Do Potential Future Health Shocks Keep Older Americans from Using Their Housing Equity?

JOB MARKET PAPER

By TIM MURRAY*

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Abstract: Many retirees retain their housing equity until they die and do not utilize it to help finance spending on consumption. In this paper, I examine how older Americans (age 55+) may use their house as a form of precautionary savings in the event they face an increase in out-of-pocket medical expenses due to a health shock. I find that households are 12-percentage points more likely to own a home in their late retirement years if they might face an unexpected increase in medical bills, indicating that many of such households prefer not to own but choose to knowing they may get sick and face an increase in out-of-pocket medical expenses. Accordingly, I propose an insurance policy that would cover any out-of-pocket medical expenses not covered by Medicaid. When the price of the insurance policy is between 0.15%-0.50% of each household's house value, 12.8% of households purchase the insurance policy. In the presence of an insurance policy and health shocks, the homeownership and moving rates look like an economy without health shocks, thus correcting a possible market failure that causes households to use their house as a form of precautionary savings.

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* Department of Agricultural and Resource Economics, University of Connecticut, 1376 Storrs Rd, Unit 4021, Storrs, Connecticut 06269. Email: timothy.murray@uconn.edu. I would like to thank the members of my committee Richard Dunn, Kenneth Couch, and Charles Towe for their support and invaluable feedback. I would also like to thank Fei Zou for his helpful comments and suggestions.

1. Introduction

Accumulated housing equity constitutes a large portion of the savings portfolio of Americans aged 55 and older. With nearly 80% owning a home[1], housing equity accounts for nearly half the net worth of retired Americans (Moulton, Haurin, Dodini, & Schmeiser, 2016). Households have accumulated housing equity that could be used to help finance consumption in retirement, as is the case with other investments such as stocks and bonds. While households could extract equity from their home by taking out a reverse mortgage or moving, research suggests this is not usually the case. Previous research has shown that 57-75 percent of households 65 and older will live alone in their house after retirement with approximately 16 percent staying in that home until death (Borsch-Supan, Hajivassiliou, & Kotlikoff, 1992). Households do not adjust their housing equity except in the event of a shock to the structure of the household such as divorce or the death of a spouse (Ai, Feinstein, McFadden, & Pollakowski, 1990; Feinstein & McFadden, 1989; J. D. Fisher, Johnson, Marchand, Smeeding, & Torrey, 2007; Poterba, Venti, & Wise, 2011; Venti & Wise, 1989, 1990, 2001, 2004). This contradicts the predictions of the Life-Cycle Hypothesis (LCH) which suggests that households save during their working years and draw down those savings in retirement (Modigliani & Brumberg, 1954).

As homeowners age, it becomes more difficult to borrow money. Therefore, they may choose to use their home as a form of precautionary savings and sell it to cover unexpected medical bills (Nakajima & Telyukova, 2013; Poterba et al., 2011; Venti & Wise, 2001). In this paper, I explore the how this option might preclude such homeowners from using the equity in their home to help finance consumption in retirement. I construct a calibrated dynamic general equilibrium model to assess the impact of an increase in out-of-pocket medical expenses caused

[1] US Census Bureau (2018)

by potential health shocks in old age on the housing choices of older Americans in their late working and retirement years.

I model an economy that consists of overlapping generations of heterogeneous agents who are faced with certain decisions: whether to rent or buy, what size house to inhabit, and how much to spend on consumption in each period. Agents can borrow (subject to a loan-to-value constraint) or save in each period. In the model, homeowners must pay property taxes and face transaction costs if they sell their homes. I can show that this model produces similar homeownership rates to data found in the Health and Retirement Study, which will be demonstrated later.

I start by modeling an economy where agents in late retirement (age 72-77) have a chance of receiving a health shock where they incur out-of-pocket medical expenses that they are forced to pay for through either their income or accumulated assets (including the house). Next, I model an economy where agents know with certainty that they will not incur an increase in medical bills and compare the housing choices of the two groups. When agents are certain they are not at risk of an increase in medical bills, homeownership rates decrease by as much as 12-percentage points after reaching age 72. There is also an increase in the rates if moving and in changing from owning to renting. This indicates that households are using their home as a form of precautionary savings. This notion is reinforced in a sensitivity analysis showing that for higher rates of out-of-pocket medical expenses, rates of homeownership increase beyond what is seen in the benchmark model.

As of 2010, 86% of Medicare beneficiaries had some sort of supplemental coverage (e.g., private insurance, Medicaid, or employer-sponsored coverage). Yet, they still face between $4,000-$8,000 of out-of-pocket medical expenses each year, constituting 13.9% of annual household spending (Cubanski et al., 2015). Even with supplemental coverage, it appears that households retain excess housing equity as a form of precautionary savings. Considering this, I propose an insurance policy that would cover any unforeseen out-of-pocket medical expenses, thereby freeing equity in the house to help finance consumption in retirement in accordance with the LCH. I find that if an insurance policy of this nature is offered, 12.8% of households would be willing to purchase this insurance policy at a cost of between 0.15%-0.50% of their home value. This causes the rates of homeownership and moving rates of in an economy with possible health shocks and an insurance policy to look like the economy where agents know with certainty that they will not incur an increase in medical bills. This suggests that if households do not have to worry about saving for potential out-of-pocket medical costs, they would be more willing to use the equity in their house to help finance consumption in retirement.

This paper contributes to two strands of literature. First, it supplements existing literature on the housing-equity puzzle that addresses the question of why so many Americans do not use their housing toward consumption in retirement. Empirical studies, such as Borsch-Supan et al. (1992); Feinstein and McFadden (1989); J. D. Fisher et al. (2007); Hurd (1992); Poterba et al. (2011); Venti and Wise (1989, 1990, 2001, 2004) and others, show that retirees are not using their housing equity in accordance with the LCH and explore possible causes such as precautionary savings, bequests, and high transaction costs. This paper approaches the housing-equity puzzle from a theoretical framework and offers a possible policy solution to address the possible market failure.

This papers second contribution is its framework of overlapping generations which models housing and consumption, complementing the work of Anagnostopoulos, Atesagaoglui, and Carceles-Poveda (2013); Cocco (2004); Davis and Heathcote (2005); J. D. M. Fisher and

Gervais (2011); Imrohoroglu, Matoba, and Tuzel (2018); Li and Yao (2007) and others. While most of these investigations focus on the entire life cycle, this paper restricts its focus to Americans age 55 and older. By looking at the impact of an increase in out-of-pocket medical expenses due to health shocks at an older age and giving older Americans an insurance option to help mediate these costs, this model provides a unique framework bridging the literature on the housing-equity puzzle with the literature on housing and consumption.

2. Data

Due to its specific focus on Americans in their late working and retirement years, I use the Health and Retirement Study (HRS) to determine many of the parameters of the model and compare the output of the model. The HRS includes information on health status and out-of-pocket medical expenses in addition to demographic and housing characteristics. All of this information is useful for this study.

I use individual and household level data from ten waves (1996-2014) of the HRS are used to analyze homeownership rates, transition rates, and housing dynamics of retired Americans. The HRS is a longitudinal survey that includes about 20,000 households over age 50 selected through a multi-stage probability sample design that is representative of the United States population over age 50. This survey oversamples Black and Hispanic populations to support research on racial and ethnic disparities and defines an observational unit as an eligible household financial unit where at least one person is an eligible member the defined cohorts[2]. The HRS is administered by the University of Michigan Institute for Social Research in partnership with the RAND Center for the Study of Aging[3]. The original target population for the HRS, when the

[2] For more information see HRS Staff (2008)
[3] Grant number NIA U01AG009740

study was initiated in 1992, were adults born between 1931-1941 (HRS Cohort) and those born before 1924 (AHEAD cohort). Every six years the survey adds a new cohort starting in 1998 with those born between 1924-1930 (Children of the Depression) and 1942-1947 (War Babies Cohort). In 2004 those born between 1948-1953 (Early Baby Boomers Cohort) were added, and then lastly in 2010, those born between 1954-1959 (Mid-Baby Boomers Cohort) were added.

I restrict attention to two household types: one-person households where the person is aged 55 or older and two-person households of married couples where the male is aged 55 or older.

3. A Model of Housing Dynamics with Potential Health Shocks at Old Age

A. Demographics and Income

In a framework that is similar in nature to Imrohoroglu et al. (2018) and Gervais (2002), the economy is populated with overlapping generations of agents at three stages of life, $(s_t = 1, 2, or 3)$. Agents are working during the first stage (age 55-64) and are retired in the last two stages (age 65-71 and 72-77 respectfully). In each period t, agents advance from one stage to the next with probability π_s and spend another period in the current stage with probability $1-\pi_s$. When an agent dies, they are replaced by a new agent in the first stage of life.

During the first stage of life, labor income, y_t^s, is given by $\log\left(y_t^s\right) = \log\left(w^s\right) + e_t$. The term w^s represents the wage profile of the individual and e_t represents the stochastic shock to income every period, given by $e_t = \Theta e_{t-1} + \varepsilon_t$. ε_t is normally distributed with mean zero and variance σ_ε^2 and $\Theta < 1$, it captures the persistence of the stochastic component to labor income. During the final two stages of life, individuals are retired and face a certain retirement income. In the third stage of life, agents are subject to a possible health shock, λ_t, that is associated with unexpected medical bills. Agents are aware that there is a possible health shock in the future but do not know whether they will receive one. Agents die with probability π_3 in the third stage and are replaced by an agent in the first stage.

B. Housing

Agents will be endowed with units of housing at time $t = 0$ which they will live in the first period. After the first period, agents will have access to a mortgage market when purchasing a home. If they purchase a home, they are required to make a down payment. If an agent sells their home, they face transaction costs (e.g., realtor fees, moving costs, etc.). Homeowners have to pay property taxes, $T_t^p = \tau_t^p p_t h_t$, where τ_t^p is the property tax rate and p_t is the price of a unit of housing. Renters do not have to pay property taxes. Households make decisions on consumption, housing arrangements, and their mortgage each period after observing their income and whether they receive a health shock[4].

In the background of the model, there are financial institutions that provide loans to homeowners, hold residential rental capital, and pool individuals' deposits. These financial institutions own all the rental housing units. In this model, housing stock is fixed at $\overline{H}$. Housing stock is equal housing owned by individuals plus housing owned by the financial institutions. Homeowners can either be savers – earning an interest rate of r^d; or borrowers in the mortgage market facing a mortgage rate of r^m. The interest payments on mortgages is tax deductible.

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[4] In this paper, health shock refers to an increase in unexpected medical bills in the third stage of life. While individuals can suffer health shocks at any age, this study is specifically interested in how an increase unexpected medical bills in the late years of retirement affects housing choices

C. Individual's Problem

Homeowners must pay a transaction cost if they choose to sell their home. Let h_t be the quantity of housing an agent has at time t. Let h^{rent} be the set of house sizes available to renters and h^{own} be the sizes of homes available to owners. Let $h_t \in h^{rent}$ indicate an agent who is a renter and $h_t \in h^{own}$ indicate an agent who is a homeowner. Transaction costs, $F(h_t, h_{t+1})$, are defined by

$$F(h_t, h_{t+1}) = \begin{cases} \varphi p_t h_t & \text{if } h_t \in h^{own} \text{ and } h_{t+1} \neq h_t \\ 0 & \text{otherwise} \end{cases} \tag{2}$$

where φ represents the proportion of the house value paid in transaction costs (e.g., real estate agent fees, moving costs, etc.). Homeowners who move to a different size home must pay transaction costs. I assume that a household who remains in the same size house did not move. All renters who move do not pay the transaction cost.

Households can borrow against the value of their home (mortgage a_{t+1}) and are subject to a loan-to-value constraint η, given by

$$a_{t+1} \leq \eta p_t h_{t+1} \quad \text{if } h_{t+1} \in h^{own} \tag{3}$$

Homeowners are not allowed to default on their mortgages. Renters do not have access to the mortgage market and are only allowed to save. A negative mortgage represents savings that receives interest rate r^d

$$r = \begin{cases} r^m & \text{if } a_{t+1} > 0 \\ r^d & \text{if } a_{t+1} < 0 \end{cases} \tag{4}$$

Following Imrohoroglu et al. (2018), this model implements progressive income taxes and uses the tax function from Gouveia and Strauss (1994), which has the following functional form:

$$T_t^i(\tilde{y}) = \left[\tilde{y} - \left(\tilde{y}^{-\tau_{\eta_0}} + \tau_{\eta_2} \right)^{-\frac{1}{\tau_{\eta_1}}} \right] \tag{5}$$

where $\tilde{y}$ is taxable income, and $\left(\tau_{\eta_0}, \tau_{\eta_1}, \tau_{\eta_2} \right)$ are policy parameters on income taxes. Interest paid on mortgages, ra_t, and property taxes, T_t^p, are tax deductible and interest on savings is taxable. Taxable income during the first stage of life is

$$\tilde{y} = \max\left(0, \left[y_t - ra_t - T_t^p \right] \right) \tag{6}$$

since Social Security income is not taxed for retirees as it is not subject to the income tax, but property taxes and mortgage interest are still tax deductible. Taxable income for the last two stages of life is

$$\tilde{y} = \max\left(0, \left[-ra_t - T_t^p \right] \right) \tag{7}$$

In the event an agent dies, the financial institution sells the house and distributes the net assets of all the deceased agents in the form of an accidental bequest in the next period. This bequest is denoted by q_t. Homes have a depreciation rate of δ. This can be viewed as the maintenance and upkeep costs of living in a home that homeowners must pay.

In each period agents seek to maximize utility and face budget constraints which are a function of current and future homeownership status. Agents derive utility from consumption and housing. Agents maximize the utility from consumption and housing in each stage given by:

$$\max u(c_t, h_t) = \frac{\left[c_t^{\chi} h_t^{1-\chi} \right]^{1-\sigma}}{1-\sigma} \tag{8}$$

where χ is the relative weight of housing and consumption and σ is relative risk aversion.

a. The First Stage

In the first stage, agents are considered working and receive income y_t^1 as well as a bequest from the previous generation who just died, q_t. Agents are endowed with housing h_0 and can either be a homeowner or a renter depending on the value of h_0. During the first stage, agents must decide between spending on consumption, c_t, and saving for the next period, a_{t+1}. The first stage budget constraint is as follows:

$$c_t + \hbar_{t+1} - a_{t+1} = y_t^1 + \hbar_t - T_t^i - T_t^p + q_t \tag{9}$$

$$\hbar_t = \begin{cases} (1-\delta)\, p_t h_t & \text{if } h_t \in \mathrm{h}^{own} \\ 0 & \text{if } h_t \in h^{rent} \end{cases} \tag{10}$$

$$\hbar_{t+1} = \begin{cases} p_t h_{t+1} & \text{if } h_{t+1} \in \mathrm{h}^{own} \\ rent_t h_{t+1} & \text{if } h_{t+1} \in h^{rent} \end{cases} \tag{11}$$

The rental rate is determined by the financial institutions and covers the depreciation expenditure, property taxes, and mortgage interest payments:

$$rent_t = \left(r^m + \delta + \tau_t^p\right) p_t \tag{12}$$

b. The Second Stage

All agents retire at the beginning of the second stage and they observe their fixed retirement income, y_t^2. Agents then make decisions on how much to spend on consumption, c_t, and their choice of dwelling, h_{t+1}. Households can stay in their current residence or they can move. All homeowners who move face transaction costs, F_t. Those who purchase another home can choose to borrow against it in the mortgage market or save for the next period, a_{t+1}. The budget constraint in the second stage is as follows:

$$c_t + \hbar_{t+1} - a_{t+1} = y_t^2 + \hbar_t + (1+r)a_t - T_t^i - T_t^p - F_t \tag{13}$$

c. The Third Stage

At the beginning of each period in this stage, agents observe their fixed retirement income, y_t^3 and unexpected medical bills as a result of a health shock, λ_t. λ_t occurs with probability d_t which takes a value of 1 if the agent receives a health shock and 0 if they do not. Agents must pay for their unexpected medical bills, either from current income, accumulated savings, or by selling their home. Agents make decisions on how much to spend on consumption, c_t, and type of preferred dwelling, h_t in light of the potential the health shock. Households can stay in their current residence or they can move, either purchasing or renting. Homeowners who choose to move face transaction costs, F_t. Those who purchase another home, can choose to borrow against the home in the mortgage market. The third stage budget constraint for a household is:

$$c_t + h_{t+1} - a_{t+1} = y_t^3 - d_t\lambda_t + h_t + (1+r)a_t - T_t^i - T_t^p - F_t \tag{14}$$

At the end of the third stage agents die. Any assets the agent does not consume are distributed as an accidental bequest to the first generation in a way proportional to income.

D. Government

The government has a balanced budget and finances its expenditures, G_t, with tax revenue collected through income and property taxes.

4. Equilibrium

Individuals at time t are heterogeneous with respect to life stages s_t; assets/mortgages a_t; housing h_t; and income y_t. Let $\Gamma(e,e')$ be the transition matrix for labor income; $\Lambda(s,s')$ be the transition matrix for life stages; $\vartheta^s(\lambda')$ be age dependent probability of a health shock; Ω_t

represent the state (s,a,h,y) faced by an agent at time t; and $V(\Omega_t)$ be the maximized value of the objective function at state Ω_t. The dynamic programming problem faced by individuals is given by:

$$V_t(\Omega) = \max_{c,h',m'} u(c,h) + \beta \sum_{s'} \sum_{e'} \sum_{\vartheta'} \Lambda(s,s')\Gamma(e,e')\vartheta^s(\lambda')V_{t+1}(\Omega') \tag{15}$$

subject to the constraints (2)-(14).

Given government policy $\left\{\tau_{\eta_0}, \tau_{\eta_1}, \tau_{\eta_2}, \tau_t^p\right\}_{t=0}^{\infty}$ and mortgage and deposit rates $\left\{r^m, r^d\right\}_{t=0}^{\infty}$; a competitive equilibrium is a sequence of value functions $V_t(\Omega)$; individual decision rules for consumption goods; housing; and mortgages; a measure of agent types $\Pi_t(\Omega)$; and the price of housing p_t; such that, for all t:

- Given the price of the house, interest rates on mortgages and deposits, and the government policy, the dynamic programming problem is solved by the individuals decision rules.
- p_t clears the housing market, $\sum_{\Omega} \Pi_t(\Omega) h_t(\Omega) = \bar{H}$, where $h_t(\Omega)$ is the optimal housing allocation resulting from the dynamic programming problem of the household.
- Accidental bequests are given by

$$q_t = \frac{\pi_3 \sum_{m,h;a} \Pi_t(\Omega)\left[(1-\delta)\left(p_t(\Omega)h_t(\Omega)\right) - (1+r)\left(a_t(\Omega)\right)\right]}{\sum_{\Omega} \Pi_t(\Omega) y_t^s} \tag{16}$$

Death occurs (with probability π_3) after agents in the third stage have made their homeownership, mortgage, and savings decisions.

5. Calibration

The goal for the benchmark economy is to match the housing market of Americans 55 and older. This paper uses national level data to calibrate the initial steady state of the benchmark economy with a possible health shock.

In the benchmark economy, agents live through three life stages. They work during the first stage and are retired in the second and third stage. In each life stage, s, agents face a probability π_s of moving to life stage $s+1$. π_s is set so that on average, agents spend ten years in the first stage and six years in the last two life stages. This makes the average life expectancy 77 years. The transition matrix for life stages is:

$$\Lambda(s,s') = \begin{bmatrix} .90 & .10 & .00 \\ .00 & .83 & .17 \\ .00 & .00 & .83 \end{bmatrix} \tag{17}$$

The labor income process that is used in the model is calibrated to help the model match homeownership and savings rates of the HRS. The idiosyncratic component of labor income, $e_t = \Theta e_{t-1} + \varepsilon_t$, is calibrated using the four-state Markov chain found in Imrohoroglu et al. (2018). The values of e_t are (-0.41, -0.10,0.10,0.41) and the transition matrix is:

$$\Gamma(e,e') = \begin{bmatrix} .84 & .16 & .00 & .00 \\ .16 & .64 & .20 & .00 \\ .00 & .20 & .64 & .16 \\ .00 & .00 & .16 & .84 \end{bmatrix} \tag{18}$$

The tax function in equation 4 is calibrated to the US federal tax code. τ_{η_1} determines the progressivity of taxes and is estimated by Gouveia and Strauss (1994) to take the value of 0.768. They also estimate τ_{η_0} to be 0.258. τ_{η_2} is calibrated to be 0.5. Property tax rates in the US vary between 0.28 percent (Hawaii) to 2.38 percent (New Jersey) (Walczak, 2015), so τ^p is set in the middle at 1.0.

The interest rate on mortgages, r^m, is set to 4.05 percent[5] and the interest rate on deposits, r^d, is set to 1.7 percent.[6] The transaction cost of selling a home, φ, is 6 percent.[7] Following Imrohoroglu et al. (2018), the maximum loan-to-value parameter, η, is set to 80 percent. The depreciation rate, δ, is set to 1.7 percent.[8]

The time period, t, is one year. The subjective time discount factor, β, is assumed to be 0.96, a value in line with what is commonly used in the literature. The 2016 Consumer Expenditure Survey shows that non-housing consumption makes up 66.4 percent of a household's personal expenditure (Bureau of Labor Statistics, 2018), so the relative weight of consumption and housing, χ, is set at 0.66. Fore risk aversion, σ, this paper uses the value 9. This rate is higher than what is traditionally found in the literature. It is intentionally calibrated this way as the model does not simulate the entire life cycle – only late working years and retirement and older individuals tend higher degrees of risk aversion than working age individuals (Ablert & Duffy, 2012; Tymula, Belmaker, Ruderman, Glimcher, & Levy, 2013). A summary of all the parameters used in the model can be found in Table 1.

[INSERT TABLE 1 HERE]

[5] The average rate on a 30-year fixed mortgage is 4.05 percent between 2010-2017 (Freddie Mac, 2018)

[6] The average one-year treasury rate from 2010-2017 is 0.38 percent (Board of Governors of the Federal Reserve System, 2018) but this is a period of Quantitative Easing (QE). Since low interest rates will not be the norm in the future, this paper uses the interest rate on deposits from Imrohoroglu et al. (2018), the expected standard as QE ends

[7] Gruber and Martin (2003) suggest 6 percent a good conservative estimate for transaction costs of selling a home

[8] The range of δ is between 1.5 and 2.0 percent in DeNardi (2004), Imrohoroglu et al. (2018), and Nakajima and Telyukova (2017), so the midpoint is selected

The HRS shows that for households aged 72-77, between 40-45% report having a health condition or bad health as well as an increase in out of pocket medical expenses[9]. Therefore, the probability of receiving a health shock, d_t, in each period is set to 40 percent when agents are in the third stage and 0 percent otherwise to keep it on the conservative side and the value of out-of-pocket medical bills, λ_t, is set to 0.75[10].

The housing grid is based on the square footage for homeowners and renters from the US Census Bureau, American Housing Survey 2017. Renters can chose between two house sizes: 1 and 1.5. Owners can choose between four house sizes: 1.75, 2, 2.25, 2.5, and 3.25. The average house size is set to 2.5.

The state variables in the dynamic programing problem consist of life stages s_t, net assets (savings and mortgage) a_t, housing h_t, and employment state e_t. Average labor income is normalized to 1. There are 3 grid points for life stages, 76 grid points for assets (-9.9 to 3.6), 6 grid points for housing (1 to 3.25), and 4 values for idiosyncratic income. This results in 5,472 possible state combinations in the model.

6. Results

In this section, I use the calibrated model to investigate whether Americans age 55 and older are using their house as a form of precautionary savings by simulating the housing choices made by this demographic. First, I simulate the benchmark model where individuals are aware that their health could change in the future, and they will be forced to pay out-of-pocket medical bills from either their income, savings, or by selling their house. I then simulate a model

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[9] I use questions in the HRS to look at if respondents had an increase in health conditions; has cancer, a stroke, lung disease, or heart disease; of if they reported having bad health combined with an increase in out of pocket medical expenses to determine these percentages

[10] A sensitivity analysis in section 7 explores what happens to the model with higher and lower values λ_t

eliminating the health shock to determine how this population makes housing decisions in its absence.

To solve for the steady state decision rules in the economy, I begin by guessing the house price and solving the decision rules using value function iteration. Using these decision rules, I simulate an economy with 10,000 individuals for 3,750 periods and generate aggregate statistics for the economy. I discard the first 750 periods to avoid any issues with initial conditions. To compute the simulation, I check to make sure that aggregate housing demand is equal to aggregate housing supply and adjust the price until there is no excess demand or supply[11].

To assess the validity of the model, I compare homeownership rates in the benchmark model with a health shock to those in the HRS. Table 2 shows the results of the model compared

[INSERT TABLE 2 HERE]

to the HRS. The model also generates an average homeownership rate of 75.6% compared with 77.8% in the HRS. The model also does also a reasonable job of approximating homeownership rates for each stage of life.

A. Economies with and without an Economics Impact of a Potential Health Crisis

The results, presented in Table 3, indicate that if a possible health shock is taken out of

[INSERT TABLE 3 HERE]

the equation, average homeownership rates are 68.0 percent (compared to 75.6 percent when such a possibility is considered). The model shows that when households retire (stage 2), the percent of households who own is almost 10-percentage points lower and the rate of moving is double when a health shock is not considered than when it is. In late retirement (stage 3), homeownership rates are 12-percentage points lower when a health shock is not considered, and

[11] Following the same procedure found in Imrohoroglu et al. (2018)

moving rates are 2.8 percentage points higher. In both retirement stages, households are more likely to move from owning to renting when a health shock is taken out of the equation.

Fewer households own a home in their late working years when future medical expenses are not considered, but the difference is small compared to homeownership rates in retirement. Since fewer households want to own a home in retirement when out-of-pocket medical expenses are not expected, the indication is that more would prefer to use their housing equity to help finance consumption but fear they might need to sell it if they get sick in the future. This provides additional evidence that households are treating their home as a form of precautionary savings.

B. Insurance Policy to Correct Market Failure

There fact that households are more likely to behave in accordance with the LCH when future medical expenses are not considered than when they are suggests some sort of a market failure. I am therefore proposing an insurance policy to correct this, going beyond what is currently covered by Medicare and supplemental coverage.

Homeowners can choose to purchase insurance, as a percentage of their house value, α, that would cover any medical costs not picked up by Medicare. Here, the choice to purchase such a policy will be given by the value $\kappa_t = 1$; and the choice not to purchase the policy is assigned a value of $\kappa_t = 0$. With this insurance policy available to homeowners, the budget constraint faced by agents in the model becomes:

$$c_t + \hbar_{t+1} - a_{t+1} = y_t^s - d_t \lambda_t - \kappa_t insurance_t + \hbar_t + (1+r) a_t - T_t^i - T_t^p - F_t \tag{19}$$

Where,

$$insurance_t = \begin{cases} \alpha p_t h_t & \text{if } h_t \in h^{own} \text{ and } \kappa_t = 1 \\ 0 & \text{if } h_t \in h^{rent} \text{ or } \kappa_t = 0 \end{cases} \tag{20}$$

An agent who purchases insurance might still get sick, however they will not be forced to pay medical bills out of their income, savings, or by selling their house. It will be covered by the insurance policy. So, the health shock λ_t becomes:

$$\lambda_t = \begin{cases} \lambda_t & \text{if } \kappa_t = 0 \\ 0 & \text{if } \kappa_t = 1 \end{cases} \tag{21}$$

Table 4 presents the homeownership and moving rates for different values of α. When

[INSERT TABLE 4 HERE]

$\alpha = 0.15\% - 0.50\%$, 12.8% of households purchase the insurance. Then, homeownership and moving rates become very similar between the two model populations (those preparing for a future health shock and those who are not) shown in Table 3. This provides evidence that with the proper insurance coverage in their later years, Americans age 55 and older would be more willing to use the equity in their homes in accordance with the LCH if they knew all future medical expenses would be covered.

7. Sensitivity Analysis

This section provides a sensitivity analysis to the results of the calibration, which are shown in Table 5. First, I evaluate the impact of higher and lower values of possible out-of-

[INSERT TABLE 5 HERE]

pocket medical expenses, λ_t. Lowering λ_t to 0.25 from 0.75 results in a decrease in the rate of homeownership to 68.2 percent compared with 75.6 percent in the benchmark model. Also, this results in an increase in the rate of moving to 7.2 percent from 4.8 percent. Increasing λ_t to 1.25 yields the opposite effect. The rate of homeownership increases to 78.6 percent and the rate of moving decreases to 4.0 percent. This reinforces the results shown earlier that Americans age 55 and older are using their house as precautionary savings for possible future medical bills. The higher the increase in the cost of medical bills from a potential health shock, λ_t, an increasing number of households stay in their home late into retirement and a decreasing number move. The higher the potential medical bills, the more likely households are to stay in their home in case they need to sell it to offset these costs. This reinforces the notion that homeowners do not use their housing equity in retirement because they are treating it as precautionary savings.

Additionally, I evaluate the impact of transaction costs on the model by comparing a model without transaction costs to the benchmark model. When households do not have to pay transaction costs, it has a minimal impact on the distribution of homeownership rates in each stage, however, there is an increase in the rate of moving in each stage. This is to be expected as when households do not have to pay to move, they are more likely to change residences. Since the distribution of individuals who own a home and the rate at which current homeowners move to renting is relatively unchanged from the benchmark economy, this does not provide any evidence that transaction costs are preventing Americans age 55 and older from using the equity in their home in retirement.

8. Conclusions

In this paper, using an economy populated with overlapping generations of heterogeneous agents, I examine how homeowners treat their house as a form of precautionary savings for potential future medical bills, rather than using its equity toward consumption in retirement. Whether it is due to gaps in Medicare, supplemental insurance, or lack of savings, a significant number of Americans appear to own a house well into retirement to offset the costs of possible future out-of-pocket medical bills. In a theoretical economy that lacks such medical needs, more households are moving from owning to renting. Further, in their late retirement years there is a 12-percentage point decrease in the number of homeowners compared to the model where potential health shocks are a factor. Evidence that homeowners are using their house as a form of precautionary savings is further reinforced as the more money that households might have to spend for potential increases in medical bills leads to an increase in the number of Americans age 55 and older who own homes.

Using this framework, I propose an insurance policy that exceeds what is currently offered by Medicare and supplemental coverage. This policy, if purchased, will cover *all* out-of-pocket medical expenses, so the house does not need to be used as precautionary savings. I show that if the cost of such a policy is between 0.15%-0.50% of the home value, then 12.8% of households will purchase it. Agents may still receive a health shock, but they will not be forced to pay for it from their income, savings, or selling their house. The two model economies in this study – the one where agents face a potential health shock and the one where they do not – exhibit similar rates of homeownership and moving when the insurance policy is available. This will free up more households to use the equity in their house to help finance consumption in retirement in accordance with the Life Cycle Hypothesis.

There are other important and interesting questions related to housing equity and precautionary savings that I did not explore in this paper. Future research should seek to investigate the impact of local and state policies on how Americans age 55 and older make housing decisions; how reverse mortgages and changes to the way they are administered could allow homeowners to use the equity in their home without moving to cover out-of-pocket medical expenses; and the possibility that homeowners derive utility from leaving the house as a bequest along with precautionary savings cause older Americans to not use their housing equity.

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Table 1. Calibration Summary of Parameters

τ^p	Property Tax Rate	1.0%
r^d	Interest Rate for Deposits	1.7%
r^m	Interest Rate for Mortgages	4.05%
φ	Transaction Cost of Selling a Home	6.0%
η	Maximum Loan-to-Value	80%
τ_{η_0}	Income Tax Parameter	0.258
τ_{η_1}	Income Tax Parameter	0.768
τ_{η_2}	Income Tax Parameter	0.50
χ	Relative Weight of c in Utility	0.66
σ	Relative Risk Aversion	9.0
δ	Housing Depreciation Rate	1.7%
β	Time Discount Factor	0.96
w^s	Wage Profile	2.7, 2.2, 2.2
λ_t	Health Shock to Income	0.75
d_t	Probability of Health Shock	0, 0, 0.40

Table 2. Model Fit vs HRS Data

	First Stage[a]	Second Stage[b]	Third Stage[c]
Model with Health Shock	80.0	81.2	64.6
HRS Data	76.0	80.4	78.9

a stage 1 represents age 55-64
b stage 2 represents age 65-71
c stage 3 represents 72-77

Table 3. Results of Economy with Health Shock vs No Health Shock

		Economy	
		Health Shock	No Health Shock
Stage 1	Percent Own	80.0	75.0
	Percent Move	5.1	7.5
	Percent Move Own to Rent	1.8	2.0
Stage 2	Percent Own	81.2	71.8
	Percent Move	3.6	6.6
	Percent Move Own to Rent	1.3	2.5
Stage 3	Percent Own	64.6	52.6
	Percent Move	4.8	7.6
	Percent Move Own to Rent	3.4	4.0
Overall	Percent Own	75.6	68.0
	Percent Move	4.8	7.3

Table 4. Homeownership and Moving Rates with the Insurance Policy

		Values of α					
		0.15%	0.25%	0.50%	1.00%	3.00%	5.00%
Stage 1	Percent Own	74.3	74.3	74.2	73.9	71.8	69.1
	Percent Move	7.5	7.5	7.5	7.7	8.5	9.6
	Percent Move Own to Rent	2.0	2.0	2.0	2.1	2.3	2.6
Stage 2	Percent Own	71.2	71.1	71.1	70.9	69.7	68.5
	Percent Move	6.6	6.6	6.6	6.6	7.1	7.8
	Percent Move Own to Rent	2.5	2.5	2.5	2.5	2.6	2.8
Stage 3	Percent Own	52.2	51.9	51.8	50.9	45.2	41.3
	Percent Move	7.5	7.6	7.6	7.8	8.8	9.7
	Percent Move Own to Rent	4.0	4.0	4.0	4.1	5.0	5.6
Total	Percent Own	67.4	67.3	67.2	66.8	64.0	61.3
	Percent Move	7.2	7.3	7.3	7.4	8.2	9.1
	Percent Bought Insurance	12.8	12.8	12.8	12.8	12.8	12.8

Table 5. Sensitivity Analysis

		Benchmark[a]	Low λ_t [b]	High λ_t [c]	No TC
Stage 1	Percent Own	80.0	74.8	82.2	79.4
	Percent Move	5.1	7.4	4.7	15.2
	Percent Move Own to Rent	1.8	2.0	1.8	1.9
Stage 2	Percent Own	81.2	72.0	84.3	80.7
	Percent Move	3.6	6.4	2.8	9.8
	Percent Move Own to Rent	1.3	2.4	1.2	1.4
Stage 3	Percent Own	64.6	53.3	67.0	63.1
	Percent Move	4.8	7.7	4.2	8.8
	Percent Move Own to Rent	3.4	3.9	3.5	3.6
Overall	Percent Own	75.6	68.2	78.6	75.3
	Percent Move	4.8	7.2	4.0	11.9

a $\lambda_t = 0.75$ in the benchmark economy

b $\lambda_t = 0.25$ when looking at a lower value of the health shock

c $\lambda_t = 1.25$ when looking at a higher value of the health shock