and the presence of financial constraints. Therefore, an unexpected positive housing wealth shock (either permanent or transitory) could help ease the constraint by financing consumption directly (e.g., Case et al., 2005; Bostica et al., 2009; Gan, 2010) [6] or by allowing households to finance expenditures through home equity-based borrowing (e.g., Mian and Sufi, 2011; Cooper, 2013; Aladangady, 2017).[7] We consider both channels to determine which one is the most likely to drive our empirical results.

The main challenge in identifying the impact of changes in home equity on the timing of claiming Social Security is the likely presence of unobserved local demand shocks that are correlated with both changes in house prices and the decision to receive the benefits. The failure to directly control for unobserved local demand shocks would lead to an omitted variables problem that could bias the estimated coefficient (e.g., Chaney et al., 2012; Zhao and Burge, 2017; Charles et al., 2018). To address this endogeneity concern, we utilize a control function approach by

[6] For example, upon retirement or in preparation for retirement, elderly households may sell their home and buy a new smaller, less expensive property or become renters. A household has a stronger incentive to do so when their house value appreciates and there is more equity to receive from selling the house.

[7] For example, an elderly household could remain in their home but draw upon the increased home equity by refinancing, taking out a second mortgage, or applying for a Home Equity Line of Credit (HELOC).

exploiting the exogenous geographic variations at the MSA and the CBSA level as two independent sets of instrumental variables in our analysis. For the first instrument, we interact the MSA-level supply elasticity measure, developed by Saiz (2010), with the change in the national house price index. The identifying assumption for this approach is that the deviation in local house price appreciation from the national house price index is driven by the underlying exogenous differences in local land supply elasticities, which are not correlated with time-varying local economic activity.[8] The second instrument is developed by Guren et al. (2019), which exploits systematic differences in CBSA-level exposure to regional house prices. The main identifying assumption of this instrument is that there are no unobserved factors that are correlated with house prices and that differentially affect the cities that are historically sensitive to housing market cyclicality. We find consistent evidence with both sets of instruments.

Our empirical analysis relies on four data sources that span across survey data, government data, and academically compiled information. The primary dataset is the restricted Health and Retirement Study (HRS), which is a biannual longitudinal survey of more than 26,000 Americans over the age of 50. We use the restricted version of the HRS with county-level geographic identifiers, as it allows us to link the respondents to their corresponding MSAs and CBSAs and then match to our MSA-level and CBSA-level instruments. The three additional datasets used are the housing price index constructed by the Federal Housing Finance Agency (FHFA), the MSA-specific housing supply elasticities for 269 MSAs provided by Saiz (2010), and CBSA-specific housing price sensitivity measures provided by Guren et al. (2019). These datasets

[8] Either the supply elasticity instrument or its interaction has been used in in the previous research, including Mian and Sufi (2011, 2014), Chaney et al. (2012), Mian et al. (2013), Cvijanović (2014), Dettling and Kearney (2014), Aladangady (2017), Chetty et al. (2017), and Stroebel and Vavra (2019). Concerns have been raised regarding the validity of this instrument by Davidoff (2016). Therefore, we use a second instrument developed by Guren et al. (2019) to safeguard our findings.

provide two different sources of exogenous variation to implement our identification strategies.

We obtain the following results. First, we find that increases in house prices result in elderly individuals delaying claiming Social Security benefits during the boom period from 2002–2006. Results are similar using each of the two independent sets of instrumental variables. Specifically, if house prices increased by 10 percent in the previous two years, the probability of claiming Social Security benefits within one year of becoming eligible is reduced by 4.26 percentage points using the Saiz (2010) instrument and 4.06 percentage points using the Guren et al. (2019) instrument, and the probability of claiming within two years of becoming eligible is reduced by 5.47 percentage points and 5.56 percentage points, respectively. This translates into a 7.89-8.28% decrease in the probability of claiming within one year of becoming eligible and a 9.02-9.16% decrease in the probability of claiming within two years of becoming eligible. Second, during the bust period from 2007–2009, we do not find a statistically significant effect on Social Security claiming. This lack of a result is consistent with the argument that home equity-based borrowing is only viable when house prices appreciate.

Furthermore, we find that the baseline effects are concentrated among individuals who had an outstanding balance on their mortgage prior to becoming eligible for Social Security and households that did not have any stock account balances. This finding is consistent with our priors, in that households that are more likely financially constrained are drawing upon home equity to finance expenditures. We also find that the effect is concentrated among women. This result is corroborated by a simple actuarial analysis and is also consistent with the financial calculations presented in Coile et al. (2002) and Shoven and Slavov (2014), which show that delayed claiming is more beneficial for individuals with a longer life expectancy.[9]

After establishing our baseline results, we consider the channels that could drive these results. We do not find an effect of an increase in home value on mobility, and especially, we find that the effect of house price appreciation on delaying receipt of Social Security is concentrated among the stayers. The evidence suggests that a mobility response, where households sell their house and either downsize or become renters, is not driving our results. Furthermore, among the stayers, we find that the effects are concentrated among those that are more likely to be financially constrained. To look for direct evidence of home equity-based borrowing, we consider if there is an increase in the total home loan amount, which includes the amount owed on a first mortgage, any additional mortgages, and any home equity line of credit (HELOC) taken out. We find that among stayers, there is an increase in the total amount of home loans when house prices appreciate. We also find that this effect is again concentrated among those who are more likely to be financially constrained. This result is consistent with our hypothesis that the home equity-based borrowing channel helps to alleviate a binding financial constraint.

Our research contributes to the literature in several ways. First, we contribute to the literature on Social Security claiming decisions. There is an extensive literature documenting large gains in lifetime wealth from delaying receipt of Social Security.[10] Yet, despite the gains from delaying, many people still claim shortly after becoming eligible (Shoven et al., 2017). There are many potential explanations for this behaviour, such as liquidity constraints, life expectancy, self-

[9] Coile et al. (2002) looked at household decisions. Besides financial calculations, they also derive their findings based on simulations of an expected utility maximization model. They note that "the financial calculations for the delaying benefit may generally understate the benefits of delay relative to the maximization of a risk averse utility function." In our conceptual model, our focus is on establishing *whether or not* certain individuals have incentives to delay. To achieve this, we look at contrasting gender groups and rely on the simple financial calculation, recognizing that the actual incentives could be larger.

[10] See, for example, Coile et al. (2002), Munnell and Soto (2005), Mahaney and Carlson (2007), Meyer and Reichenstein (2010), Sass et al. (2013), and Shoven and Slavov (2014).

assessed health status, and labor market shocks (Crawford and Lilien, 1981; Hurd et al., 2004; Munnell and Soto, 2005; Rutledge and Coe, 2012; Card et al., 2014).[11] Our paper highlights another important factor – appreciated housing value – that may alleviate financial constraints and allow individuals to delay claiming Social Security. To our knowledge, our paper is the first to examine the link between a change in home equity and when an individual starts receiving Social Security.[12]

Second, we contribute to the literature on the impact of home equity on consumption and saving behaviour. There is an extensive literature on the extent to which consumption and savings may respond to a change in home equity.[13] Early literature focuses more on the housing wealth effect. For example, Bostic et al. (2009) found that fluctuations in housing wealth have a larger effect on changes in consumption. Recent literature highlights an important home equity-based borrowing channel. For example, Mian and Sufi (2011), Mian et al. (2013), Cooper (2013), and Aladangady (2017) suggest that the home equity-based borrowing channel is a viable means for individuals to finance consumption.[14] However, in general, this research has not specifically considered the elderly and their financial planning.[15] We contribute to this literature by highlighting the decision elderly households make when choosing whether to use their housing wealth to finance consumption so as to delay receipt of Social Security. To our knowledge, our

[11] Recent studies have shown that behavioral factors also affect the timing of Social Security claiming, including framing effects (Brown et al., 2016), reference dependence with loss aversion (Behaghel and Blau, 2012) and eligibility for Medicare (Madrian et al., 1994; Rust and Phelan, 1997; Blau and Gilleskie, 2006, 2008; French and Jones, 2011).

[12] Shoven et al. (2017) used survey evidence to gain insights into the reasons individuals choose to claim Social Security. Silva et al. (2015) found that negative financial wealth shocks increase early claiming and time in the labor market.

[13] The literature is too extensive to provide an exhaustive review. Some examples include Attanasio and Weber (1994), Engelhardt (1996), Muellbauer and Murphy (1997), Lehnert (2004), Case et al. (2005, 2013), Haurin and Rosenthal (2006), Campbell and Cocco (2007), Greenspan and Kennedy (2008), Bostic et al. (2009), Gan (2010), Carroll et al. (2011), Jiang et al. (2011), Browning et al. (2013), Ong et al. (2013), and Cloyne et al. (2017).

[14] McCully et al. (2018) examined how much car purchases are driven by home equity withdrawal.

[15] One exception to this is Harding and Rosenthal (2017) who recognize that elderly individuals are more responsive to withdraw home equity to finance entry into self-employment.

paper is the first to reveal the home equity borrowing mechanism for the elderly in conjunction with considerations of Social Security benefits.

The rest of the paper will proceed as follows. Section 2 discusses the rationale behind the relationship between house prices and the Social Security claiming. We discuss our empirical strategies in Section 3. Data and summary statistics are provided in Section 4. Our baseline results are presented in Section 5, including detailed heterogeneity analysis. The channels that could drive these results are analysed in Section 6. Section 7 concludes and discusses the policy implications of this research.

2. House Price and Social Security Claiming

a. The Social Security Retirement Program in the United States

Social Security has grown to become an essential facet of modern life in the U.S, with more than 90 percent of all workers covered by Social Security. The benefits represent a substantial component of total assets for an elderly household. For example, Social Security benefits comprise about 40% of the net wealth that baby boomer household has accumulated (Gustman et al., 2010) and it has provided the largest share of aggregate income for aged population over time.[16]

The amount of Social Security benefits that an individual receives depends on a set of rules applied to the earnings history and when an individual starts receiving the benefits. First, the Social Security Administration adjusts an individual's previous earnings to account for changes in average wages since the year the income was received. The Average Indexed Monthly Earnings (AIME), which are based on the 35 years in which the person earned the most, are calculated, and

[16] Social Security benefits takes a larger share for middle or low income aged household. The share of aggregate income from Social Security benefits varies by total income. It takes 80.7% for the lowest quintile while only 15.4% for the highest quintile for the persons aged 65 or older in 2014. Source: https://www.ssa.gov/policy/docs/chartbooks/income_aged/2014/iac14.pdf.

a formula is applied to the AIME to arrive at the Primary Insurance Amount (PIA). The PIA is the benefit a person would receive if Social Security is claimed at the Full Retirement Age (FRA).

In addition, the monthly benefits received depends on when an individual decides to start receiving Social Security. This amount is lower the earlier the beneficiary begins claiming because the claimant will receive benefits for a longer period of time. Besides the deduction for early claiming before FRA, the government provides Delayed Retirement Credits (DRC) to increase the monthly benefit amount for people who delay claiming past the FRA, but the benefits increase is capped at age 70. The reduction in benefits for early claiming or credit for delayed claiming is birth-year cohort-specific. For example, the reduction in benefits for claiming Social Security at age 62 is 20 percent for people born in 1937 or earlier but is 20.8 percent for people born in 1938. The maximum reduction for claiming at age 62 is 30 percent for the cohort whose FRA is 67.[17] The credit to delay claiming past the FRA is larger for people born in later cohorts.[18]

When to claim Social Security benefits is one of the most crucial and complex financial decisions facing U.S. workers (Shoven and Slavov, 2014). The Social Security Advisory Board summarizes the decision an elderly individual has to make by stating that: "If you withdraw early, you may not have enough income to enjoy the years ahead of you. Likewise, if you withdraw late, you'll have a larger income, but fewer years to enjoy it. Everyone needs to find the right balance based on his or her own circumstances" (Social Security Advisory Board, 2009). The American Association of Retired Persons website begins its advice about when to claim Social Security benefits with the statement: "If you're healthy and can afford it, you should consider waiting until

[17] For example, if a beneficiary born in 1938 starts receiving retirement benefits at age 62, the monthly benefit would be 79.2% of that if claiming at the FRA. For people born between 1943 and 1954, the benefit at age 62 is reduced to 75.8% of the benefit at FRA. For more details, please visit https://www.ssa.gov/planners/retire/ageincrease.html.

[18] For example, the yearly rate of increase for delayed claiming is 3.0% for 1917-1924 birth cohort, 3.5% for 1925-1926 cohort, and 8.0% for people born in 1943 and later. For more details, please visit https://www.ssa.gov/planners/retire/delayret.html and https://www.ssa.gov/oact/quickcalc/early_late.html.

you reach your full retirement age."[19] Hence, in general, the decision should be made based on a specific individual's background. As a whole, Figure 3 shows that there is a large claiming spike at age 62. According to the Social Security's Annual Statistical Supplement, 56% of eligible individuals claimed Social Security at age 62 in 2002, and an additional 8% of eligible individuals claimed before turning 64.[20]

b. Optimal Timing of Claiming

Given the observed peak of claiming at age 62, the next question is whether it is indeed optimal for the majority to claim at this early. The answer to this question depends on several factors aside from market frictions. [21]

First, the optimal timing of claiming depends on the specific Social Security rules that govern the magnitude of the penalty for early claiming. As the penalizing scheme is cohort-specific, the optimal timing is also cohort-specific. For instance, the younger cohorts generally have larger expected gains from delay as they face more substantial reduction in their monthly benefits for early claiming. If the increased benefits from delaying translate into a larger lifetime benefits, they will be better off claiming at a later stage to optimize their lifetime benefits (Meyer and Reichenstein 2010, 2012; Munnell and Sass, 2012; Shoven and Slavov, 2014).

Second, the expected life expectancy plays an important role in determining the optimal timing of claiming. The monthly Social Security benefits are higher the later the beneficiary begins claiming. Intuitively, individuals with longer life expectancy have more years to enjoy the

[19] http://www.aarp.org/work/social-security/info-12-2010/top-25-social-security-questions.5.html.
[20] This is similar to the phenomenon of "annuity puzzle" in the literature. Many households are reluctant to voluntarily convert accumulated assets into a life annuity (Inkmann et al., 2011), although life annuities are highly beneficial for most households (Yaari, 1965; Davidoff et al., 2005). The decision to delay claiming could be equivalent to purchasing a deferred joint and survivor life annuity (Hubener et al., 2016).
[21] In reality with the presence of financial constraints for instance, the optimal timing of claiming will deviate from what suggested below. This is something we discuss in the next subsection.

increased benefits after delaying. If the design of the Social Security benefits intends for claiming at various ages to be actuarially fair based on average life expectancy, those with longer life expectancy will achieve a higher lifetime value from delaying claiming Social Security to a later stage. This is consistent with Duggan and Soares (2002) and Heiland and Yin (2014) that suggest delaying is actuarially favourable for women than men due to female's longer life expectancy.

Third, whether it is beneficial to delay claiming Social Security also depends on the opportunity costs of investment. For instance, a historically low interest rate reduces returns than historical averages in equity and fixed income markets. When this is taken into account, individuals could gain from delaying Social Security which provides higher financial returns in this circumstance (Mahaney and Carlson, 2007; Shoven and Slavov 2014; Glickman and Hermes, 2015).

Taken together, in a life cycle model in absence of financial constraints and bequest motives, the decision to claim should be determined by the expected utility after taking into consideration of the Social Security rules, expected life expectancy, the opportunity costs of investment, and other idiosyncratic preference related factors (Shoven et al. 2018). Given the considerations, it is plausible that individuals could benefit from delaying Social Security under certain circumstances. In fact, Coile et al. (2002) conducts simulations of an expected utility maximization model and show that delays are optimal in a wide variety of cases and that gains are often significant.

c. Financial Constraint and Housing Shock

Despite potential gains highlighted in the previous subsection, in a world with the presence of financial constraints, individuals with insufficient wealth are not able to claim at the time that maximizes their lifetime benefits or their expected utility.[22] In this section, we present a simple conceptual framework that establishes the incentives for individuals to delay claiming Social Security when they experience a housing wealth shock. To do this, we consider how financial constraints may prohibit a delay in claiming as well as the role that housing wealth may play in allowing individuals to access additional funds. Following the framework of Mariger (1987), Feldstein (1990), and Mirer (1998), we focus our analysis on age 62 onwards and consider a simple model with the following assumptions:

a.1: Individuals have no labor income (they have already retired at age 62);[23]

a.2: Individuals do not have any financial wealth at age 62;

a.3: Individuals may experience an unexpected positive housing wealth shock at age 62, which could be permanent or transitory;

a.4: There is no bequest motive.

Given these assumptions, we derive our hypothesis to be tested later in the empirical analysis:

Hypothesis: If financial constraints exist and individuals experience an unexpected positive housing wealth shock at age 62, they will delay claiming Social Security. This applies regardless of whether the change in housing wealth is permanent or transitory.[24]

We explain the intuition behind the hypothesis in this section, and mathematical derivations on consumption outcomes are provided in the appendix. We start by claiming that: if financial constraints exist and individuals do not experience a housing wealth shock at age 62, they will

[22] The presence of financial constraints is also considered in Coile et al. (2002), but they do not take into account a wealth shock.

[23] Similar to Mirer (1998), in order to focus on the question of when to claim the Social Security benefits, we take the time of retirement as given rather than as something to explain. The decision of when to exit the labor market requires the individual to determine the optimal age of claiming retirement benefit as well as the age of retirement. Such a model is much more complex and beyond the scope of this paper, though interesting. In our empirics, we control for an individual's employment status.

[24] While unanticipated shocks to housing wealth are likely to be perceived as permanent (Zhao and Burge, 2017), it is possible that these shocks are perceived as transitory given the existence of housing cycles in the history of U.S.

claim Social Security at age 62; Consumption in each period will equal the benefit annuity received, which is lower than the maximized consumption without financial constraints.

The above statement follows directly from the lack of initial wealth and the presence of financial constraints. To better understand the role of financial constraints, we first consider the case without financial constraints. In this situation, we assume there exists a financial market that allows individuals to arrange a lifetime consumption profile that is independent of the time at which income is received without additional cost. At the optimum, retired individuals will delay claiming until the actuarial value of the benefits is maximized. The maximized lifetime wealth allows for maximum consumption, which leads to the highest expected lifetime utility. Then, we consider the situation with a financial constraint that prevents an individual from borrowing tomorrow's money to finance today's consumption. In this situation, an individual will have to claim Social Security at age 62, given the lack of initial wealth. Consumption will be smoothed throughout the remaining lifetime and is the same as the Social Security benefit determined by claiming at age 62. With financial constraints, the achieved consumption level is lower than the consumption achieved without financial constraints.

Given the argument, we derive our hypothesis by separately considering the case of expected versus unexpected housing wealth shock. First, expected housing capital gains are already smoothed into consumption and do not affect behaviour. Second, if individuals experience an unexpected and positive housing wealth shock at age 62, the additional housing wealth should cause the optimal time to claim Social Security to no longer be at the initial eligibility age. The specifics of the behavioral response will depend on whether the shock is permanent or transitory.

If the housing capital gains are permanent, there are two channels that may affect the timing of claiming Social Security. First, if the increased housing wealth is marketable, suggesting individuals can sell their homes for a gain, then the additional wealth generated from that sale will directly expand the budget constraint. This expansion eases financial constraints in the initial periods and allows individuals to delay Social Security claiming for higher lifetime monthly benefits. Alternatively, if an individual does not want to move, the increased housing wealth could be used directly as collateral. In this situation, individuals may borrow against housing wealth to finance consumption. In either case, a permanent positive housing wealth shock will lead to a delay in claiming Social Security.

If the housing capital gains are transitory, the effect from the direct consumption channel will be limited as there will not be a lifetime wealth expansion. However, this transitory shock could still provide opportunities for individuals to smooth intertemporal consumption by consuming housing wealth initially and paying back the debt later. Individuals could also use the appreciated home equity at the early stage as collateral to finance early consumption even if the housing wealth shock is transitory.

The simple conceptual framework provides the intuition for the impact of a housing wealth shock on the timing of claiming Social Security. For now, we do not consider the cost associated with various ways of withdrawing home equity (by either selling the house or home equity-based borrowing). In our empirical analysis, we will look for evidence of the specific channel through which the claiming response may take place. We will then provide a simple numerical analysis to shed light on the net gains after taking into account the cost associated with the specific channel.

3. Empirical Strategy

To determine the effect of changes in the house value on the decision of an elderly individual to begin receiving Social Security, we exploit the recent housing market fluctuations and conduct our analysis separately for the housing boom (2002 to 2006) and bust (2008 to 2010) periods.[25] We separate our sample into these time periods because households may respond differently to house price growth versus decline. For example, households have more of an ability to borrow against home equity when house prices appreciate, but not when house prices decline (Mian and Sufi, 2011).

We consider the impact of a percentage change in housing values on the probability of claiming Social Security once individuals become eligible. To do so, we estimate the following probit regression for elderly homeowners:

$$claim_t^{i,c} = \Phi\left(\beta_1 \Delta\% H_t^{i,c} + \beta_2 X_t^{i,c} + \gamma_s + \delta_t + \varepsilon_t^{i,c}\right) \qquad (1)$$

where $claim_t^{i,c}$ is an indicator variable equal to one if individual *i*, living in city *c*, began receiving Social Security benefits after becoming eligible in year *t*. We allow *t* to be within one or two years of reaching age 62, depending on the specification. Φ is a standard normal cumulative distribution, $\Delta\% H_t^{i,c}$ is the percentage change in house value in the previous two years for individual *i* living in city *c* in year *t*. We use the two-year change in house prices because our data, the Health and Retirement Survey, is a biannual survey, and thus we only observe house prices every other year. We control for individual attributes, $X_t^{i,c}$, including gender, race, marital status, tenure in the last job, education, total non-housing wealth, self-assessed health status, and retirement status. We include state fixed effects, γ_s, to control for unobserved state-specific attributes and year fixed effects, δ_t , to capture unobserved year-specific shocks.

We focus on claiming Social Security within one or two years in a probit setting instead of the traditional hazard approach for two reasons. First, as illustrated in Figure 3, more than 50% of

[25] Although house prices started to decrease before 2008, we focus on 2008 to 2010 because we use the house price change in the previous two years.

individuals claim Social Security within one year of becoming eligible, and more than 60% claim within two years. Hence, the main variation in the timing of claiming Social Security is whether or not an individual claims within the first one or two years of becoming eligible. Second, as we discuss in detail later, we implement a control function approach to address the potential endogeneity problem. Given the assumptions of the control function approach, using this methodology within a traditional hazard model is not feasible in our setting.[26] To strike a balance between the limited amount of variation in the timing of the decision to claim and the assumptions that have to be imposed in the empirical setting, we use a probit model.

As mentioned earlier, a probit model likely suffers from endogeneity issues that would bias our estimates. Specifically, there may be unobserved local demand shocks correlated with local house price appreciation, which simultaneously affect when an individual chooses to start receiving Social Security benefits. For example, unobserved positive local demand shocks may contribute to higher house prices and overall price inflation in the area. This situation may increase the likelihood of claiming Social Security benefits early in order to pay the higher prices to fund current consumption.[27] Alternatively, if house prices increase, the local economy may be experiencing a positive demand shock in the labor market, which may cause individuals to continue working to delay claiming Social Security benefits. If either situation were true, our estimation would suffer from the omitted variable bias, and the sign of that bias is ambiguous.

To combat this issue, we use a control function approach. In our non-linear setting, a traditional two-stage least squares approach will produce inconsistent estimates of the coefficients

[26] The same approach to estimate a hazard model that takes into consideration the full spectrum of the timing variation is subject to more stringent assumptions. MacKenzie et al. (2014) shows that the instrumental variables estimator for the marginal hazard ratio relies on the assumption that the omitted covariate has an additive effect, which has to satisfy mean-zero property to ensure the marginal distribution of the outcome variable satisfies a proportional hazard model with the specified hazard ratio.

[27] The Social Security Administration make the Cost-of-Living adjustment for the benefit but it is at the national level.

and partial effects (Blundell and Powell, 2003, 2004; Wooldridge 2005). Therefore, to obtain consistent estimates, we utilize the control function method to address the endogeneity concern (Petrin and Train, 2010; Wooldridge, 2015).[28]

We use two different instruments to show the robustness of our results. The first-stage regression for the control function for our first instrument is specified as follows:

$$\Delta\%H_t^{i,c} = \theta_1 \Delta\%P_t^{US} \times Elasticity^c + \theta_2 X_t^{i,c} + \gamma_s + \delta_t + \epsilon_t^{i,c} \quad (2)$$

where $\Delta\%P_t^{US}$ is the two-year percent change in the national house price index, $Elasticity^c$ is the Saiz (2010) estimate of the housing supply elasticity in MSA c (a city is represented by an MSA in this instance), and ϵ_t is the error term. We argue that the interaction of the supply elasticity and the percent change in the housing price index meets the exclusion restriction necessary to be used as an instrument. This is because, in response to a nation-wide positive demand shock, MSAs with more inelastic housing supply (i.e., New York City, NY or San Francisco, CA) will experience larger house price appreciations than MSAs with a more elastic housing supply (i.e., Houston, TX or Kansas City, MO). This variation is likely driven by the exogenous location-specific topological features and land use stringency embedded in the elasticity measure. Mian and Sufi (2011) have documented, for example, that the most elastic housing supply MSAs experience almost no increase in house prices during the boom period, but the inelastic housing supply MSAs experience strong growth during the boom.

To verify the rationale in our setting, Figure 6 shows the change in homeowner assessed house price for the ten most elastic MSAs and the ten most inelastic MSAs from 1994 to 2010. Houses in inelastic MSAs are associated with higher values. More importantly, the figure shows that during the housing boom period, inelastic MSAs experienced a much more dramatic house

[28] Despite with a different way to construct the "controls," Wooldridge (2015) states that the control function approach is inherently an instrumental variables method as it also relies on excluded instrumental variables.

price appreciation compared to the elastic MSAs. The pattern is consistent with the housing price growth rate documented in Mian and Sufi (2011).

Furthermore, Figure 7 shows the extent to which early claiming of Social Security benefits is correlated with MSA land supply elasticity. If the MSA-specific land supply elasticity provides variation in explaining the house price appreciation which further explains the tendency to claim Social Security early, we should observe that during the housing boom period, early claiming rate declines faster for inelastic MSAs. Figure 7 shows a clear divergence in the probability of claiming within 1 or 2 years for the most elastic MSAs versus the most inelastic MSAs during the housing boom period. Consistent with our hypothesis, individuals in inelastic MSAs are less likely to claim early. This evidence is consistent with the underlying rationale for exploring the exogenous variation in supply elasticity to explain the tendency to claim through the home equity-based borrowing channel.

The supply elasticity has been used as an instrument extensively in the literature in similar contexts (e.g., Mian and Sufi, 2011, 2014; Chaney et al., 2012; Mian et al., 2013; Cvijanović 2014; Dettling and Kearney 2014; Akadabgadt 2017, Chetty et al., 2017 and Stroebel and Vavra, 2019). However, we recognize that the validity of using the supply elasticity as an instrument has been criticized by Davidoff (2016), arguing that the attributes of housing supply that make areas more difficult to develop (such as lakes and mountains) are valued amenities which will be correlated with demand for housing in the area.

We believe that the Saiz instrument is appropriate in our context, despite the critique, for two reasons. First, Mian and Sufi (2011, 2014) show that changes in many fundamental local economic indicators are uncorrelated with the elasticity measures, such as wage growth. The authors also show that the Saiz (2010) elasticities are uncorrelated with the 2006 employment share in construction, construction employment growth, and population growth during the housing boom. Similar evidence has also been documented more recently in Akadabgadt (2017), Chetty et al., (2017), Stroebel and Vavra (2019). To test this within our sample, we find that the correlation between housing supply elasticity and income growth is -0.0994 during the housing boom – consistent with what has been documented in the literature. Based on the fact that we do not find correlations between housing supply elasticity and local demand factors, we believe that the exclusion restriction is met.

Second, unlike Mian and Sufi (2011, 2014) we do not use the supply elasticity directly for our analysis but the interaction between the supply elasticity and the national house price index, similar to Cvijanović (2014). The intuition behind using the interaction is that for an equivalent aggregate house price shock, measured using the national house price index, the land supply curve determines the degree to which real estate prices rise in different areas. This methodology allows our instrument to provide the local house price appreciation that is unrelated to local economic conditions, except through its effect on house prices. Given that our sample period is a relatively short time period, we believe it is plausible that these short-run changes in house prices do not have a sufficient amount of time to be compensated by a change in amenities or productivity.

However, even with the above arguments, to safeguard our estimates and also to show robustness, we employ a second instrument proposed by Guren et al. (2019). The control function is specified as follows with the second instrument:

$$\Delta\% H_t^{i,c} = \mu_1 \Delta\% P_t^r \times \varphi^c + \mu_2 X_t^{i,c} + \gamma_s + \delta_t + \epsilon_t^{i,c} \qquad (3)$$

where $\Delta\% P_t^r$ is the percent change in regional house prices. φ^c is estimated by Guren et al. (2019) and is a proxy for the housing price sensitivity in a CBSA c, which plays a similar role to the supply elasticities used for the first instrument (a city is represented by a CBSA in this instance).[29] When they estimate the φ^c, the authors include various controls, such as local and regional changes in retail employment. This allows the authors to remove possible reverse causation when estimating φ^c. The key identifying assumption of this instrument is that conditional on the controls, there are no other aggregate factors that are correlated with regional house prices and that differentially affect the decision to claim Social Security immediately that are sensitive to house prices as captured by φ^c.

The second instrument exploits the fact that house prices in some cities are systematically more sensitive to regional house price cycles than other areas. First, the authors estimated the systematic historical sensitivity of local house prices to regional house price cycles. This historical sensitivity estimate is then interacted with today's shock to regional house prices, giving it a structure similar as Bartik-type instruments. For this instrument to be valid, the identifying assumption is that, conditional on the control variables included, there are no other unobserved factors that are both correlated with regional house prices and that differentially affects the same cities that are more historically sensitive to regional housing cycles.

4. Data and Summary Statistics

Our analysis relies on four data sources. The primary data source is the restricted access Health and Retirement Study (HRS) with geographic identifiers. The HRS is a longitudinal household survey of more than 26,000 Americans over the age of 50 and is collected every two years. The public version of the HRS provides detailed information on demographics, financial and housing wealth, health, labor market status, etc. The restricted geographic version adds additional details

[29] As noted by Guren et al. (2019), φ^c is the proxy for the inverse of the housing supply elasticity in CBSA c.

on the county in which the respondent lives, which is necessary because our instrument is at the MSA level. After a preliminary screening, our sample includes 19,027 individuals.[30]

The remaining three data sets are used to create our instruments. For our first instrument, we utilize the national house price index constructed by the Federal Housing Finance Agency (FHFA).[31] The FHFA index is widely used to capture national and local house price trends (e.g., Himmelberg et al., 2005). In addition, we use the housing supply elasticities for 269 MSAs, calculated by Saiz (2010). He estimates land supply elasticities by processing satellite-generated data on elevation, the presence of bodies of water, and the Wharton Regulation Index (WRI), which is a measure of the stringency of land use regulation. Land use regulations play a role in differences in the availability of land (Glaeser and Gyourko, 2003; Glaeser et al., 2005), together with physical constraints. The second instrumental variable is a measure of how sensitive a CBSA is to house price cycles, created by Guren et al. (2019).[32]

We match MSAs and counties using the Geographic Correspondence Engine.[33] Given that we use the MSA-level housing supply elasticity for our identification strategy, we limit our sample to the counties located within the MSAs covered by the Saiz (2010) elasticity measure. We further restrict our sample to those who are homeowners at the time when they become eligible for Social Security.[34] We also drop individuals who moved in the previous two years to ensure that the

[30] Initially, the sample included 37,319 elderly individuals. We exclude the 5,729 individuals who report receiving Social Security benefits before becoming age eligible. We also exclude the 706 respondents who report ever receiving disability retirement benefits. Further, we include only individuals whom we observe before they turn 60 (two years before the eligibility age), which causes us to lose 11,857 respondents.

[31] http://www.fhfa.gov/DataTools/Downloads/Pages/House-Price-Index-Datasets.aspx#qat.

[32] This instrument is available online at the authors' websites.

[33] http://mcdc2.missouri.edu/websas/geocorr2k.html.

[34] We limit our sample to homeowners due to the fact that we are examining how a change in house value affects Social Security claiming behaviour. Renters do not own the residence they reside in. Therefore a change in house prices will not affect their assets or budget constraint and thus should not affect their Social Security claiming behaviour. Other researchers have used renters as controls or robustness checks (Zhao and Burge, 2017, for example). It is not feasible for us for three reasons. First, our key explanatory variable is the change in owner's assessed home value as opposed to a change in the aggregate housing price index as used in other settings. We focus on the owner's

change in home equity is due to price appreciation/depreciation of the same housing unit. Finally, we exclude households that experienced a percent change in house prices in the previous two years, either above the 99th percentile or below the 1st percentile. This reduces the sample to 8,959 individuals within 1,235 counties in 215 MSAs.[35]

Table 1 presents summary statistics for all our variables. We present the mean and standard deviation of each variable for three periods: the full sample (2002 to 2010), the boom period (2002 to 2006), and the bust period (2008 to 2010). In the full sample, around 52% of the elderly claim Social Security within one year of becoming eligible, which is consistent with the number reported by the U.S. Social Security Administration. This number is higher during the boom period but decreases during the housing bust. The lower probability of claiming early on average during the bust period may be due to changes in the Social Security program. Specifically, there were changes in the generosity of benefits that made claiming early less beneficial for the cohorts who happened to become eligible during the bust period.

Note that, although the HRS is conducted every two years, the respondents report the actual year and month they started receiving Social Security. This information allows us to expand the biannual survey to an annual panel and record precisely the timing of Social Security receipt. However, because respondents only report house values during the survey years, we still need to

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assessed value because we think the change in the claiming behaviour should result more from the owners' perceived home value change as compared to that of the housing price index at an aggregate level. If a homeowner does not realize the house price appreciation despite there is, his or her budget constraint should remain unchanged and there should not be any subsequent behaviour responses. In this logic, we cannot extend our analysis to renters as the assessed value is not reported by renters. Second, our identification relies on exogenous variation in the interaction of the supply elasticity and the national house price appreciation which is highly correlated with MSA housing price index. If we impute the renter's assessed value using the MSA housing price index, we introduce arbitrary correlations in the data which invalidates our identification strategy. Third, even if renter's assessed values could be imputed, owners and renters have very different social demographics in our data. Therefore, we worry that the two groups are not comparable and comparing the two would create bias in our empirical approach.

[35] This sample size is before we restrict observations to the boom and bust periods and to those with valid entries for all included control variables.

use the two-year change in house prices. For survey years, we take the difference in reported house prices between the two surveys. In non-survey years, we use the reported house prices in the adjacent two years and the MSA house price index to extrapolate the house value. For example, for 2005 we use the reported house values in 2004 and 2006, as well as the MSA house price index in 2004, 2005, and 2006, to estimate the reported house value in 2005.

With regards to the change in house prices, we see in Table 1 that the two-year average percentage change in house values in our sample is 12% from 2002 to 2010. The national and MSA house price appreciation rate, however, are both approximately 10%. From 2002-2006, this number increased to approximately 19% in our sample, 17.5% at the national level and MSA level. However, during the bust period from 2008-2010, house prices declined by about 4% as calculated based on owner's reported housing values in our data, and 8.3-8.5% based on national housing price index and MSA-specific housing price index.[36]

The average housing supply elasticity is approximately 1.73. The average sensitivity of house prices in different cities to regional house price movements is 1.07. Approximately 57% of respondents are female, 86% are white, and 82% are married. Older workers with more than ten years of service in their last job are 35% of our sample. Approximately 56% of the sample has completed high school, and 28% have a college degree. The average non-housing wealth is about $428,063. The average self-assessed health status is 2.48, which suggests that elderly individuals

[36] One explanation for why the reported house values are above the national and MSA house price index values is that we are only considering a sample of the elderly population while the indices are based on the entire population. It is plausible that the average house value of an elderly individual is different from the national average. Alternatively, individuals may overestimate the value of their home. The evidence on what determines the possible reporting errors is mixed. Haurin et al. (2018), who examined just the elderly population, found that the size of the error changes with income, credit score, and ethnicity. Goodman and Ittner (1992), however, found that this reporting error is uncorrelated with characteristics of the home, the local economy, and the homeowner. We include a variety of controls to minimize any bias in the error term similarly as in Corradin and Popov (2015) and Harding and Rosenthal (2017). In the empirics to follow, the possible existence of reporting errors is addressed by using the control function approach.

assess their health as "good" on average.[37] Given the important role of retirement decisions in Social Security claiming, we also control for retirement status. Approximately 38% of the respondents are no longer working. These averages are similar for both the boom and bust periods.

5. Results

a. Baseline

We begin our analysis by estimating Equation (3) using a probit model. Results are presented in Table 2. Column (1) examines whether an individual claims Social Security within one year of becoming eligible during the housing boom (2002 to 2006). Column (2) examines whether an individual claims Social Security within two years after becoming eligible. Columns (3) and (4) follow the same structure as Columns (1) and (2) but cover the bust period (2008 to 2010). All specifications include controls for gender, race, marital status, tenure at their last job, education, non-housing wealth, self-assessed health, and employment status. We report the coefficients from the probit model in the upper panel and the corresponding marginal effects in the lower panel. Standard errors are clustered at the city level and are reported in parentheses.

As shown in Table 2, we do not find consistent evidence of an effect of changes in house value on Social Security benefit claiming during either the boom or bust period. This result suggests that when house prices change, there is no statistically significant effect on whether elderly households claim Social Security within one or two years of becoming eligible. However, as discussed previously, a probit model is likely to suffer from endogeneity issues due to omitted variable bias at the local level. We address this concern by using a control function approach, and

[37] The variable "self-reported general health status" includes five values, with 1 for "excellent," 2 for "very good," 3 for "good," 4 for "fair," and 5 for "poor."

two independent sets of instrumental variables: the interaction of the housing supply elasticity, created by Saiz (2010), and the change in the national house price index and a measure of house price variability to regional price cycles, created by Guren et al. (2019).

Table 3a reports results using the Saiz (2010) instrument and Table 3b reports results using the Guren et al. (2019) instrument. Both tables follow the same structure as Table 2. The first-stage results at the bottom of both tables indicate that our instrument has significant explanatory power for our endogenous regressor because the F-stat is consistently above the standard threshold of 10. The estimated coefficient is also consistent with our priors that areas which have a lower supply elasticity or a higher price sensitivity are associated with a higher rate of house price appreciation.

The second-stage results reported in Tables 3a and Table 3b indicate a negative and statistically significant effect of a change in house prices on the likelihood of claiming Social Security benefits early during the boom period. This statistically significant negative effect contrasts our probit estimates in Table 2 and suggests that when house prices increase, elderly individuals delay receiving Social Security. Quantitatively, using the Saiz (2010) instrument, the findings suggest that when housing values increase by 10%, the probability of claiming Social Security within one year of becoming eligible is reduced by 4.26 percentage points and the probability of claiming within two years of becoming eligible is reduced by 5.47 percentage points. This translates into a 8.28% decrease in the probability of claiming within one year of becoming eligible and a 9.02% decrease in the probability of claiming within two years of becoming eligible. The results in Table 3b using the Guren et al. (2019) instrument are of a similar magnitude. Specifically, the results show that when housing values appreciate by 10%, the probability of claiming Social Security within one year of becoming eligible is reduced by 4.06 percentage points and the probability of claiming within two years of becoming eligible is reduced by 5.56

percentage points. This translates into a 7.89% decrease in the probability of claiming within one year of becoming eligible and a 9.16% decrease in the probability of claiming within two years of becoming eligible. Overall, the results suggest that elderly individuals utilize housing capital gains to finance expenditures and delay receipt of Social Security to receive higher lifetime monthly benefits.

Comparing our probit estimates and control function estimates, we may draw some insight on the underpinnings of the bias present in the probit model. First, the null finding of the probit model could result from severe attenuation bias due to measurement errors of the key independent variable. Second, it could also result from a dominating upward bias through one of the channels. As mentioned earlier, we are concerned with two main sources of endogeneity: the unobserved local inflation or unobserved local labour market performance. The former leads to an upward bias while the latter leads to a downward bias of the probit estimate. Given that we explicitly control for the labor force participation, we are less concerned with the second source of bias. The magnitude of the positive bias is then determined by the correlation between the unobserved increased cost of consumption and the likelihood of early claiming, as well as the ratio of the standard deviation associated with both. If the magnitude of this bias roughly matches the true estimated coefficient, we may end up having a probit estimate that is close to zero and statistically insignificant.

During the bust period, however, we do not find a statistically significant effect using either instrument. This result is consistent with the argument that when house prices depreciate, borrowing against home equity is no longer a viable option. Furthermore, as argued in Bhutta and Keys (2016), housing is a durable good, and there is less likely to have a supply response during a bust period, which would affect the identifying variation that both instruments can use. In general, our results are consistent with Harding and Rosenthal (2017) who find that housing capital gains encourage entry into self-employment, but housing capital losses have no discernible effect on entry into or exit from self-employment.

b. Heterogeneity by Financial Constraints

Next, we consider if the impacts of house values on claiming behaviour found above differ based on if an individual is more likely to be financially constrained. As explained in the conceptual model, having more wealth and assets allows individuals to finance consumption without having to claim Social Security benefits. This additional wealth provides the opportunity for an individual to delay claiming to receive higher monthly benefits.

We explore this empirically by looking at two indicators reflecting an individual's assets: the stock account balance and the outstanding mortgage amount two years before becoming eligible to claim Social Security. Results using the Saiz (2010) instrument are presented in columns (1) and (2) and results using the Guren et al. (2019) instrument are reported columns (3) and (4) in Table 4. Going forward, we focus only on the decision to claim within two years of becoming eligible during the boom period. Results regarding the decision to claim within one year are similar and are reported in the Appendix Table A1. We focus on the boom period given the results from Tables 3a and 3b that the effect of house price changes on Social Security claiming is only present when house prices appreciate.[38]

As shown in Table 4, using both instruments we find that a positive shock to housing wealth delays claiming Social Security for those individuals with a zero stock account balance but there is no statistically significant relationship for those individuals with a positive stock account balance.

[38] When examining the bust period, we do not find any statistically significant effects. In the interest of brevity, we do not include these results. These results are available from the authors upon request.

Note that the first-stage F-statistics are not over the standard threshold of 10 for those households with a positive stock balance, so these results may suffer from a weak instrument problem.[39] However, the findings in columns (1) and (3) are in line with our priors that those who are financially constrained are more likely to need to draw upon housing assets to finance current consumption and delay claiming Social Security because they do not have another option.

Similarly, in Table 5, we find that those individuals with a positive mortgage outstanding two years before becoming eligible to claim Social Security are more likely to delay claiming within two years of becoming eligible if house prices appreciate.[40] This is true when we further restrict our sample to individuals who did not move in the previous two years. Note that stayers with an outstanding mortgage are identified based on the lagged status, as we think the current mortgage status could be simultaneously determined by home equity-based borrowing. For those individuals who do not have a mortgage, the results are statistically insignificant. Overall, the findings in Tables 4 and 5 support the argument that the households who are more likely to be financially constrained are driving the baseline results.

c. Heterogeneity by Gender and Actuarial Analysis

The second important heterogeneity dimension that we explore is by gender. Gender should play an important role in Social Security claiming as there is a significant difference in the average longevity between males and females. Despite having a higher monthly benefit amount, an

[39] The first-stage F-statistic could be lower than the full sample due to the fact that when we restrict our sample to different groups we exclude some geographic areas. These excluded areas could be in the MSAs with large variations in the supply elasticity. Losing these observations would hence reduce the variation of our instrument and the power of identification. In future regressions with restricted samples, we believe a similar situation of dropping MSAs and variation may be the reason we do not have as strong of an F-statistic as our full sample results.

[40] We find similar results that individuals with a positive mortgage outstanding are more likely to delay claiming within one year of becoming eligible if house prices appreciate in Table A2 in the Appendix.

individual claiming later will receive the benefits for a shorter period of time given fixed life expectancy. Then females, often associated with a longer life expectancy, would be more inclined to delay claiming Social Security benefits since they will receive higher benefits for a longer period of time. Table 6 reports the control function results stratified by gender.[41] As we did for the financial constraint variables, we show results using the Saiz (2010) instrument in columns (1) and (2) and results using the Guren et al. (2019) instrument in columns (3) and (4). As shown in Table 6, we do not find a statistically significant effect for males, but we find a strong and statistically significant negative effect for females.[42]

The empirical evidence is in line with the role of life expectancy in determining claiming decisions. We formalize this intuition by conducting a gender-specific actuarial analysis. In a simple world where Social Security benefits were only based on income earned, we first consider how the Social Security benefit stream changes with the claiming age. Let $B_{a,c}$ denote the Social Security benefits received at age a for cohort c. We specify $B_{a,c}$ as,

$$B_{a,c} = \begin{cases} 0 & \text{for } \; a = 62, \dots, \tau - 1 \\ (1 - \delta_{\tau,c}) B_{FRA,c} & \text{for } a = \tau, \dots, N, \end{cases}$$

where τ is the age (in months) that a person starts to receive Social Security, $B_{FRA,c}$ is the cohort-specific benefit at the FRA, and $\delta_{\tau,c}$ is the penalty or credit imposed on early or late claimers, respectively.

When individuals become eligible for Social Security at age 62, the expected present value of the Social Security benefits for cohort c conditional on τ, denoted as $PV_c|\tau$, can be written as,

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[41] Results are similar when we look at the decisions over one year, reported in Table A3 of the Appendix.

[42] The first-stage F-statistic for the female claiming within one year is a bit low compared to other cases. We do,however, find statistically significant evidence for the case of female claiming within 2 years.

$$PV_c|\tau = \sum_{a=62}^{N} \frac{S_{a,c}B_{a,c}}{(1+r)^{a-62}},$$

where $S_{a,c}$ is the probability an individual born in cohort c survives to age a conditional on the person being alive at age 62. r is the discount factor, and N is 120. Individuals have an incentive to delay claiming Social Security if delaying leads to a higher PV.

Next, we assess PV conditional on τ separately for each cohort by gender. We separate the sample as such because the FRA and deductions are cohort-specific, and the life tables of survival rates, which give us $S_{a,c}$, are cohort-specific and gender-specific. On average, women have a longer life expectancy than men. According to the institutional features of the Social Security system, the average value across all cohorts of $\delta_{\tau,c}$ is approximately $\pm\frac{5}{9}$ percent for each month the individual deviates from the FRA (i.e., 6.67 percent reduction per year for earlier claimers).

The present value is quantified as follows. For simplicity, we assume that the monthly benefit is $1,000 at the FRA for each cohort. We then apply the penalty for claiming before the FRA and the credit for delayed claiming after the FRA from the Social Security Administration.[43] We assume that the annual discount rate is 3%, which is the long-term inflation rate in the U.S. [44] and has been used previously in the literature (e.g., Heiland and Yin, 2014). Finally, we use the Life Table by birth cohort and gender provided by Bell and Miller (2005) and Poterba (2014) to impute the monthly mortality rates.[45]

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[43] The reduction for early claiming and credit for delayed retirement are from https://www.ssa.gov/planners/retire/ageincrease.html, and https://www.ssa.gov/planners/retire/delayret.html, respectively.

[44] The long term inflation rate is from http://www.usinflationcalculator.com.

[45] The Life Table has mortality at each age until age 120 (in years). Poterba (2014) projected the mortality based on the cohort life tables from Bell and Miller (2005) and calculated the annual mortality rates as the probability of dying within one year at certain age (conditional on living at certain age). We calculate the monthly mortality rate to be $S_{a,c}^{m} = 1 - (1 - S_{a,c}^{y})^{1/12}$. $S_{a,c}^{y}$ is the annual mortality rate and $S_{a,c}^{m}$ is the probability of dying within one month at a certain age. We then calculate the unconditional survival rate at age 62 based on the conditional mortality rate.

We present the calculated present values in Figures 4 and 5. The patterns suggest that both males in the 1938–1939 birth year cohort and females in all birth year cohorts have an incentive to delay claiming past age 62 because the present value is higher at a later claiming age. Males in the younger cohorts seem not to have an incentive to delay as the maximized PV is achieved close to age 62 in this example.[46] Comparing males in the older cohorts and females, the present value for females is maximized at a claiming age older than 64, but the present value for males is maximized at a claiming age younger than 64. In addition, the difference in magnitude between the initial present value and the maximized present value is larger for females than for males in the early cohorts. These differences in present value suggest that men may not be as responsive as women with regards to delaying claiming Social Security. Our results are generally consistent with our empirical finding and are also consistent with the literature that emphasizes the role of life expectancy in determining whether to delay claiming Social Security (Coile et al., 2002; Shoven and Slavov, 2014).

d. Heterogeneity by Marital Status

For simplicity, the previous subsection only considers the differences in the tendency to claim Social Security across gender groups due to differences in life expectancy. In reality, beyond life expectancy, the benefit streams are affected by marital status and survivor benefits based on spouse's death. Taking into account all these factors will likely change the incentives of males and females based on specific circumstances. Therefore, given the complex rules of Social Security, we next explore the heterogeneity based on marital status to hopefully shed lights on the

[46] The cohort differences are due to the fact that different cohorts have different mortality rates. Plus, the reduction for early claiming and the credit for late claiming are also different for different cohorts as regulated by the Social Security Administration (SSA).

dominating factors governing Social Security claiming in our context.[47]

We stratify our sample by marital status and present these results in Table 7. When looking at the married group, we also control for the spouse's age as it could be associated with the incentive to claim Social Security.[48] We find significant claiming responses to housing shocks for the married group using both instruments but statistically insignificant evidence for the singles, though the first stage F-statistic is low for singles.[49] The result might be explained by the findings in Shoven and Slavov (2014) that the gains from delaying could be greater for married couples relative to singles. If so, married couples should be more responsive to a positive housing wealth shock. The differing results could also be due to the small sample size for the single group. As such, we try not to over-interpret the results for singles.

We think the result for couples could be driven by the incentives of both the husband and the wife, despite the null findings on male reported earlier. This is because the Social Security rules provide generous widow benefits and allow for switching possibilities. For example, a wife is allowed to switch from her own benefits to her husband's benefits or widow benefits if her husband passes away. In this case, the husband may have the incentive to claim the benefits later to increase his own benefits and his potential widow's benefits after his death (Hubener et al., 2016). We attempted to divide the sample into married men versus married women to explore

[47] Unfortunately, due to sample size issues, we do not have the capacity to compare across all possible combinations of individual subgroups based on gender, marital status, wealth, income etc. Hence, we focus on more broadly defined categories that help to shed light on the differences in delaying incentives.

[48] For example, consider a situation of spousal benefits with a husband who has worked for 35 years and a wife who has never worked. The wife is entitled to spousal benefits, which is equal to 50% of the benefit amount paid to the husband if the wife claims the benefits at her FRA. We can see that the wife has similar incentives to delay receiving her spousal benefits as her husband does to claiming his benefits. Furthermore, as noted the wife gets 50% of the husband's monthly benefits. If the husband delays claiming Social Security, he increases both his monthly benefits as well as his wife's spousal benefits. We see how the age of the spouse, as it relates to these claiming decisions, is important for a household financial planning.

[49] The effects reported in Table A4 for claiming within one year are not significant for married couples using the Guren et al. instrument, though.

possible heterogeneity, but unfortunately lost significant power in our identification, and the results were very noisy.

Alternatively, it might be possible that the husband and wife are not making decisions jointly. The wife is in general associated with a longer life expectancy and could also be more likely to be financially constraint due to lower labour force participation rate and lower income. In this case, the wife could have a stronger incentive to claim Social Security early, regardless of husband's incentives. We cannot attempt to prove the validity of this argument though, despite that it is consistent with our empirical findings. However at least along these lines, the evidence seems to suggest that the role of life expectancy in determining claiming decisions has a stronger effect than differences in the Social Security rules regarding early claiming.

6. Mechanisms

Our results thus far indicate that elderly individuals delay claiming Social Security when house prices appreciate, especially those that are more likely to be financially constrained. Next, we consider the mechanism through which elderly individuals draw down their home equity. There are two main channels elderly individuals could use to withdraw home equity. First, homeowners could sell their home and move into either a cheaper unit, or they move and become renters. Second, homeowners could stay in their current home but borrow against the appreciated home equity.[50] We consider these two channels and examine which one is driving our baseline results below.

a. Do Individuals Sell Their Current Home?

[50] We also considered other possibilities such that individuals could rent out their residence(s) and derive a higher positive rental income from the boom market. To investigate this channel, we examine whether the total rental income has increased or not during the same period. We report our estimates in Table A6 of the Appendix. Overall, we do not find any significant impact on the increased rental income.

One possible mechanism behind our findings is that when house prices appreciate, elderly households downsize and move to a cheaper house or switch from homeownership to renting. By selling their house and moving, these individuals are able to withdraw their home equity. We examine these mechanisms in Tables 8. In columns (1) to (5) we use the Saiz (2010) instrument and in columns (6) to (10) we use the Guren et al. (2019) instrument.

In columns (1) and (6), we examine the likelihood that an elderly individual stays in his or her current home when the value of the house increases. We see that households are more likely to stay in the same home over the next two years[51] after their home value appreciates.[52] In columns (2) and (7), we restrict our sample to stayers and look at the probability of claiming within two years of becoming eligible for Social Security.[53] We find consistent negative effects, indicating that stayers are more likely to delay receiving Social Security if their house value appreciates. Overall, these results do not support an argument that a mobility response is driving our results.

In columns (3) to (5) and (8) to (10), we consider the effects of claiming Social Security within one year of becoming eligible among different types of individuals. In columns (3) and (8), we consider if households that do not have a secondary property claim within one year of becoming eligible. This is an important check for three reasons. First, those individuals who have a secondary property could sell their second home to obtain the additional income needed for consumption. In this case, even though individuals do not move, they are still relying on the channel of selling their properties (as mentioned in Footnote 61, we do not find increased rental income, as reported in Table A6 in the Appendix). Second, a secondary home could lead to measurement error in

[51] Results are similar when we look at these decisions over 1 year. Those results are available in Table A5 of the Appendix.

[52] In our sample of 1,124 elderly individuals, only 65 moved after turning 62.

[53] In the interest of brevity, we only report results for claiming within one year of turning 62. Results for claiming within two years of becoming eligible are consistent and available from the authors upon request.

capturing the appreciated housing value that the individual experiences, as we do not know the location of their secondary properties. Third, having a second property may be an indicator of being less financially constrained. Hence, it is worth looking at individuals without a secondary property to obtain results that do not have these possible confounding factors. We find that the baseline results persist for this group of individuals.

Furthermore, in columns (4) and (9), we restrict the sample to stayers with zero stock account balance. In columns (5) and (10), we restrict the sample to stayers who have not paid off their mortgage as a proxy for being financially constrained. These results are similar to our earlier findings, in that these individuals are more likely to delay claiming Social Security when their home value increases. Overall, these findings suggest that the stayers who are more likely to be financially constrained are the ones who are delaying claiming when their house price increases versus the lack of results regarding a possible mobility response.

b. Do Individuals Borrow Against Home Equity?

In Table 9, we provide direct evidence of cashing-out home equity, which could occur by taking out a first mortgage, a second mortgage, or a Home Equity Line of Credit (HELOC). To capture this mechanism, we examine the effect of an increase in home value on whether the total housing loan amount increased or not.[54] Due to this, the sample is restricted to those individuals in the HRS who have valid data on the total home loan amount. Table 9 follows a similar structure as Table 8, except in this case the dependent variable is an indicator variable for whether or not the total home loan amount increased. In columns (1) and (6), we look at if the total home loan

[54] Reverse mortgages are another tool that is available in practice for the elderly. In reality, very few individuals take out a reverse mortgage. For more information on reverse mortgages, see Mayer and Simons (1994), Merrill et al. (1994) and Haurin et al. (2018).

amount increases after house prices appreciate for all individuals in our baseline regression with the slightly restricted sample. We find a strong positive effect, which suggests that households draw upon their home equity in response to house price appreciation. This evidence is consistent with previous findings on the home equity-based borrowing channel as documented in Mian and Sufi (2011), Cooper (2013), Aladangady (2017), and others.

In columns (2) to (5) and (7) to (10), we dig further into these results regarding the increase in home loan amount when house prices appreciate. In columns (2) and (7), we focus on the stayers. Again, we find a strong positive effect, suggesting that those staying in the same home are taking actions to increase the amount of their home loans. In columns (3) and (8) we focus on those without a secondary home, in columns (4) and (9) we focus on those with zero stock account balance, and in columns (5) and (10) we examine those who have a mortgage two years before becoming eligible to claim Social Security as a proxy for financial constraint. Again, we believe that these households are more likely to be financially constrained and therefore are more likely to take out a home loan to finance expenditures and delay claiming Social Security. We find positive and statistically significant results in all regressions when we use the Saiz (2010) instrument. When using the Guren et al. (2019) instrument, we find positive but not statistically significant effects for stayers without a secondary property and stayers with zero stock account balance, but positive and statistically significant results for all individuals, for stayers, and for those who have an outstanding mortgage. Overall, these findings support the result that households, especially those that are more likely to be financially constrained, are drawing upon their home equity to delay claiming Social Security.

c. Cost-Benefit of Home Equity-Based Borrowing

The evidence thus far suggests that individuals may substitute home equity-based borrowing for Social Security benefits. The next question is, what could be the potential financial gains if individuals choose to do so, taking into account the interest rate cost associated with taking out an additional home loan. To shed light on the financial incentives to delay after considering these costs, we follow the same numerical set-up as in our gender-specific actuarial analysis in Section 3 to illustrate the potential net gains through a simple example. We use the 1940 cohort as an example because this cohort reaches age 62 in 2002, the beginning of our sample period.

We report our calculations of the cost and the benefit in Table 10. First, we quantify the benefits of delaying based on the exercise that produced Figures 4 and 5. We again assume that the monthly benefits will be $1,000 if an individual claims Social Security at the FRA. We find that, relative to the present value of the benefit stream if claiming at age 62, men in the 1940 cohort in our example would suffer a loss of $193 if they delay claiming to age 63, a loss of $4 if they delay claiming to age 64, and a loss of $821 if they delay claiming at age 65. Women, however, in the same cohort gain $874, $2,243, and $2,537 if they delay claiming Social Security at age 63, 64, and 65, respectively. Second, we consider the cost of home equity borrowing to arrive at the net benefit of delaying. The cost side is gender neutral because we assume markets are efficient, and there is no discrimination. However, since men report a negative benefit to delaying claiming past age 62, regardless of the costs of home equity borrowing, they do not have an incentive to delay claiming in our example. Therefore, we focus on whether the gains females realize from delaying receiving Social Security is sufficient to cover the cost of withdrawing home equity.

We calculate the net benefit by assuming the amount of money individuals need to borrow to delay receiving Social Security. For simplicity, we assume this amount is $775 monthly, or $9,300 annually, at age 62 to delay claiming Social Security. We select $775 because that is the monthly benefit an individual will receive if she claims at age 62 given that the FRA benefit amount is $1,000. We assume that any money borrowed is paid back when the individual begins receiving Social Security. For example, if an individual claims Social Security at age 64, she needs to borrow $18,600 and will pay back the money at age 64. We report the net benefits at different claiming ages in Table 10. We discount the cash flows back to age 62 to compare this to the present value of gains. We use a mortgage interest rate of 6.54%, as that was the approximate value in 2002.[55] If the loan is paid one year later, the present value of the interest is $334 based on the monthly periodic rate. Similarly, the present value of interest is $1,359 if the loan is paid off two years later and $3,113 if the loan is paid off three years later. By comparing the benefits and costs, we see that women in this example would like to delay one or two years. Through this simple exercise, we gain insight on the financial incentives to rely on the home equity-based borrowing channel to delay the claiming of Social Security benefits.

Despite the above exercise being intuitive and helpful, we also recognize that it is not sufficient to capture the accurate level of the benefits for different individuals. First, the actuarial analysis that gives rise to the benefit amount does not take into consideration various other individual characteristics. Second, calculated benefit amounts are based on the assumption of $1000 of monthly benefits at the FRA. We assume that people borrow the amount equivalent to how much they receive if they claim at age 62. In reality, the actual realized gains are proportional to how much is received at the FRA and are affected by the amount of borrowing. For example, individuals may have a certain level of financial wealth to begin with. In this case, the amount needed to borrow would be less than $775, which will lead to a more substantial gain. This is

[55] http://www.freddiemac.com/pmms/pmms30.html.

because the lower the loan amount, the less interest that will have to be paid back. The benefits to delaying, however, stay the same, which implies that the net benefit will be larger.

Finally, the financial calculations ignored the utility aspect of the benefits. As delaying the claiming of Social Security is similar to purchasing an annuity (Coile et al., 2002; Shoven and Slavov, 2014; Hubener et al., 2016), risk-averse individuals would derive large gains in utility despite the financial benefits of the annuity being small. For example, in Coile et al. (2002), simulations of the expected utility maximization model for a single worker show that optimal delays are longer and that gains from delay may be 10 or more times larger when risk aversion is incorporated. In addition, in reality, the delay of claiming Social Security may not be the sole decision made in response to the opportunity of home equity-based borrowing. For example, Harding and Rosenthal (2017) show that housing capital gains have a significant impact on entry into self-employment for older individuals and the potential channel is to configure mortgages to facilitate access to home equity.

Overall, we acknowledge that what we present here does not mean quantitatively the gains will be as such. However, a qualitative interpretation provided by the simple calculation helps to shed light on the financial incentives of delays as individuals could obtain a net gain if they rely on home-equity based borrowing channel to delay claiming of Social Security.

7. Conclusions and Policy Implications

Social Security and the timing of when the elderly decide to claim Social Security benefits have become increasingly important due to the rapid increase in the aging population in the U.S. Besides Social Security payments, most elderly households carry a large fraction of their asset portfolio in their home equity. We use restricted access HRS data and a control function approach to investigate the effects of changes in housing wealth on the probability of claiming Social Security when individuals become eligible during the recent housing boom and bust periods.

We find consistent evidence that when house prices increase, individuals delay receiving Social Security benefits instead of claiming within two years of becoming eligible. This estimated effect is statistically significant during the boom period but not during the bust period. We find that these results are concentrated among individuals who are more likely to be financially constrained. Furthermore, the effect is stronger for women than for men, consistent with the implications of our actuarial analysis based on different survival rates for women and men.

We also consider the channels that could be driving these results. We do not find strong effects of increases in home value on mobility. In fact, we find that the claiming response is concentrated among stayers, not movers. This suggests that it is unlikely to be the case that homeowners sell their property to cash out home equity. Furthermore, we find that among stayers, there is an increase in the total amount of home loans when house prices appreciate. The evidence suggests that individuals are borrowing against home equity, either by refinancing their current mortgage, taking out a HELOC, or taking out a secondary mortgage. We also find that this effect is again concentrated among individuals who are more likely to be financially constrained.

Our findings have important implications for policymakers. A widespread concern is that the financial stability of the Social Security system in the U.S. is worsening. The program has paid more in benefits and expenses than it has collected in taxes and other noninterest income since 2010 and the Trustees Report projects this pattern will continue for the next 75 years.[56] In the meantime, it is widely recognized that the United States, like many other countries, is moving into

[56] The deteriorating financial stability of the system is driven largely by the fact that the program was set up as a pay-as-you-go program, where payroll taxes collected today are used to pay current recipients. https://www.ssa.gov/OACT/TR/2018/tr2018.pdf.

an aged society. The proportion of individuals over the age of 65 in the U.S. rose from 8 percent in 1950 to 13 percent in 2010 and is expected to rise to over 20 percent by 2030 as the Baby Boomer generation ages (Lee, 2014). The rapidly increasing aging population creates issues regarding the funding of the Social Security program. The elderly's decision of when to claim Social Security benefits, and hence the lifetime benefits received, will greatly influence the expenses of the program over time. Given that home equity makes up a large portion of an elderly household's balance sheet, the decision to claim could be influenced by the housing market fluctuations if home equity can be used to finance current expenses. A more complete understanding of the impact of housing shocks is important for designing appropriate policy to ensure the solvency of the Social Security system.

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Table 1: Summary Statistics

	2002-2010		2002 – 2006		2008- 2010	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Claim Social Security within 1 year of eligibility	0.5149	0.4999	0.5460	0.4980	0.4438	0.4972
Claim Social Security within 2 years of eligibility	0.6066	0.4886	0.6311	0.4826	0.5493	0.4979
Δ% in house value in previous 2 years	0.1186	0.3209	0.1888	0.3224	-0.0419	0.2528
Δ% in US HPI in previous 2 years	0.0965	0.1222	0.1746	0.0319	-0.0833	0.0253
Δ% in MSA HPI in previous 2 years	0.0969	0.1653	0.1754	0.1159	-0.0854	0.1095
Saiz Housing supply elasticity	1.7326	1.0724	1.7252	1.0865	1.7500	1.0393
Guren et al. Housing price sensitivity	1.0897	0.5817	1.0937	0.5783	1.0804	0.5901
Dummy for total home loan increased in the previous 2 years	0.2062	0.4047	0.2191	0.4137	0.1773	0.3822
Female	0.5677	0.4955	0.5553	0.4971	0.5960	0.4910
White	0.8633	0.3436	0.8619	0.3451	0.8663	0.3406
Married	0.8213	0.3832	0.8302	0.3756	0.8009	0.3996
Tenure at last job zero to five years	0.2302	0.4211	0.2257	0.4182	0.2404	0.4276
Tenure at last job five to ten years	0.1159	0.3203	0.1051	0.3068	0.1408	0.3481
Tenure at last job more than ten years	0.3492	0.4768	0.3576	0.4794	0.3300	0.4706
High school	0.5638	0.4960	0.5653	0.4959	0.5605	0.4967
College	0.2774	0.4478	0.2568	0.4370	0.3243	0.4685
Non-housing wealth	428063	2201155	462014	2610368	350404	579714
Self-assessed health status	2.4773	0.9848	2.4565	0.9968	2.5248	0.9558
Retired	0.3847	0.4866	0.3837	0.4864	0.3869	0.4874

Table 2: Probit Regressions – Claiming Social Security within 1 or 2 years after Becoming Eligible
(standard errors are clustered at the city level and are reported in parentheses)

	2002 – 2006		2008- 2010	
	(1)	(2)	(3)	(4)
Dependent Variable	Claim SS within 1 Year	Claim SS within 2 Years	Claim SS within 1 Year	Claim SS within 2 Years
	Probit Regression Coefficient			
Δ% in house value in previous 2 years	-0.0967	-0.1177	0.1468	0.1832
	(0.1224)	(0.0878)	(0.2191)	(0.2655)
	Marginal Effect			
Δ% in house value in previous 2 years	-0.0283	-0.0342	0.0423	0.0513
	(0.0358)	(0.0253)	(0.0622)	(0.0743)
State Fixed Effects	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES
Observations	1,600	1,578	677	669
Log Pseudolikelihood	-828.8786	-812.5042	-246.3202	-332.8628

Notes: This table reports the probit regression estimates for the probability of claiming Social Security within 1 or 2 years after becoming eligible. Other control variables include gender, race, marital status, tenure at last job, education, total non-housing wealth, employment status, and self-assessed health status. Regressions are run separately for the boom and the bust periods.

Table 3a: Control Function Regressions – Claiming Social Security within 1 or 2 Years after Becoming Eligible
Using Δ% in U.S. HPI in previous 2 years Interacted with MSA Supply Elasticity as IV
(standard errors are clustered at the city level and are reported in parentheses)

	2002 – 2006		2008- 2010	
	(1)	(2)	(3)	(4)
Second Stage Dependent Variable	Claim SS within 1 Year	Claim SS within 2 Years	Claim SS within 1 Year	Claim SS within 2 Years
	Second Stage Probit Regression Coefficient			
Δ% in house value in previous 2 years	-1.4673**	-1.5158**	-0.3451	-0.4111
	(0.5893)	(0.6396)	(0.6391)	(0.6229)
	Second Stage Marginal Effect			
Δ% in house value in previous 2 years	-0.4262**	-0.5469**	-0.1082	-0.1504
	(0.1705)	(0.2288)	(0.2004)	(-0.2279)
First Stage Dependent Variable	Δ% in house value in previous 2 years			
	First Stage Regression Coefficient			
Δ% in U.S. HPI in previous 2 years × MSA land supply elasticity	-0.5080***	-0.5174***	-0.4651***	-0.4663***
	(0.1114)	(0.1113)	(0.1314)	(0.1271)
First-stage F-Statistic	20.7936	21.6225	12.5316	13.4689
State Fixed Effects	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES
Observations	1,197	1,181	486	477
Log Pseudolikelihood	-834.4523	-796.5949	-73.0165	-72.4506

Notes: This table reports the second stage of control function regression estimates for the probability of claiming Social Security within 1 or 2 years after becoming eligible. Other control variables include gender, race, marital status, tenure at last job, education, total non-housing wealth, employment status, and self-assessed health status. Regressions are run separately for the boom and the bust periods. Endogenous regressor of Δ% in house value in the previous two years is instrumented using Δ% in U.S. HPI in previous two years × MSA land supply elasticity.

Table 3b: Control Function Regressions – Claiming Social Security within 1 or 2 Years after Becoming Eligible
Using Δ% in Region HPI in previous 2 years Interacted with Guren et al. CBSA Measure as IV
(standard errors are clustered at the city level and are reported in parentheses)

	2002 – 2006		2008- 2010	
	(1)	(2)	(3)	(4)
Second Stage Dependent Variable	Claim SS within 1 Year	Claim SS within 2 Years	Claim SS within 1 Year	Claim SS within 2 Years
	Second Stage Probit Regression Coefficient			
Δ% in house value in previous 2 years	-1.3911**	-1.5540***	0.1289	-0.0051
	(0.5392)	(0.5442)	(0.6445)	(0.5100)
	Second Stage Marginal Effect			
Δ% in house value in previous 2 years	-0.4063**	-0.5557***	0.0379	-0.0018
	(0.1580)	(0.1949)	(0.1895)	(0.1800)
First Stage Dependent Variable	Δ% in house value in previous 2 years			
	First Stage Regression Coefficient			
Δ% in Region HPI in previous 2 years × Guren et al. CBSA Sensitivity Measure	0.9169***	0.9012***	1.0769***	1.0588***
	(0.2089)	(0.2101)	(0.2009)	(0.1936)
First-stage F-Statistic	19.2721	18.4041	28.7296	29.9209
State Fixed Effects	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES
State × Year Fixed Effects	NO	NO	NO	NO
Observations	1.242	1,225	501	492
Log Pseudolikelihood	-866.9046	-826.0363	-61.1810	-61.8102

Notes: This table reports the second stage of control function regression estimates for the probability of claiming Social Security within 1 or 2 years after becoming eligible. Other control variables include gender, race, marital status, tenure at last job, education, total non-housing wealth, employment status, and self-assessed health status. Regressions are run separately for the boom and the bust periods. Endogenous regressor of Δ% in house value in the previous two years is instrumented using Δ% in U.S. HPI in previous two years ×MSA land supply elasticity.

Table 4: Control Function Regressions - Claiming SSRI within 2 Years after Becoming Eligible (Heterogeneity by Stock Account Balance Two Years Ago)
Sample Period: 2002-2006
(standard errors are clustered at the city level and are reported in parentheses)

	(1)	(2)	(3)	(4)
Dependent Variable	Saiz Instrument		Guren et al. Instrument	
Sample	Stock Account = 0	Stock Account > 0	Stock Account = 0	Stock Account > 0
	Probit Regression Coefficient			
Δ% in house value in previous 2 years	-1.6694**	-1.3364	-1.6202***	-1.7735
	(0.6870)	(1.7819)	(0.6208)	(1.7053)
	Marginal Effect			
Δ% in house value in previous 2 years	-0.5576**	-0.5262	-0.4817***	-0.6596
	(0.2285)	(0.7016)	(0.1845)	(0.6342)
First-stage F-Statistics	19.7136	5.8564	16.9744	4.4944
State Fixed Effects	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES
Observations	667	507	691	527
Log Pseudolikelihood	-489.3326	-213.2091	-505.8252	-213.2091

Notes: This table reports the second stage of control function regression estimates for the probability of claiming Social Security within 2 years after becoming eligible. Other control variables include gender, race, marital status, tenure at last job, education, total non-housing wealth, employment status, and self-assessed health status. Regressions are run separately for those with a positive stock account balance versus zero stock account balance two years ago. Endogenous regressor of Δ% in house value in the previous two years is instrumented using Δ% in U.S. HPI in previous two years $\times$ MSA land supply elasticity.

Table 5: Control Function Regressions - Claiming SSRI within 2 Years after Becoming Eligible (Heterogeneity by Outstanding Mortgage Two Years Ago)
Sample Period: 2002-2006
(standard errors are clustered at the city level and are reported in parentheses)

	(1)	(2)	(3)	(4)
Dependent Variable	Saiz Instrument		Guren et al. Instrument	
Sample	Outstanding Mortgage = 0	Outstanding Mortgage > 0	Outstanding Mortgage = 0	Outstanding Mortgage > 0
	Probit Regression Coefficient			
Δ% in house value in previous 2 years	-0.7708	-1.9685***	-1.0643	-1.9886***
	(1.1011)	(0.6907)	(0.9947)	(0.7258)
	Marginal Effect			
Δ% in house value in previous 2 years	-0.2835	-0.6118***	-0.3915	-0.7285***
	(0.4050)	(0.2147)	(0.3658)	(0.2658)
First-stage F-Statistics	8.4681	19.2721	7.6729	14.7456
State Fixed Effects	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES
Observations	442	727	458	755
Log Pseudolikelihood	-328.1099	-213.2091	-337.4320	-405.3036

Notes: This table reports the second stage of control function regression estimates for the probability of claiming Social Security within 2 years after becoming eligible. Other control variables include gender, race, marital status, tenure at last job, education, total non-housing wealth, employment status, and self-assessed health status. Regressions are run separately depending on whether the individual had an outstanding mortgage two years ago. Endogenous regressor of Δ% in house value in the previous two years is instrumented using Δ% in U.S. HPI in previous two years × MSA land supply elasticity.

Table 6: Control Function Regressions – Claiming Social Security within 2 Years after Becoming Eligible (Heterogeneity by Gender)
Sample Period: 2002-2006
(standard errors are clustered at the city level and are reported in parentheses)

	(1)	(2)	(3)	(4)
Dependent Variable	Saiz Instrument		Guren et al. Instrument	
Sample	Male	Female	Male	Female
	Probit Regression Coefficient			
Δ% in house value in previous 2 years	-0.3354	-2.5615***	-1.4024	-1.7126**
	(1.1979)	(0.4833)	(1.0956)	(0.7511)
	Marginal Effect			
Δ% in house value in previous 2 years	-0.0779	-0.7415***	-0.4351	-0.5276**
	(0.2782)	(0.1396)	(0.3372)	(0.2314)
First-stage F-Statistics	11.3569	13.6161	3.8025	29.9209
State Fixed Effects	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES
Observations	526	652	545	677
Log Pseudolikelihood	-312.5938	-435.3687	-328.2231	-449.8393

Notes: This table reports the second stage of control function regression estimates for the probability of claiming Social Security within 2 years after becoming eligible. Other control variables include race, marital status, tenure at last job, education, total non-housing wealth, employment status, and self-assessed health status. Regressions are run separately for male and female. Endogenous regressor of Δ% in house value in the previous two years is instrumented using Δ% in U.S. HPI in previous two years × MSA land supply elasticity.

Table 7: Control Function Regressions – Claiming Social Security within 2 Years after Becoming Eligible (Heterogeneity by Marital Status)
Sample Period: 2002-2006
(standard errors are clustered at the city level and are reported in parentheses)

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable		Saiz Instrument			Guren et al. Instrument	
Sample	Married		Single	Married		Single
			Probit Regression Coefficient			
Δ% in house value in previous 2 years	-2.1191***	-2.2064***	0.5135	-1.9365*	-2.1066**	-1.3138
	(0.6072)	(0.5530)	(1.5103)	(0.9982)	(0.8669)	(1.0681)
			Marginal Effect			
Δ% in house value in previous 2 years	-0.7992***	-0.8379***	0.1865	-0.6550*	-0.4287**	-0.4972
	(0.2297)	(0.2422)	(0.5485)	(0.3376)	(0.1764)	(0.4042)
First-stage F-Statistics	16.8100	15.7609	11.8336	5.8564	5.3361	7.1824
State Fixed Effects	YES	YES	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES	YES	YES
Control for the Spouse's Age	NO	YES	N/A	NO	YES	N/A
Observations	957	957	191	991	991	199
Log Pseudolikelihood	-630.5394	-628.2993	-116.1525	-655.0931	-653.1136	-117.7819

Notes: This table reports the second stage of control function regression estimates for the probability of claiming Social Security within 2 years after becoming eligible. Other control variables include gender, race, tenure at last job, education, total non-housing wealth, employment status, and self-assessed health status. Regressions are run separately for male and female. Endogenous regressor of Δ% in house value in the previous two years is instrumented using Δ% in U.S. HPI in previous two years × MSA land supply elasticity.

Table 8: Control Function Regressions – Mobility and Claiming Social Security within 2 Years after Becoming Eligible
Sample Period: 2002-2006
(standard errors are clustered at the city level and are reported in parentheses)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
			Saiz Instrument					*Guren et al. Instrument*		
Sample	All	Stayers	Stayers without Secondary Properties	Stayers with Zero Stock Account Balance	Stayers with an Outstanding Mortgage	All	Stayers	Stayers without Secondary Properties	Stayers with Zero Stock Account Balance	Stayers with an Outstanding Mortgage
Dependent Variable	Stay in the next two years		Claim SS within 2 years			Stay in the next two years		Claim SS within 2 years		
					Probit Regression Coefficient					
Δ% in house value in previous 2 years	2.3355***	-1.6081**	-1.4587**	-1.7480**	-2.1332***	2.5325***	-1.7777***	-1.9322***	-1.9685***	-2.1712***
	(0.4865)	(0.6957)	(0.6999)	(0.7383)	(0.6632)	(0.5014)	(0.4878)	(0.4722)	(0.5795)	(0.6518)
					Marginal Effect					
Δ% in house value in previous 2 years	0.3265***	-0.5516**	-0.4258**	-0.6029**	-0.8344***	0.3814***	-0.6001***	-0.6664***	-0.6759***	-0.8347***
	(0.0680)	(0.2386)	(0.2043)	(0.2546)	(0.2594)	(0.0755)	(0.1646)	(0.1628)	(0.1989)	(0.2505)
First-stage F-Statistic	12.8881	18.6624	21.2521	16.3216	18.3184	10.1124	20.1601	16.8921	13.1044	22.0900
State Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	1124	1,055	882	588	640	1,166	1,089	911	607	662
Log Pseudolikelihood	-534.6243	-686.8682	-584.3111	-422.9285	-327.0325	-551.9909	-704.7377	-599.6441	-433.3396	-340.6890

Notes: This table reports the second stage of control function regression estimates for the probability of staying (column 1) and the probability of claiming Social Security within two years after becoming eligible (Column 2– 5) when using Saiz instrument. The results using Guren et al. instrument are reported in column (6) – (10). Other control variables include gender, race, marital status, tenure at last job, education, total non-housing wealth, employment status, and self-assessed health status. Endogenous regressor of Δ% in house value in the previous two years is instrumented using Δ% in U.S. HPI in previous two years × MSA land supply elasticity. Stayers with an outstanding mortgage are identified based on the lagged status.

Table 9: Control Function Regressions – Total Housing Loan Amount in Previous Two Years Increased or not
Sample Period: 2002-2006
(standard errors are clustered at the city level and are reported in parentheses)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Saiz Instrument					*Guren et al. Instrument*				
Sample	For All	For Stayers	For Stayers **without Secondary Properties**	For Stayers **with Zero Stock Account Balance**	For Stayers **with an Outstanding Mortgage**	For All	For Stayers	For Stayers **without Secondary Properties**	For Stayers **with Zero Stock Account Balance**	For Stayers **with an Outstanding Mortgage**
	Probit Regression Coefficient									
Δ% in house value in previous 2 years	1.8820***	1.6723***	1.5262**	1.3979**	1.4313**	1.5288***	1.4310***	1.1141	1.1406	1.8788***
	(0.4717)	(0.5767)	(0.7373)	(0.6990)	(0.7303)	(0.4675)	(0.4802)	(0.6835)	(0.7759)	(0.5746)
	Marginal Effect									
Δ% in house value in previous 2 years	0.5183***	0.5093***	0.6050**	0.5545**	0.5702**	0.5781***	0.5359***	0.4418	0.4536	0.7463***
	(0.1299)	(0.1756)	(0.2923)	(0.2759)	(0.2909)	(0.1767)	(0.1792)	(0.2710)	(0.3085)	(0.2289)
First-stage F-Statistic	27.3529	21.2521	21.6225	19.5364	17.8084	21.0681	24.0100	17.1396	14.5161	30.1401
State Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	1161	1052	852	576	650	1,203	1,086	879	595	672
Log Pseudolikelihood	-720.7790	-789.0506	-625.3638	-478.6432	-429.6555	-910.1191	-806.8123	-637.9365	-491.0330	-441.1769

Notes: This table reports the second stage of control function regression estimates for the probability of whether the total housing loan amount in the previous two years increased or not. Other control variables include gender, race, marital status, tenure at last job, education, total non-housing wealth, employment status, and self-assessed health status. Endogenous regressor of Δ% in house value in the previous two years is instrumented using Δ% in U.S. HPI in previous two years × MSA land supply elasticity. Stayers with an outstanding mortgage are identified based on the lagged status.

Table 10: Cost and Benefit Analysis by Delaying Claiming

	Delay Claiming at …		
	Age 63	Age 64	Age 65
Panel A: Benefit			
Male	-193	-4	-821
Female	874	2243	2537
If an individual borrows $775 per month and repays at the time of claiming Social Security benefits			
Panel B: Cost	334	1359	3113
Panel C: Net value			
Male	-527	-1363	-3934
Female	541	884	-576

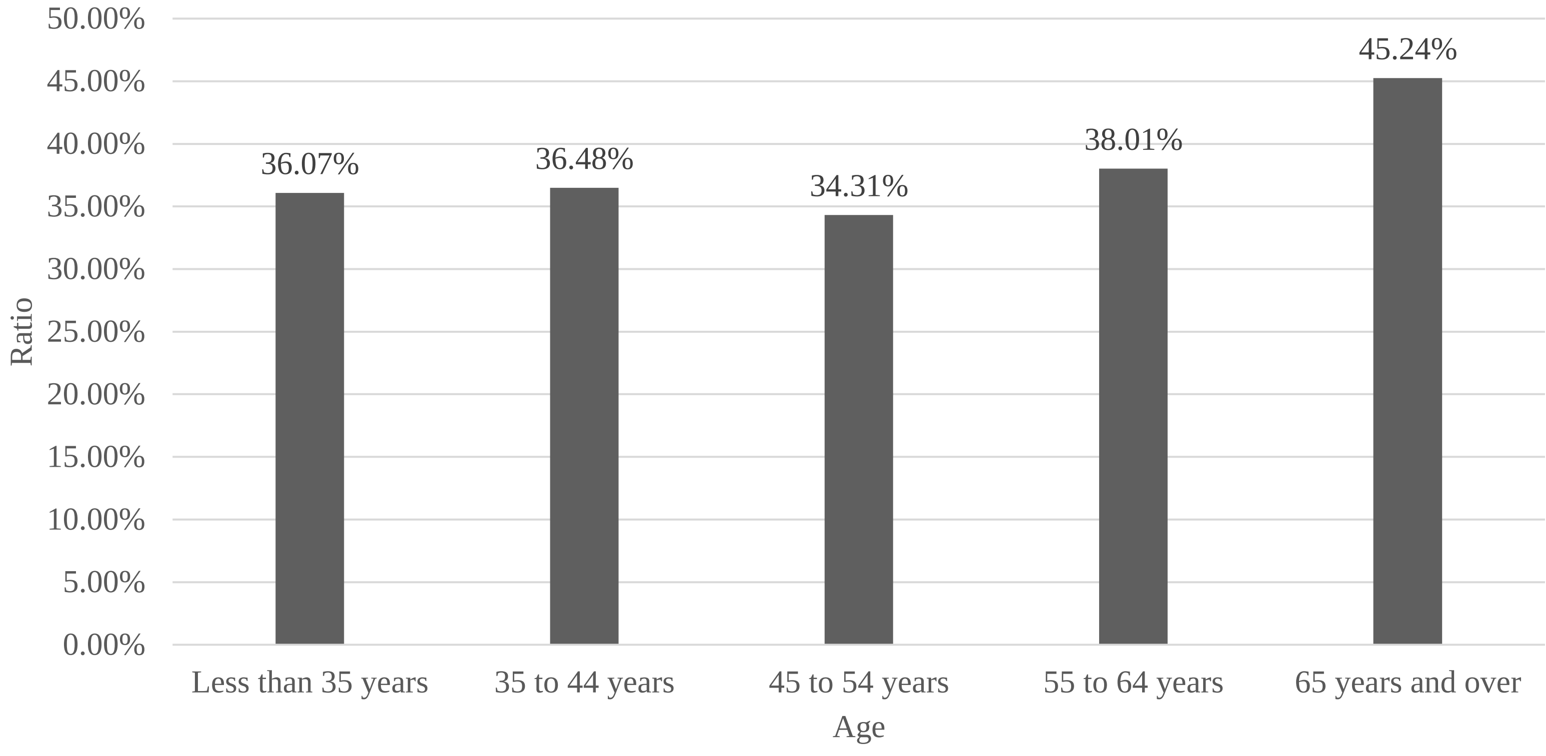

Figure 1: Ratio of Home Equity to Household Net Worth

Source: Survey of Income and Program Participation, 2005

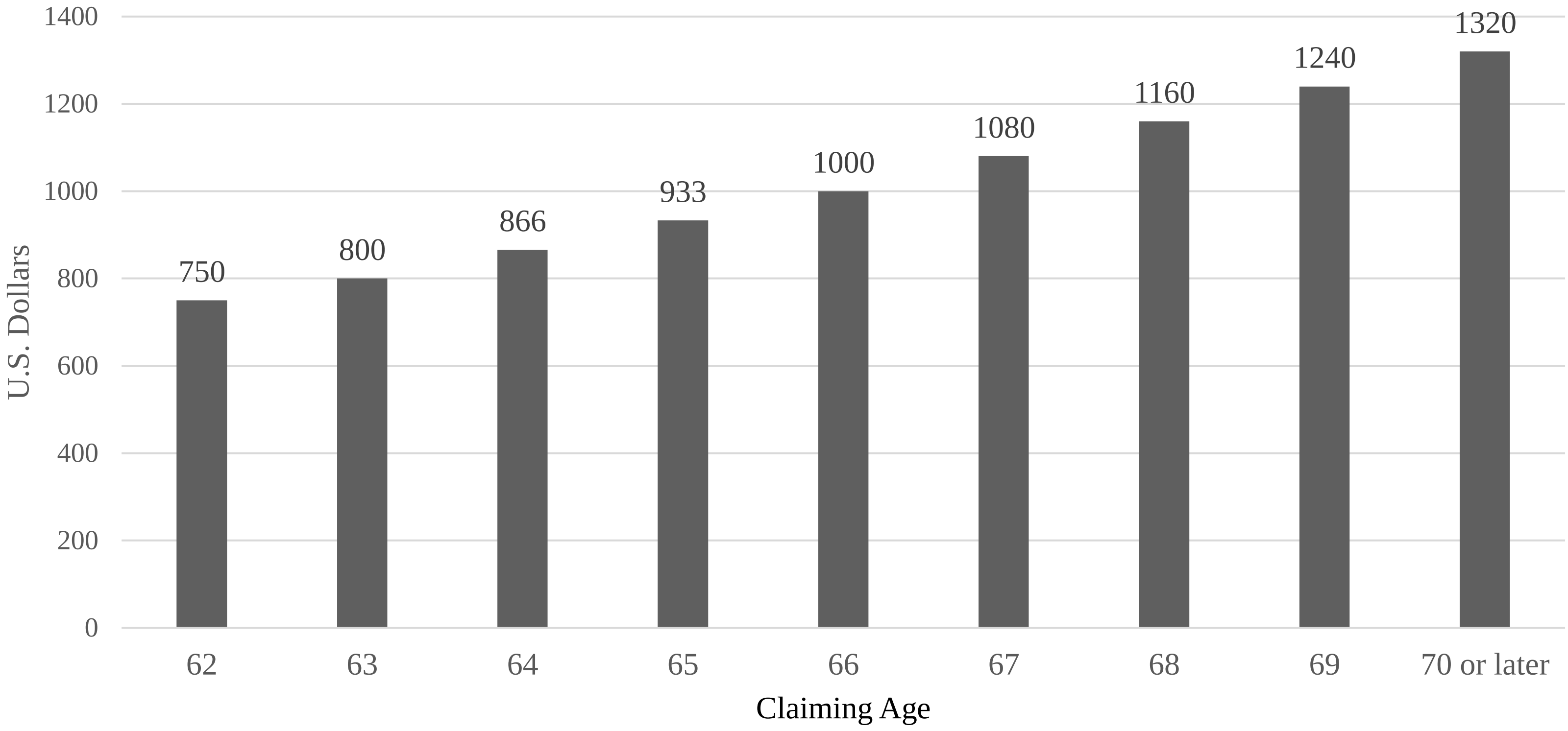

Figure 2: Monthly Social Security Benefit Amount for Cohort from 1943 to 1954

Source: https://www.ssa.gov.

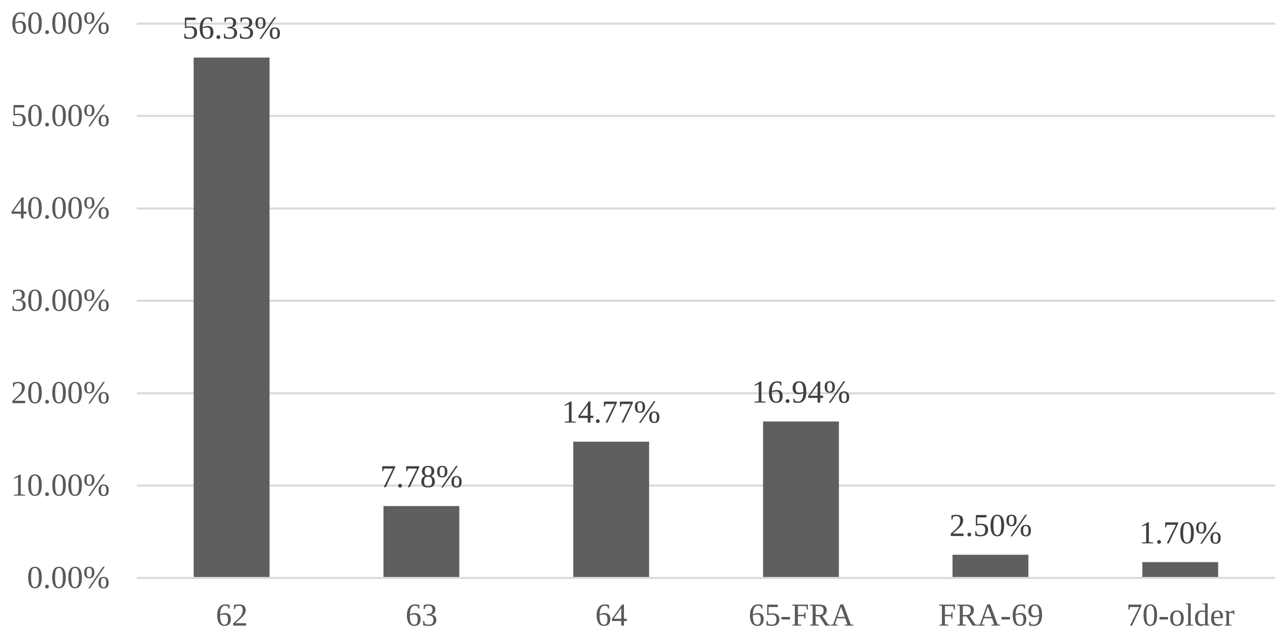

Figure 3: Age Distribution of Individuals Claiming Social Security Retirement Benefits

Source: Annual Statistical Supplement to the Social Security Bulletin (2016)
Note: We exclude disabled worker whose benefit automatically converts to a retired worker benefit in the month the worker attains FRA. We use statistics in 2002, the beginning of our sample period.

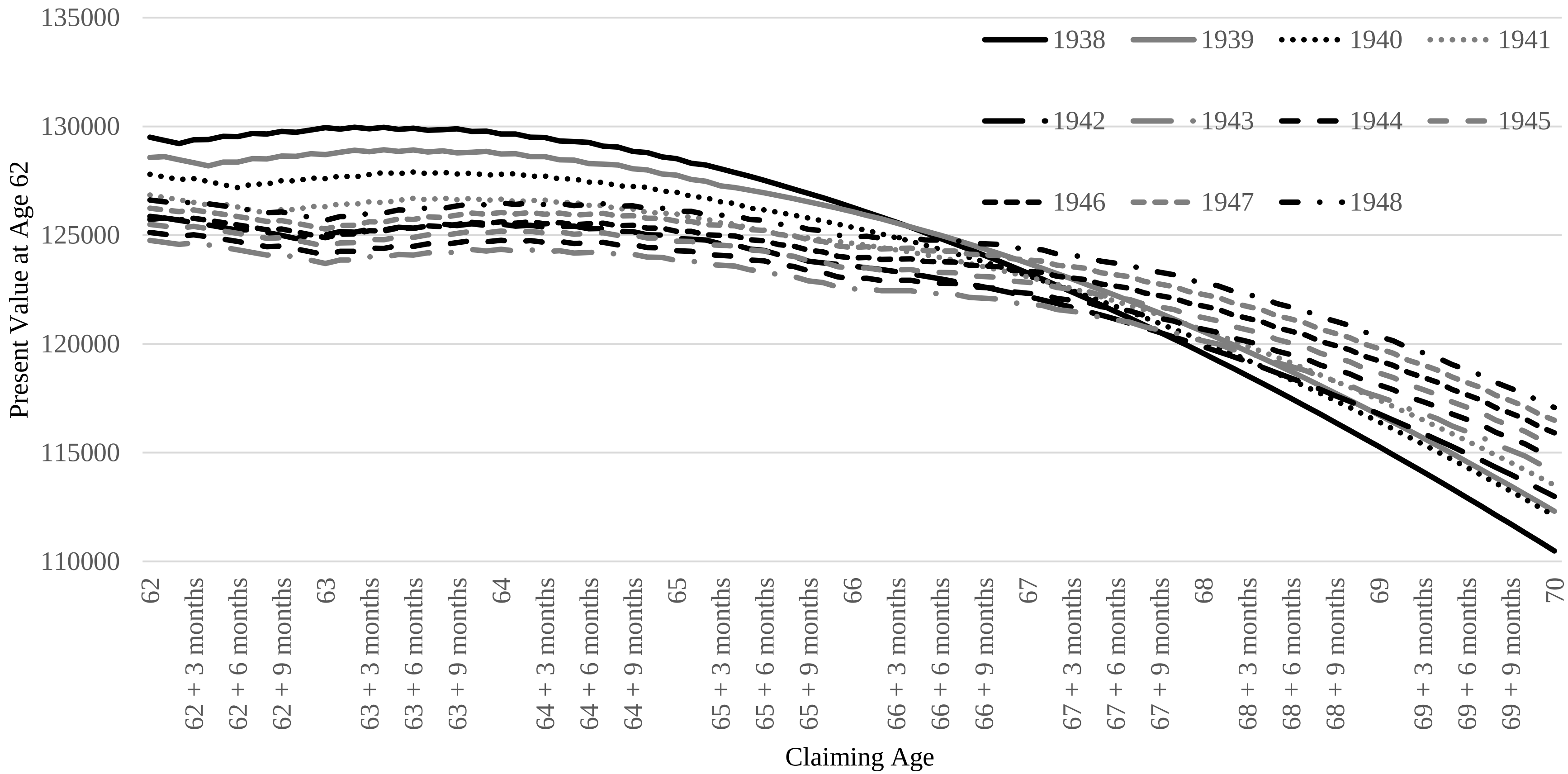

Figure 4: Present Value by Claiming Age and Birth Cohort for Males

Note: The figure shows the expected present value of Social Security benefits at age 62 for male cohorts between 1938 and 1948 and the extent to which the value changes with the claiming age.

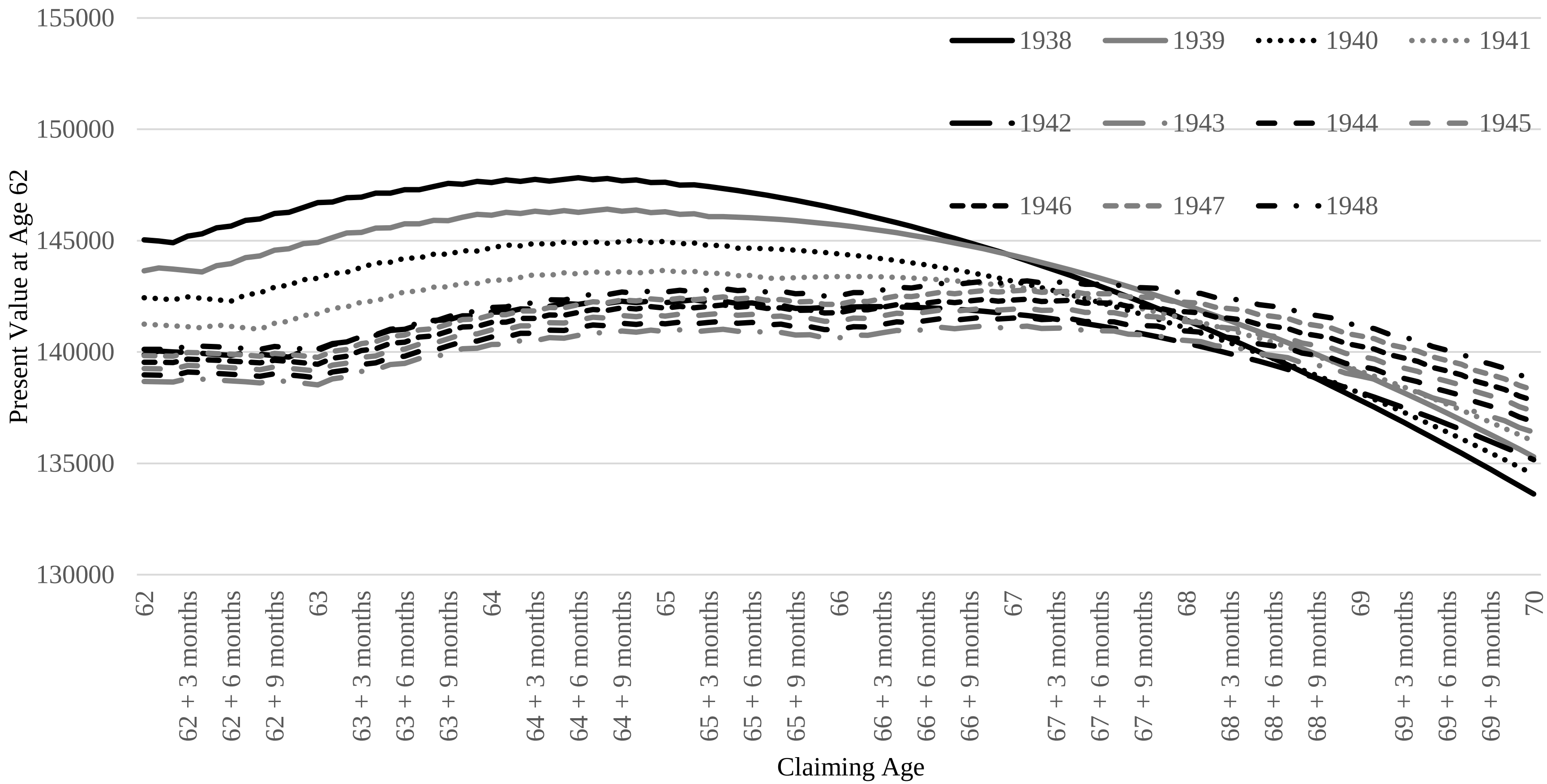

Figure 5: Present Value by Claiming Age and Birth Cohort for Females

Note: The figure shows the expected present value of Social Security benefits at age 62 for female cohorts between 1938 and 1948 and the extent to which the value changes with the claiming age.

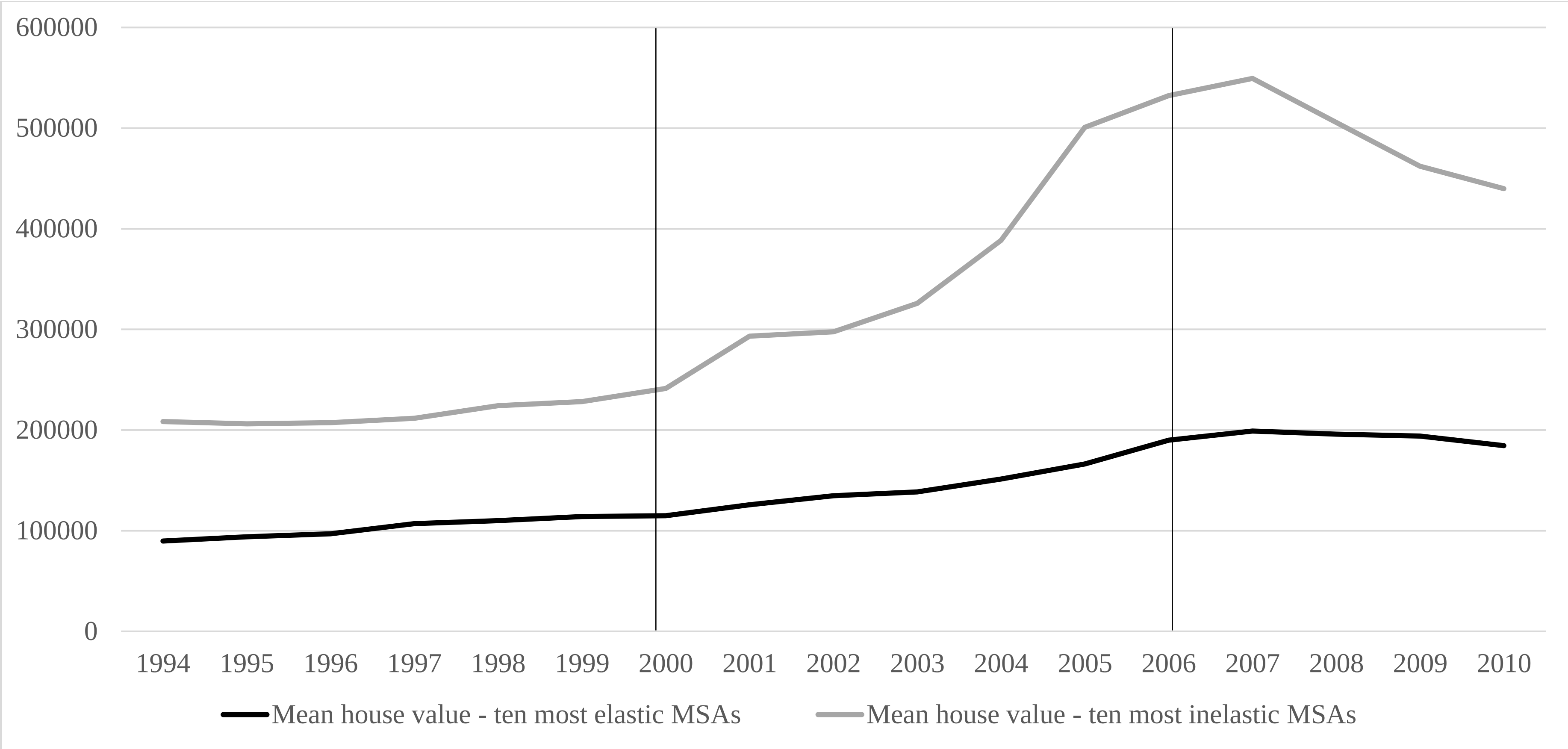

Figure 6: Homeowner Assessed House Value by MSA Land Supply Elasticity

Note: The figure shows that the house value appreciation is associated with the MSA-specific land supply elasticity. Houses in inelastic MSAs fetch higher values and experience more dramatic house price appreciations during the boom period.

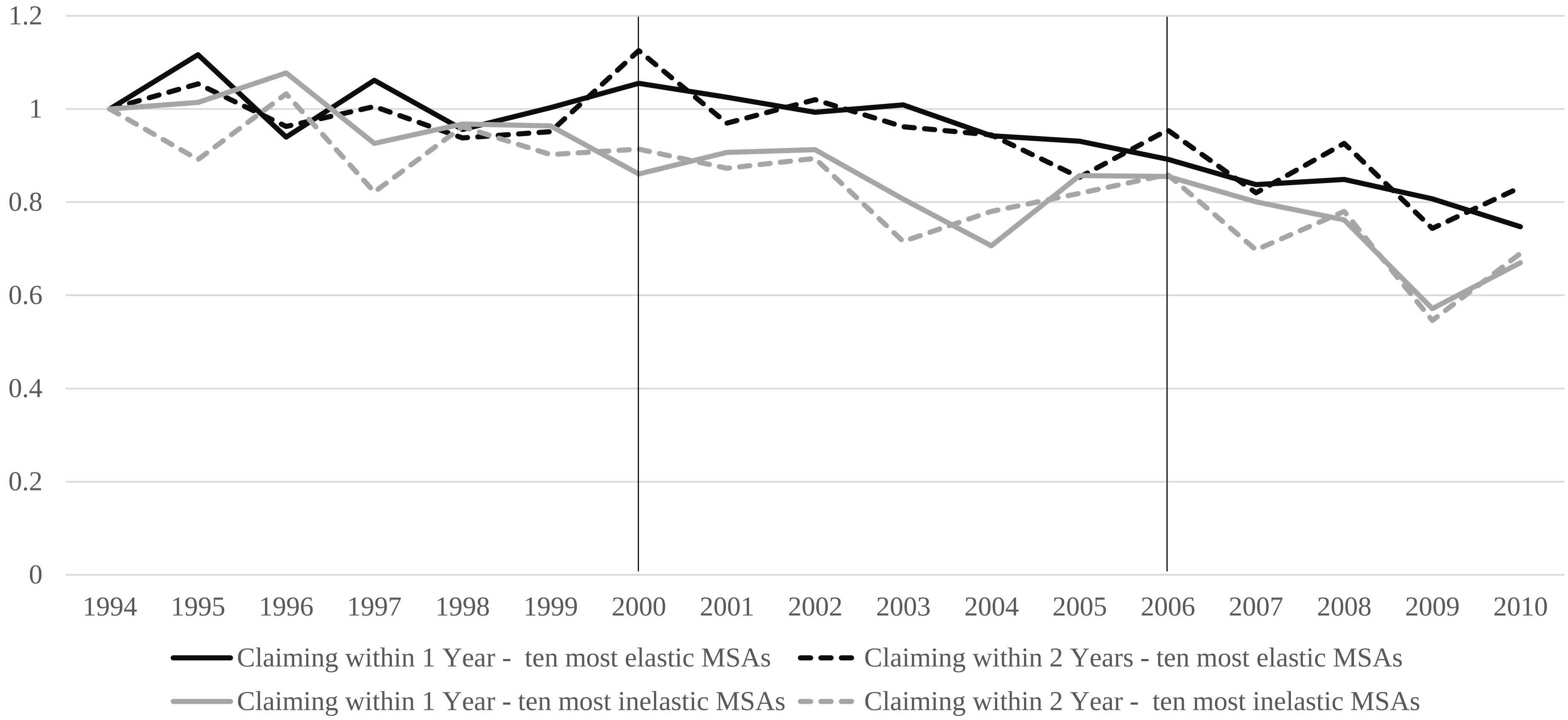

Figure 7: Early Claiming of Social Security Benefits by MSA Land Supply Elasticity

Note: The figure shows that taking the probability of claiming Social Security either within 1 year or 2 years in 1994 as the benchmark, the claiming probability in the subsequent years steadily declines. During the housing boom in the early 2000s, there seems to be a divergence in the rate of early claiming depending on whether the individual resides in an MSA with elastic or inelastic land supply.

Appendix 1

Table A1: Control Function Regressions - Claiming SSRI within 1 Year after Becoming Eligible (Heterogeneity by Stock Account Balance Two Years Ago)
Sample Period: 2002-2006
(standard errors are clustered at the city level and are reported in parentheses)

	(1)	(2)	(3)	(4)
	Saiz Instrument		Guren et al. Instrument	
Sample	Stock Account = 0	Stock Account > 0	Stock Account = 0	Stock Account > 0
	Probit Regression Coefficient			
Δ% in house value in previous 2 years	-1.6185***	-1.1659	-1.5485***	-1.4653
	(0.5154)	(1.6656)	(0.5530)	(1.2632)
	Marginal Effect			
Δ% in house value in previous 2 years	-0.5404***	-0.4593	-0.4515***	-0.5504
	(0.1721)	(0.6561)	(0.1612)	(0.4744)
First-stage F-Statistics	18.5761	6.7600	17.7241	5.1529
State Fixed Effects	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES
Observations	677	513	701	534
Log Pseudolikelihood	-538.2275	-198.4536	-557.5734	-210.9641

Notes: This table reports the second stage of control function regression estimates for the probability of claiming Social Security within 1 year after becoming eligible. Other control variables include gender, race, marital status, tenure at last job, education, total non-housing wealth, employment status, and self-assessed health status. Regressions are run separately for those with a positive stock account balance versus zero stock account balance two years ago. Endogenous regressor of Δ% in house value in the previous two years is instrumented using Δ% in U.S. HPI in previous two years × MSA land supply elasticity.

Table A2: Control Function Regressions - Claiming SSRI within 1 Year after Becoming Eligible (Heterogeneity by Outstanding Mortgage Two Years Ago)
Sample Period: 2002-2006
(standard errors are clustered at the city level and are reported in parentheses)

	(1)	(2)	(3)	(4)
	Saiz Instrument		Guren et al. Instrument	
Sample	Outstanding Mortgage = 0	Outstanding Mortgage > 0	Outstanding Mortgage = 0	Outstanding Mortgage > 0
	Probit Regression Coefficient			
Δ% in house value in previous 2 years	-0.4101	-2.1875***	-0.2710	-2.1858***
	(1.2062)	(0.6836)	(1.0037)	(0.6467)
	Marginal Effect			
Δ% in house value in previous 2 years	-0.1287	-0.4744***	-0.1258	-0.5296***
	(0.3785)	(0.1483)	(0.4659)	(0.1571)
First-stage F-Statistics	9.6100	18.8356	7.3984	16.0000
State Fixed Effects	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES
Observations	456	734	472	763
Log Pseudolikelihood	-354.1458	-397.6699	-364.0559	-422.8467

Notes: This table reports the second stage of control function regression estimates for the probability of claiming Social Security within 1 year after becoming eligible. Other control variables include gender, race, marital status, tenure at last job, education, total non-housing wealth, employment status, and self-assessed health status. Regressions are run separately depending on whether the individual had an outstanding mortgage two years ago. Endogenous regressor of Δ% in house value in the previous two years is instrumented using Δ% in U.S. HPI in previous two years × MSA land supply elasticity.

Table A3: Control Function Regressions – Claiming Social Security within 1 Year after Becoming Eligible (Heterogeneity by Gender)
Sample Period: 2002-2006
(standard errors are clustered at the city level and are reported in parentheses)

	(1)	(2)	(3)	(4)
	Saiz Instrument		Guren et al. Instrument	
Sample	Male	Female	Male	Female
	Probit Regression Coefficient			
Δ% in house value in previous 2 years	-0.3590	-2.4488***	-0.8896	-1.6697**
	(11.9667)	(0.4404)	(1.1120)	(0.8519)
	Marginal Effect			
Δ% in house value in previous 2 years	-0.0756	-0.7205***	-0.1873	-0.3645**
	(2.5200)	(0.1296)	(0.2341)	(0.1840)
First-stage F-Statistics	13.6901	8.8209	5.1076	25.8064
State Fixed Effects	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES
Observations	534	660	554	685
Log Pseudolikelihood	-302.6201	-479.0185	-319.6192	-496.7859

Notes: This table reports the second stage of control function regression estimates for the probability of claiming Social Security within 1 year after becoming eligible. Other control variables include race, marital status, tenure at last job, education, total non-housing wealth, employment status, and self-assessed health status. Regressions are run separately for male and female. Endogenous regressor of Δ% in house value in the previous two years is instrumented using Δ% in U.S. HPI in previous two years × MSA land supply elasticity.

Table A4: Control Function Regressions – Claiming Social Security within 1 Year after Becoming Eligible (Heterogeneity by Marital Status)
Sample Period: 2002-2006
(standard errors are clustered at the city level and are reported in parentheses)

	(1)	(2)	(3)	(4)	(5)	(6)
	Saiz Instrument			Guren et al. Instrument		
Sample	Married		Single	Married		Single
	Probit Regression Coefficient					
Δ% in house value in previous 2 years	-1.6537***	-1.7397***	-1.4358	-1.2072	-1.3677	-1.8879**
	(0.6264)	(0.5877)	(1.2272)	(0.9815)	(0.9368)	(0.7706)
	Marginal Effect					
Δ% in house value in previous 2 years	-0.4262***	-0.5917***	-0.3810	-0.3727	-0.4374	-0.5094**
	(0.1614)	(0.1992)	(0.3256)	(0.3030)	(0.2995)	(0.2079)
First-stage F-Statistics	20.6116	19.7136	4.2025	11.4244	10.3041	7.5625
State Fixed Effects	YES	YES	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES	YES	YES
Control for the Spouse's Age	NO	YES	N/A	NO	YES	N/A
Observations	973	973	206	1,008	1,008	214
Log Pseudolikelihood	-671.7694	-670.0038	-115.7701	-696.6396	-695.0496	-117.1302

Notes: This table reports the second stage of control function regression estimates for the probability of claiming Social Security within 1 year after becoming eligible. Other control variables include gender, race, tenure at last job, education, total non-housing wealth, employment status, and self-assessed health status. Regressions are run separately for male and female. Endogenous regressor of Δ% in house value in the previous two years is instrumented using Δ% in U.S. HPI in previous two years × MSA land supply elasticity.

Table A5: Control Function Regressions – Mobility and Claiming Social Security within 1 Year after Becoming Eligible
Sample Period: 2002-2006
(standard errors are clustered at the city level and are reported in parentheses)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Saiz Instrument					*Guren et al. Instrument*				
Sample	All	Stayers	Stayers without Secondary Properties	Stayers with Zero Stock Account Balance	Stayers with an Outstanding Mortgage	All	Stayers	Stayers without Secondary Properties	Stayers with Zero Stock Account Balance	Stayers with an Outstanding Mortgage
Dependent Variable	Stay in the next two years	Claim SS within 1 year				Stay in the next two years	Claim SS within 1 year			
	Probit Regression Coefficient									
Δ% in house value in previous 2 years	2.3355***	-1.8832***	-1.8476***	-1.9291***	-2.4177***	2.5325***	-1.7262***	-2.0646***	-1.8097***	-2.4232***
	(0.4865)	(0.5395)	(0.4862)	(0.5037)	(0.6552)	(0.5015)	(0.4653)	(0.3963)	(0.5534)	(0.5482)
	Marginal Effect									
Δ% in house value in previous 2 years	0.3265***	-0.6460***	-0.5487***	-0.6047***	-0.9643***	0.3814***	-0.5810***	-0.6132***	-0.5653***	-0.8991***
	(0.0680)	(0.1856)	(0.1444)	(0.1579)	(0.2613)	(0.0755)	(0.1566)	(0.1176)	(0.1728)	(0.2038)
First-stage F-Statistic	12.8881	17.0569	18.7489	17.3889	16.3216	10.1124	17.3889	13.5424	11.7649	22.3729
State Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	1,124	1,059	886	591	643	1,166	1,093	915	610	665
Log Pseudolikelihood	-534.6243	-702.1770	-602.9671	-456.6941	-335.8122	-551.9909	-724.7599	-620.5390	-471.0182	-351.4541

Notes: This table reports the second stage of control function regression estimates for the probability of staying (column 1) and the probability of claiming Social Security within one year after becoming eligible (Column 2–5) when using Saiz instrument. The results using Guren et al. instrument are reported in column (6) – (10). Other control variables include gender, race, marital status, tenure at last job, education, total non-housing wealth, employment status, and self-assessed health status. Endogenous regressor of Δ% in house value in the previous two years is instrumented using Δ% in U.S. HPI in previous two years × MSA land supply elasticity. Stayers with an outstanding mortgage are identified based on the lagged status.

Table A6: Control Function Regressions – Total Rental Income in Previous Two Years Increased for Different Types of Stayers
Sample Period: 2002-2006
(standard errors are clustered at the city level and are reported in parentheses)

Sample	(1) All	(2) Stayers	(3) Stayers **without Secondary Properties**	(4) Stayers **with Zero Stock Account Balance**	(5) Stayers **with an Outstanding Mortgage**
			Probit Regression Coefficient		
Δ% in house value in previous 2 years	0.9370	0.9581	-0.1271	2.0827	-1.0528
	(0.9760)	(1.3125)	(1.4122)	(1.4072)	(1.3497)
			Marginal Effect		
Δ% in house value in previous 2 years	0.2976	0.3063	-0.0380	0.6096	-0.3130
	(0.3100)	(0.4196)	(0.4222)	(0.4119)	(0.4013)
First-stage F-Statistic	21.5296	18.4900	18.7281	2.4649	16.8921
State Fixed Effects	YES	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES	YES
Observations	1114	959	765	325	533
Log Pseudolikelihood	-494.1245	-396.5225	-290.9055	-172.7845	-167.2261

Notes: This table reports the second stage of control function regression estimates for the probability of whether total rental income in the previous two years increased or not. Other control variables include gender, race, marital status, tenure in the last job, education, total non-housing wealth, employment status, and self-assessed health status. Endogenous regressor of Δ% in house value in the previous two years is instrumented using Δ% in U.S. HPI in previous two years × MSA land supply elasticity. Stayers with an outstanding mortgage are identified based on the lagged status.

Appendix 2

Following the framework of Mariger (1987), Feldstein (1990) and Mirer (1998), we focus our analysis on age 62 onwards and consider a simple model with the following specifications.

The model assumptions are the same as in Section 3.2 (a.1 – a.4). We also note that individuals receive positive Social Security benefits B_a once they have decided to claim the benefit. The utility is assumed to be isoelastic, which is specified as,

$$U(C) = \begin{cases} \dfrac{C^{1-\gamma}}{1-\gamma} & \gamma > 0 \; and \;\; \gamma \neq 1 \\ \log(C) & \gamma = 1. \end{cases} \tag{A1}$$

The expected lifetime utility for people reaching age 62 is given by

$$EU = \sum_{a=62}^{N} \frac{S_a}{(1+\rho)^{a-62}} \frac{{C_a}^{1-\gamma}}{1-\gamma}, \tag{A2}$$

where S_a is the probability of surviving to age a from age 62 conditional on that the person is alive at age 62, ρ is the rate of time preference, γ is the coefficient of relative risk aversion and C_a is consumption at age a. We suppress the cohort index for easy presentation. We use the mortality rate until age 120.

Let W_a denote the wealth at age a. Then $W_{62} = 0$ if there is no positive housing wealth shock (Section 3.2 a.2). If $W_a(a > 62)$ is either positive or negative, it could be carried forward with risk-free interest rate r. In any period a, the end-period wealth level W_{a+1} is determined by the start-period wealth W_a plus annuity benefits B_a minus the concurrent consumption C_a. Hence,

$$W_{a+1} = (1+r)W_a + B_a - C_a. \tag{A3}$$

Under such a setup, we consider three scenarios separately:

First, as a baseline scenario, we assume there is no housing wealth shock at age 62. In the presence of financial constraints ($W_a \geq 0$), individuals will have to claim Social Security benefits at age 62, given the lack of initial wealth. At equilibrium, the optimal lifetime consumption is smoothed out intertemporally. The corresponding consumption level C_a^0 is then determined as follows:

$$C_a^0 = C_{62} = (1-\delta_{62})B_{FRA} \quad \text{for } a = 62, \dots, N \qquad \text{(A4)}$$

where δ_{62} is the penalty imposed on early claiming at age 62.

Second, we assume, in a different scenario, there is an unexpected permanent increase in housing wealth when individuals reach age 62 ($W_{62} > 0$). We first consider the case when the housing wealth is marketable. Following Mariger (1987), and based on empirical facts that age-specific rate of death d_a increases with age in retirement. Mirer (1998) shows that the optimal plan, in this case, consists of two sequential phases. In the first phase, individuals have marketable wealth to consume. The phase ends when the marketable wealth is exhausted, which we denote as age $\bar{a}$. $\bar{a}$ is not necessarily equal to the claiming age τ but cannot be less than τ. In the second phase, the only resource is the Social Security benefit. Age from $\bar{a}+1$ to N is the second phase. If the financial constraints are not binding in this case, the necessary condition for interior solutions leads to

$$\frac{C_a^{\bar{a}}}{C_{a-1}^{\bar{a}}} = \left[\frac{(1+r)(1-d_a)}{1+\rho}\right]^{1/\gamma}, \qquad \text{(A5)}$$

where $d_a = 1 - \frac{s_a}{s_{a-1}}$.

Since the present value of all consumption expenditures in the first phase must be equal to the resources available through $\bar{a}$, the temporal consumption in the first phase from age 62 to $\bar{a}$ is

$$C_a^{\bar{a}} = \frac{W_{62} + \sum_{a=62}^{\bar{a}} B_a (1+r)^{-(a-62)}}{\sum_{a=62}^{\bar{a}} (\prod_{j=62}^{a} F_j)(1+r)^{-(a-62)}} \quad \text{for } a = 62, \dots, \bar{a} \qquad \text{(A6)}$$

where $F_j \equiv \frac{C_a^{\bar{a}}}{C_{a-1}^{\bar{a}}}$ and $F_1 = 1$ for convenience. In this setting, additional initial wealth allows individuals to delay the time of claiming social security benefit. But whether there is an increase in consumption in the first phase is ambiguous. The consumption amount could be lower since more periods of B_a before $\bar{a}$ become zero, which reduces the numerator in A6. The consumption amount could be higher since the positive initial wealth W_{62} increases the first term in the numerator in A6 and the increased magnitude of positive B_a from delaying increases the second term in the numerator in A6.

The consumption in the second phase will be

$$C_a^{\bar{a}} \;= B_a \text{ for } a = \;\bar{a}+1,\dots,N \qquad \text{(A7)}$$

In this case, the consumption $C_a^{\bar{a}}$ in the second phase will be higher than C_a^0. Delaying claiming Social Security allows B_a to increase.

The above discussion considers the case when the positive housing wealth can be directly used for consumption, such as downsize by moving to a smaller house or by switching from homeownership to renting. If the appreciated housing capital gains are not realized directly, individuals may also have incentives to delay claiming Social Security when financial constraints are binding. This is because the housing capital gains can be used as collaterals to relax the initial borrowing constraints. The optimal consumption, in this case, will depend on the benefit gains from delaying and the cost of borrowing against home equity.

Third, we assume, in another scenario, that there is an unexpected increase in housing wealth, but the wealth shock is transitory. Let's assume that the wealth drops to zero at age $\bar{a}'$. $\bar{a}'$ is greater than or equal to τ. In this case, although the present value of this additional wealth is zero, it has time value. Given that it is temporary, we assume that the borrower needs to pay back the money at age $\ddot{a}$ with $\ddot{a} < \bar{a}'$.

The consumption between age 62 and age $\ddot{a}$ is

$$C_a^{\ddot{a}} \;= \frac{W_{62} + \sum_{a=62}^{\ddot{a}} B_a\,(1+r)^{-(a-62)}}{\sum_{a=62}^{\ddot{a}}(\prod_{j=62}^{a} F_j)(1+r)^{-(a-62)}} \quad \text{for } a = 62,\dots,\ddot{a} \qquad \text{(A8)}$$

The consumption between age $\ddot{a}+1$ and age $\bar{a}'$ is

$$C_a^{\bar{a}'} = \frac{-W_{62} + \sum_{a=\ddot{a}+1}^{\bar{a}} B_a (1+r)^{-(a-62)}}{\sum_{a=\ddot{a}+1}^{\bar{a}} (\prod_{j=\ddot{a}+1}^{a} F_j)(1+r)^{-(a-62)}} \quad \text{for } a = \ddot{a}+1, \dots, \bar{a}' \tag{A9}$$

Whether consumptions in the first two phases increase is ambiguous for similar reasons as explained for Eq. A6.[57]

Similar to Eq. A7, consumption between age $\bar{a}' + 1$ and age N is

$$C_a^{\bar{a}} = B_a \text{ for } a = \bar{a}' + 1, \dots, N \tag{A10}$$

Given the presence of positive but transitory housing wealth shock, individuals may also have incentives to delay claiming Social Security. Retirement benefits are higher since B_a now is higher than if claimed at age 62. The corresponding consumption between age $\bar{a}' + 1$ and N is also higher than C_a^0. It shows that, if the housing wealth shock is transitory, individuals may also have incentives to delay claiming Social Security when financial constraints are binding.

[57] One possibility is that the individual choose to delay and has started to receive the retirement benefit before age $\ddot{a} + 1$. Although B_a is increased compared to claiming at age 62, they need to pay back W_{62}. Another possibility is that they have not received the retirement benefit at age $\ddot{a} + 1$ but have received it before age $\bar{a}'$. In these two situations, whether there is increase in consumption is ambiguous. The third possibility is that they have not received the retirement benefit at age $\bar{a}'$, then the consumption will be decreased. However, the last two case are impossible since they won't have resources to live on if they have not claimed the retirement benefit and have paid back the money.