Investment Decisions of the Elderly

Preliminary Draft, Comments Welcome, Please Do Not Cite without the Author's Permission

Valentina Michelangeli*

March 18, 2013

1 Introduction

The aging of the population is remarkable in Italy. The old-age dependency ratio, defined as the ratio of the number of individuals aged 65 and over to the number of individuals aged 20-64, is higher than 30 in 2010 and it is projected to increase dramatically in the future (United Nations, 2011). Given the growing number of seniors in Italy, there is an imminent need to better understand how the wealth is distributed among households and how it is allocated in their portfolio (Draghi, 2007).

Data from the Bank of Italy SHIW show three main puzzles in retirees' investment and consumption choices. Firstly, most retirees have a large share of their wealth in the form of housing, also at very old age. That fact is not only typical of Italy, where the average ownership rate after retirement is about 78% and still remains very high after age 80 (above 70%), but it is also common to other countries (US, UK, France). The home is, potentially, the retirees' major source of finance for retirement. However, retirees choose not to use their home equity to finance consumption in the older ages. The 2010 SHIW data show that about 59.87% of elderly homeowners says to have some financial difficulties to sustain their per-period consumption.[1] Interestingly, about 63.96% of retired homeowners without children answer to have financial difficulties in sustaining their consumption[2]. However, even those households choose not to cash in the equity in their home. This saving behavior departs from the prediction of the traditional life-cycle model, according to which households should consume the savings accumulated in their working years to support their consumption in retirement. Not only Italian retirees do not use

*Banca d'Italia. Email: valentina.michelangeli@gmail.com. I would particularly like to thank Giorgio Gobbi, Martino Tasso, Matteo Accornero, Giorgio Albareto, Giuseppe Cappelletti, Giovanni Guazzarotti, and Valentina Nigro.

[1] Among renters, the percentage of households that says to be in financial difficulty is even larger, equal to 83.44%. Among all the retirees, renters and owners, about 64% say to have some financial difficulties to sustain their per-period consumption, where 14.32% face major difficulties, 18.43% face some difficulties, and 31.90% face a few difficulties

[2] 16.78% face major difficulties, 16.42% face some difficulties, and 30.75% face a few difficulties

financial instruments, such as reverse mortgages, to borrow against their home equity (Fornero, Rossi, and Urzi, 2011; Michelangeli, 2010), but they also have the tendency of not moving out of their home. Tatsiramos (2006) estimates Italian retirees' residential mobility to be 1.5 percent per year.

Secondly, compared to other European countries and the U.S., Italian retirees hold a smaller fraction of their financial assets in stocks (Guiso, Haliassos, and Jappelli, 2000, 2002). Almost all their financial wealth is invested in safe assets. The average share of safe assets in porfolio exceeds 90 percent. This investment behavior departs from the predictions of the classical life-cycle model of portfolio choice, according to which retiree's income acts as an implicit holding of safe assets and, therefore, a non-trivial fraction of retirement savings should be invested in risky assets, like equities, characterized by a higher average return.

Thirdly, on average, retirees behave similarly to liquidity constrained households, namely they choose to consume their current income. Paiella (2007) finds a small wealth effect on consumption. Even though the financial wealth effect on consumption is close to the one observed in the U.S., Italian households have, on average, fewer financial asset holdings. On the other hand, Italian households' marginal propensity to consume out of their real asset is quite small.

This research aims at addressing three questions: Why do the elderly maintain high level of homeownership? Why do the elderly not invest in risky financial assets? Is there any financial instrument that could provide an answer to the health and income challenges faced by the elderly? With the aim of understanding retirees' behavior[3], I build a realistic life-cycle model where households are heterogeneous with respect to age, education, marital status, financial assets, health, housing tenure and size. Households face several risks: longevity risk (risk of outliving the resources), disability risk (risk of requiring long-term care), and equity risk (risk associated to stock return). Retirees make decisions over consumption, housing, and investment in risky assets. They sustain health-related medical expenses and per-period housing costs. When retirees change home, some transaction costs are incurred.

The model predicts that households have a strong preference for homeownership. Households receive an extra utility from being homeowners relative to renters and display some attachment to their house which reduces their incentives to move out. That extra utility from homeownership may be motivated by moral hazard considerations, as homeowners have better control over the actions taken to their house. Furthermore, the house, as illiquid asset, can be liquidated only after the payment of some transaction costs. Because of its illiquid nature, the house acts as a store of value that prevents the households from completely consuming it. Only households that face a binding liquidity constraint, because of health-related medical expenses or other kind of financial restraints, found it optimal to liquidate their

[3]Even though it is not explicitly analyzed in this paper, understanding retirees' investment behavior is increasingly important for its implications on the housing and financial markets, while understanding retirees' consumption choices is relevant for studying their impact on the Italian GDP.

house to sustain their expenses and consumption. Liquidity constraints act as a major driver for the elderly to use their housing equity to sustain retirement consumption.

The empirical financial investment choices are in contrast with the predictions of the standard portfolio theory. As the holdings of riskless assets in the form of Social Security income increase at retirement, the fraction of the portfolio invested in risky assets should increase. Interestingly, while the disability risk is important among the elderly in Italy, the average medical expenses are quite low. Specifically, medical expenses are covered, for the most part, by the public Italian system and do not represent a source of background risk large enough to prevent investment in risky assets, at least for the youngest retirees.[4] Moreover, the participation costs are very low to prevent households from investing in risky assets.[5] I find that two main facts could explain retirees' financial investment decision. First, retirees have a large share of the portfolio invested in the house, which is like a long-term bond (Sinai and Souleles, 2005) that provides a stream of housing services. However, due to its illiquid nature, it is costly for households to adjust both non-housing consumption and housing consumption in response to individual shocks. Therefore, with respect to their financial portfolio, households optimally choose to to take a highly liquid position, which guarantees that household's holdings can be easily sold or converted to cash. However, the large investment in housing in itself does not appear to prevent households from investing in risky assets, that even after the inclusion of individual house price risk.[6] To reproduce the financial investment behavior of the elderly, I include the event risk, which acts as a liquidity risk. Households, facing the risk of a major change in the return on risky assets, prefer not to reallocate their investment portfolio at the time of the shock to that return and, consequently, behave like if that were investing in a buy-and-hold portfolio. In light of a possible need for liquidity, due to unexpected changes in their current income or medical expenses, households choose to reduce their exposure to financial risk by investing in safe assets. That choice appears optimal when households aim at holding a diversified portfolio.

I also find that the bequest motive plays some role in explaining retirees' housing and saving choices.

[4]According to the classical model, the investment in risky assets should then decrease over time, as the risk of incurring out-of-pocket medical expenses increases and the loss in the financial markets cannot be offset by labor income. That pattern of optimal investment in risky assets is also recommended by some financial advisors. According to the rule of thumb used by financial advisors, the share of financial assets invested in stocks should be 100 minus the investor's age, implying that at between age 65 and 70 about 30 percent of financial assets should be held in stock. The SHIW data show that, on average, the Italian elderly invest in risky assets less than 10 percent of their retirement saving, which is noticeably less than the amount considered optimal by financial economists and advisors.

[5]Even though different banks applied different fees, those fees could be very low. That is particularly true after the introduction of trading online. For instance, Fineco "Per il mercato azionario italiano, le commissioni di negoziazione sono espresse in percentuale e pari allo 0,19% del controvalore totale dell'ordine. Ad ogni negoziazione azionaria vengono applicate due soglie alla commissione percentuale: una minima di 2,95 e una massima di 19. PattiChiari ha esaminato sei maggiori banche (Intesa Sanpaolo, Unicredit, Mps, Bpm, Bnl, Ubi) e quattro istituti online (Fineco, Webank, Ing, IwBank) ed emerge che le spese damministrazione possono per le azioni possono arrivare al 70% (Bnl, Ubi), le commissioni per la compravendita allo sportello (con soglie minime, attenzione, che incidono di pi sulle cifre basse) allo 0,76% (Mps), contro una media dello 0,19% nellonline, ci significa spendere 76 euro invece di 19 solo per questa voce. "

[6]In a separate experiment, I included a shock to house price to study how households' choices would change in the presence of alternative investments, characterized by different return and liquidity. Specifically in the Italian case, introducing house price risk does not alter significantly households' choices.

The role of the bequest motive has already been studied by Bernheim (1991), Sheiner and Weil (1993), and Megbolugbe, Sa-Aadu, and Shilling (1997) among others, and, together with the precautionary motive against risks in retirement, provides a further incentive to hold real and financial assets, when liquidity constraints are still somehow loose.

The model is then able to replicate some main empirical facts:
1) High homeownership rate, equal to about 80% before age 80, and declining thereafter but remaining above 65%;
2) Tenure persistence, as households display limited changes in housing tenure, from owning to renting;
3) Low mobility, consistently with Tatsiramos (2006), about 1.5% of the elderly move every period;
4) Limited investment in risky assets: more than 90% of the retirees' financial portfolio in invested in safe assets
5) Average consumption equal to about €18,000, which is about the same as the average retirement income;
6) More educated households live in houses of higher value and consume more than less educated households;
7) Renters consume, on average, less than homeowners.

Given that the model is able to reproduce some of the main features of households' behavior in retirement, it could be used as a framework to conduct a series of policy experiments. The main finding is that, in response to an increase in the costs associated to disability or a decrease in per-period income, some households choose to use their housing equity to finance their retirement expenses. Specifically, as households live longer, an increasing fraction of them will be facing disability problems. However, increasingly often, Italian households are incapable of taking care of their elderly. As a consequence, many of those households will decide to employ a 'family caregiver' to provide assistance to their elderly. In the presence of growing and persistence medical expenses, cash in some of the home equity may appear to be the rational choice. I also find that growing housing maintenance costs induce households to reduce their housing equity. Instead, a reduction in the housing transaction costs does not appear to generate large changes in the housing choices. That result supports the fact that liquidity constraints are the driver of many housing choices. In contrast with housing choices, the financial decision to invest in safe assets is almost not affected by alternative policies.

The model predictions, obtained under a variety of alternative scenarios, support the empirical evidence that households aged 80 and over are the most financial fragile age class among retirees.[7] However, the financial markets do not seem to be able to attract the retirees' investment. In the presence of a reduction in the long-term interest rates, political uncertainty, and unpredictability in

[7] About 70% of retirees aged 80 and over answer to be in financial difficulty, relative to about 63% of those aged 64 to 79

the financial markets, households' expectations of an event risk could increase while their willingness to invest in risky assets could further decrease. At the same time, the growing budgetary pressure, resulting also from the demographic change, may induce the government to cut per-period retirement income. I study the housing, investment, and consumption choice when households choose to buy a longevity insurance at age 65. I find that, relative to the baseline scenario without longevity insurance, average consumption significantly increases after age 85 and the homeownership rate does not decrease. However, the additional available resources associated to the insurance are not invested in risky assets.

The paper is organized as follows. Section 2 present the related literature. Section 3 introduces the model, section 4 the parameterization, section 5 the main results. Section 6 shows the role of the event risk. Section 7 presents the model predictions by education, health status, and housing tenure. Section 8 presents some policy experiments. Section 9 analyzes the longevity insurance. Section 10 concludes.

2 Related Literature

This paper relates to a few strands of economic literature.

First, it relates to other studies aimed at understanding the empirical behavior of Italian households. Brunetti and Torricelli (2010) study the effects of the aging of the population on financial markets. Using data from the Bank of Italy Survey of Household Income and Wealth (SHIW), they conduct a descriptive analysis of Italian households' portfolio by age and net worth. Using the same database, Guiso and Jappelli (2000) present a detailed description of Italian households' asset allocation over the lifetime. They study the decisions over portfolio diversification and investment in risky assets. Christelis, Jappelli, and Padula (2005) use the Survey of Health, Ageing and Retirement in Europe (SHARE), which contains information about health, socio-economic status, and social and family networks for individuals aged 50 and over in ten European countries. They find that the choice to invest in stocks depends positively on social interactions, financial literacy, and desire to leave a bequest. Bad health is associated to a reduction of the propensity to invest in risky assets. Transaction and participation costs also affect individual investment decision.

Second, this paper builds on the literature on life-cycle behavior (Kotlikoff and Summers (1981), Kotlikoff (1989), Carroll and Summers (1991), Kotlikoff et al. (2001), and Carroll (1997)). Gourinchas and Parker (2002), Cagetti (2003), and Skinner and Zeldes (2002) study optimal consumption and saving behavior. Hubbard et al. (1994), Palumbo (1999), and Hurd (1989) model consumer behavior after retirement. De Nardi, French, and Jones (2011) study the saving behavior of American elderly by focusing on bequest motive, longevity and medical expenditure risks.

Third, I also follow the literature on housing and on portfolio choice (Campbell and Cocco (2003),

Cocco (2005), Gomes and Michaelides (2005), Cocco, Gomes, and Maenhout (2005), Yogo (2011), and Michelangeli (2011), among others).

Finally, Barro (2006) study the 20th century rare disasters and Alan (2012) and Liu, Longstaff and Pan (2003) solve asset allocation problems in the presence of "tail risks".

3 The Model

Let $S_t = \{X_t, H_{t-1}, Z_t, N_t, E\}$ denote the household vector of state variables, where $t = 65, ..., T$ is household's age with T set exogenously equal to 100, $X_t = W_t + Y_t$ is its cash-on-hand which includes wealth at the beginning of the period t and retirement income, H_{t-1} is the previous period house choice, Z_t is household's health status, N_t is its marital status, and E is its education.

The timing of the event is as follows. The household enters the period and it observes its cash-on-hand, previous period housing choice, current health status, current marital status, and education. Afterwords, it makes the housing choice H_t, pays the housing expenses ψ and moving costs M_t and sustains the medical expenditure $Q(Z_t, t)$. Simultaneously the household chooses consumption C_t and the fraction of the remaining cash-on-hand to invest in risky assets α_t. After those decisions are made, the shock to the return on risky assets is realized and next period available wealth is determined. Moreover the shocks to survival probability, health status, and marital status occur.

3.1 Preferences

Household's plan is to maximize its expected lifetime utility. In each period the household receives utility from non-durable consumption C_t and from housing H_t. Following Attanasio et. al. (2012), the housing preferences account for both housing tenure and housing size. Let $H_t \in \{0, 1, 2\}$, where $H_t = 0$ indicates that the household rents a flat, $H_t = 1$ that the household owns a small-size house, and $H_t = 2$ that the household owns a big-size house.

Household's preferences are described by a separable utility in consumption and housing:

$$U(C_t, H_t) = \frac{\left(\frac{C_t}{g(N_t)}\right)^{1-\gamma}}{1-\gamma} + \theta\phi(H_t) \tag{1}$$

where γ is the coefficient of relative risk aversion. The utility from current consumption is adjusted by a factor $g(N_t)$, to account for the number of household components. The separable term captures the premium for the homeownership and θ is a housing preference parameters that determines that

premium. The parameter ϕ defines the relative utility from owning a big-size house versus a small-size house. When $H_t = 0$, that is when the household rents a home, the proportional scaling term equals 0 and the household only receives utility from consumption. When $H_t = 2$, ϕ takes value 1. When $H_t = 1$, ϕ could take any value in between 0 and 1, implying that $\phi(H = 1)$ defines the value associated to the type of house. Using this specification for household's preferences, I abstract from imposing a proportionality between housing and consumption and I can capture the utility associated specifically to homeownerhip. That utility is mostly driven by moral hazard issues, that guarantees the owners to have full control over the actions taken to their home.

3.2 Bequest function

The household receives some utility from leaving a bequest to its heirs. The bequest consists of financial assets and house value $D(H)$. The bequest function takes the following specification:

$$TW(C_t, H_t) = \eta \frac{(W_t + D(H_t))^{1-\gamma}}{1-\gamma} \tag{2}$$

The parameter η captures the utility for the household from leaving a bequest.

3.3 Household's marital status

Marital status is a basic demographic factor that drives retirees' consumption and investment decisions. Households can be single or married. Let N denote the number of household components, which equals 1 for single households and 2 for married households. Marital status evolves over time according to a transition matrix Π_N, whose elements are $\pi(N_t) = Pr(N_{t+1}|N_t)$.

3.4 Household's income

In each period, the household receives a constant stream of income, which only depends on her marital status N_t and level of education E, $Y(N_t, E)$. The level of education does not change over time. I assume that the retirement income is deterministic and not affected by random shocks. The retiree's income accounts for after-tax Soc Sec Income income ('pensione') and other net transfers.[8] With the aim of studying the investment and consumption decision after retirement, I do not consider working households and, consequently, I abstract from including job-related earnings.

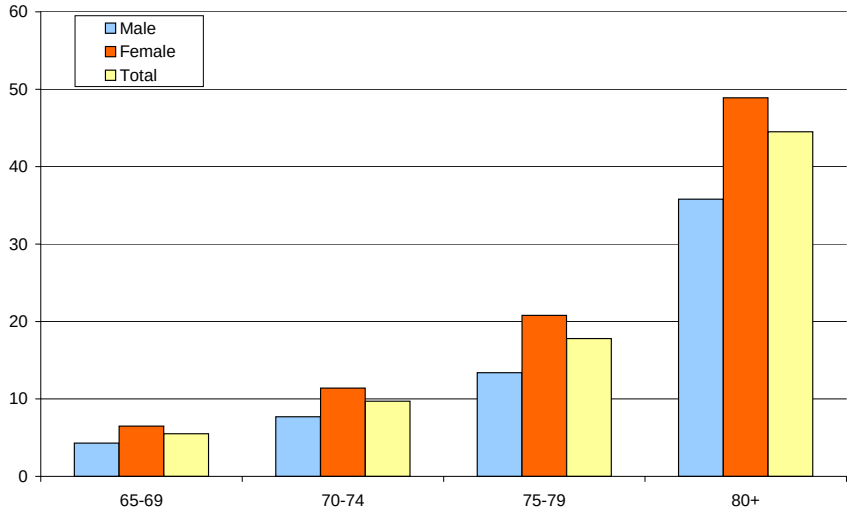
[8]Less than 5% of the sample receive those net transfers, therefore the pension income represents the main form of retirement income.

3.5 Health

Retirees differ by their health status Z, which evolves according to a Markov process.

Figure 1 shows that the number of individuals affected by some disability increases with age. The percentage of individuals affected by disability raises from 5.5 for individuals aged 65-69 to 44.5 for those older than 80.

Figure 1: Disability Rate by Age and Gender



Source: Indagine Multiscopo Istat Salute 2005. The figure shoes the number of individuals with disabity per 100 people of the same age and gender.

Given the importance of the disability risk among retirees, I consider the following three health states: good, bad but without limited ability, bad with limited ability. The health status evolves over time according to a transition matrix Π_Z, whose elements are $\pi(Z_t) = Pr(Z_{t+1}|Z_t)$. Households incur out-of-pocket medical expenses $Q(Z_t, t)$, which are function of the health status and age.

3.6 Housing Expenses

Per period housing expenses $\psi(H)$ are assumed to be function of the house size, deterministic and constant over time. For homeowners, they correspond to a maintenance cost, incurred to keep the house at a constant quality level. For renters, they represent the rental cost.

I assume that the retired homeowners cannot buy a larger house that the one currently owned. If they sell their house, they can only buy a smaller-size house or rent. If they are currently renting their home, they can only continue renting and they are not allowed to become homeowners.[9]

If the retiree decides to sell its house at time t and move to another house, it receives the difference in owner-occupied housing wealth. In addition, she sustains a one-time transaction cost, $\lambda(H_{t-1}, (H_t)$, which is a function of the house size and the housing tenure. It is given by the sum of the transaction costs sustained by the seller λ_s (if the retiree choosess to sell its home), by the buyer λ_b (if the retiree chooses to buy a new home), and by the renters λ_r (if the retiree chooses to become a renter). Let $M(H_t, H_{t-1})$ be the moving cost defined as:

$$M(H_t, H_{t-1}) = D(H_t) - D(H_{t-1}) + I_D \lambda(H_{t-1}, H_t) \tag{3}$$

where I_D is an indicator function taking value 1 if $H_{t-1} > H_t$ and 0 otherwise.

3.7 Financial assets

There are two financial assets. The first is a riskless asset with gross real return $R_F = 1 + r_F$. The second is a risky asset with gross real return R_t. As in Cocco, Gomes, and Maenhout (2005), the excess return is:

$$R_{t+1} - R_F = \mu + \iota_{t+1} \tag{4}$$

where ι_{t+1} is the innovation to the excess return distributed as $N(0, \sigma_\iota^2)$. B_t and S_t denote the amount that the homeowner has in safe and risky assets at date t, such that

$$S_t \geq 0, B_t \geq 0, \forall t. \tag{5}$$

This implies that the household cannot short-sell any of these financial assets.

3.8 The retiree's optimization problem

The Bellman equation for the household problem is:

$$V(S_t) = \max_{C_t, \alpha_t, H_t} U(C_t, H_t) + \beta sp(N_{t+1}) E_t V(S_{t+1}) \tag{6}$$

[9]This assumption is reasonable as a very small percentage of renters become homeowners.

where next period wealth is given by:

$$W_{t+1} = R_{t+1}(W_t + Y(N_t, E) - C_t - M(H_t, H_{t-1}) - \psi(H_t) - Q(Z_t, t)) \tag{7}$$

The return on the portfolio is:

$$R_{t+1} = \alpha_t(1 + r_{t+1}(1 - \tau_S)) + (1 - \alpha_t)(1 + r_F(1 - \tau_F)) \tag{8}$$

and

$$C_t \geq C_{min}, 0 \leq \alpha_t \leq 1 \tag{9}$$

where τ_S is the tax rate applied to the interests on risky assets and τ_F is the tax rate applied to interests on the safe assets.

The model is solved using numerical techniques (Judd, 1998). I simulate 10,000 households of age 65 and I use the policy functions to obtain their choices over time.

4 Parameterization

The Bank of Italy SHIW data have been used to obtain some of the parameters inputed in the model. In addition, I use the SHARE database to parameterize the medical expenditures for the elderly Italians. The year of reference for the parameterization is 2010.

In modeling the financial situation of the retirees, I restrict the sample to households born after 1946 (older than 64 in 2010). I considered only households that are fully retired, who do not perceive any income from self-employment or as employees. I also drop households that declare to have house value greater than €800,000 or financial assets greater than €150,000.[10] Those choices are motivated by the aim of studying the investment decisions of an average retiree with a fixed retirement income. I focus on households and, when the variable of interest differ among household components, I choose to use the data for the household reference person. The final sample consists of about 2,500 households and I use that sample to compare the empirical choices with the predictions of the model.

[10] 160 observations are lost from imposing a restriction on financial assets and house value.

4.1 Marital Status

Marital status is an important determinant of the elderly's investment decision. Married households consists of two individuals. Single households consist of one individual and include single, widowed, or divorced. As shown by the SHIW data, the household marital status is subject to dramatic changes in the retirement period, mostly due to the death of one of the partners. About 60 percent of households younger than 70 are married and only about 29 percent of households older than 80 are married. As the fraction of single tends to increase with age, I model transition matrices for the health status dependent on age.

I obtain the transition matrices for marital status using the SHIW 2008 and the 2010 waves.[11] I follow the counting method that consists of counting the number of married and single households in both waves and computing the changes. Since the model is annual, while the SHIW is biannual, I converted the transition matrices from biannual to annual.

Table 1: Marital Status Transition Matrices from SHIW

	Single	Married
Age 65-69		
Single	0.990	0.010
Married	0.038	0.962
Age 70-74		
Single	0.993	0.007
Married	0.042	0.958
Age 75-79		
Single	0.995	0.005
Married	0.072	0.928
Age 80+		
Single	0.996	0.004
Married	0.088	0.912

4.2 Retirement Income

I parameterize household retirement income using the 2010 SHIW Data on after-tax pension and net transfers (Pensioni e trasferimenti netti) Retirement income is assumed to be function of both marital status and level of education. I distinguish two levels of education: low and high. The low level of education include households without education or with only elementary education. The high level

[11] To parameterize the marital status in retirement I include all the households aged 65 and over, under the assumption that the financial situation does not cause a change in marital status.

of education includes households with middle school, high school, bachelor degree, master, Phd, or other post-bachelor degrees. Those two groups, different by the education level, include about the same number of households. I assume that the level of education remains constant over time, given the marital status and education. I calculate a weighted average of the retirement income for households with low and high education according to their marital status. The average retirement income for single with low education $Y(N = 1, E = 1)$ is €11,100, for single with high education $Y(N = 1, E = 2)$ is €15,930, and for married with low education $Y(N = 2, E = 1)$ is €16,650, for married with high education $Y(N = 2, E = 2)$ is €23,340.

4.3 Survival Probabilities

The survival probabilities are taken from the ISTAT statistics. The survival probability for a married couple is given by the product of the male and female survival probabilities. The survival probability for the single households equals the weighted average survival probability of male and female, using the percentage of male and female for each age class in 2010 as a weight.

4.4 Equivalence Scale

The consumption of households are adjusted using the OECD equivalence scale, according to which the consumption of a two people is equal to the consumption of a person multiplied by the square root of 2. Therefore we set the adjustment factor $g(N_t)$ equal to square root of 2. This is consistent with the SHIW data, where a retired household composed by two individuals consume on average 1.5 as much as an household composed by a single individual.

4.5 Consumption Floor

According to ISTAT data, the level of absolute poverty varies according to the number of household components and to the geographic area. Specifically, it varies from a minimum of about €490 per month for a single household living in the South and a maximum of about €1000 per month for a married couple living in the North. (Data from La misura della povert assoluta, ISTAT 2009, readjusted for inflation). I assume a minimum consumption floor C_{min} lower than the absolute poverty rate and equal to the minimum household consumption, as observed in the SHIW, equal to €3000. This implies that if, a households have decumulated all its real and financial assets, its consumption will not follow below that minimum amount. This captures the fact that Government, religious associations, or charity groups may help the households in sustaining its consumption when it has exhausted her assets.

4.6 Medical Expenses

The Bank of Italy SHIW data does not contain detailed data on household medical expenses for the year 2010. A supplementary database, which samples households aged 50 and over, that could be useful for the parameterization is the Survey on Health, Aging, and Retirement (SHARE). The SHARE is constructed to mirror the US Health and Retirement Study (HRS) and contains questions about the individual health status and medical expenditures, wealth, income, and job status (Brugiavini, Jappelli and Weber, 2002). I use the 2004 and 2006 SHARE data to parameterize the health status transition matrix and related medical expenses, as those waves contain the major number of details about medical expenditure and health.

I select a sample of households aged 65 and over. Households can be in a good health status, bad health status without limited ability, and bad health status with limited ability. The health status is subjective as it results from individuals' answers to the survey. I use two questions to identify households' health status. The first question is "how is your health?".[12] The good health status corresponds to the answers "very good", "good", and "so and so". The bad health status corresponds to the answers "very bad"and "bad". The second question concerns limited activities.[13] An household is defined to be in bad health with limited ability if the household answered to have a bad or very bad health and to be severely limited in doing normal activities because of its health. An household is defined to be in bad health without limited ability it answered to have a bad or very bad health and but also answered not to be severely limited in doing normal activities because of its health. The number of households to have limitations in doing normal activities increases with age. Consistent with the Multiscopo Analysis, the SHARE data show that about 4 percent of the population aged 65-66 is characterized by limited ability to carry on normal activities, while, on average, more than 40 percent of seniors 80 and over are characterized by having limited ability in conducting normal activities. Given the change in the health condition over age, I compute health transition matrices by age. Since the SHARE is a biannual survey, I converted the two years transition matrices into one-year transition matrices.

The health status, especially the bad health status with limited ability, is very persistent. Out-of-pocket medical expenditure include paid out-of-pocket for inpatient care[14], paid out-of-pocket for outpatient care[15], paid out-of-pocket for prescribed drugs[16], paid out-of-pocket for day care, nursing

[12] "Health in general question 1: Direbbe che la sua salute è: 1. Molto buona; 2. Buona; 3. Discreta; 4. Cattiva; 5. Molto cattiva"

[13] "Question on Limited Activities: Pensando almeno agli ultimi sei mesi, quanto sei stato/a limitato/a nelle normali attività causa di un problema di salute? 1. Notevolmente limitato/a; 2. Limitato/a, ma non in modo notevole; 3. Non limitato/a."

[14] Paid out-of-pocket for inpatient care: Senza considerare i premi delle assicurazioni sanitarie o i rimborsi pagati dai datori di lavoro, all'incirca quanto ha speso di tasca propria per tutti i suoi ricoveri ospedalieri negli ultimi dodici mesi?

[15] Paid out-of-pocket for outpatient care: Senza considerare i premi delle assicurazioni sanitarie o i rimborsi pagati dai datori di lavoro, all'incirca quanto ha speso di tasca propria per tutte le cure senza pernottamento in ospedale o clinica, negli ultimi dodici mesi?

[16] Paid out-of-pocket for prescribed drugs: Senza considerare i premi delle assicurazioni sanitarie o i rimborsi pagati dai datori di lavoro, all'incirca quanto ha speso di tasca propria per tutti i farmaci che le sono stati prescritti, negli ultimi

Table 2: Health Status Transition Matrices from SHARE 2004-2006

	Good	Bad No Limited Activities	Bad Limited Activities
Age 65-79			
Good	0.563	0.111	0.326
Bad - No Limited Activities	0.134	0.689	0.177
Bad - Limited Activities	0.300	0.115	0.585
Age 80+			
Good	0.585	0.065	0.350
Bad - No Limited Activities	0.112	0.635	0.253
Bad - Limited Activities	0.202	0.077	0.721

home and home based care[17]. I compute the total out-of-pocket expenses for year 2004 and 2006. I adjust those values to 2010 euro using the Italian Consumer Price Index and I take the average of the medical expenses of both years to obtain the average medical expenses by health status in 2010. Table 3 shows that the medical expenses are larger for households in a bad health status with limited ability and increase with age.

Table 3: Average Medical Expenses in 2010 Euro

	Single	Married
Age 65-79		
Good	340	706
Bad - No Limited Activities	520	1030
Bad - Limited Activities	700	1140
Age 80+		
Good	510	560
Bad - No Limited Activities	420	1106
Bad - Limited Activities	1255	1410

4.7 House value and Housing Expenses

House values are parameterized using the 2010 SHIW data.

To obtain the values associated to big and small houses, I first computed the weighted average house value for the entire sample, assuming a minimum house value of €30,000 to eliminate outliers. The

dodici mesi?

[17]Paid out-of-pocket for day care, nursing home and home-based care: Senza considerare i premi delle assicurazioni sanitarie o i rimborsi pagati dai datori di lavoro, all'incirca quanto ha speso di tasca propria per assistenza in casa di riposo o residenza assistenziale, in centri di assistenza diurna e per tutti i servizi di assistenza a domicilio, negli ultimi dodici mesi?)

average weighted house value equals about €200,000. I then computed the weighted median house value for those households with house value greater than €200,000, which equals €300,000. That is the house value assigned to the big-size house, $D(H = 2)$. Similarly, I computed the weighted median house value of those households living in a house of value lower than €200,000, which equals €135,000. That is the value assigned to the small house, $D(H = 1)$.

For homeowners, per-period housing expenses include ordinary maintenance that is 1.5%. For renters, per-period housing expenses involve the rent, that is parameterized using the 2010 SHIW data and equal about €3,600 annually.

If households decide to move out of their house they pay some moving costs. Those costs equal 3.5% of the house value for sellers and 8.5% of the new house value for buyers (Source: 2012 OECD report, OECD calculations based on OECD Housing Market questionnaire.). Those fees include notary fees, typical real estate agent fees, legal fees, registration fees, and transfer taxes. The housing moving cost is higher for buyers because only they are charged with notary fees, taxes and registration fees.[18]

Instead, for renters, the cost associated to entering the rented house equal one-month of rent.

4.8 Financial Markets

I define as safe assets the sum of deposits and short-term government bonds[19], and I define as risky assets other bonds, stocks, managed assets, foreign bonds, and others assets[20].

To compute the return on risky assets, I use Mediobanca data, starting in 1950. The nominal stock return has been computed starting from the index of total stock return (deflated by the consumer price index)[21]. The return on safe assets has been computed using the nominal return on Italian bonds (BOT). Then the nominal returns on the two types of assets are deflated by the consumer price index to obtain real returns. The excess premium in each period is given by the difference between the nominal return on risky assets and the average nominal return on safe assets. The mean return on safe assets is $r_F = 0.012$, the mean excess premium μ is 0.049, and the standard deviation of the innovation to risky assets, without including event risks, σ_ι is 0.20. I define as an event risk an event that implies a drop in the return of risky assets by a minimum of 30 percent. I consider two datasets, covering the years between 1950 and 2010, "Indice Annuale dei corsi della Borsa Italiana"by Mediobanca and the Milan Comit Global - DS Total Return Index (DSRI):

According to Mediobanca, there were 6 of those events in 60 years, so the probability of an event

[18] per la vendita: commissioni di agenzia + provvigioni; per l'acquisto: commissioni di agenzia + provvigioni +spese notarili+imposte+bolli

[19] "depositi e titoli di stato"

[20] "obbligazioni, azioni, gestioni patrimoniali, titoli esteri, prestiti alle cooperative, altro"

[21] "Indice dei corsi azionari deflazionato con lindice dei prezzi al consumo"

Table 4: Event Risks

Year	Event	Stock return Mediobanca	Stock return Milan Comit Global
1964		-0.31	-
1974	Oil crisis	-0.47	-0.48
1977	Recession	-0.43	-0.39
1982		-0.25	-0.31
1987	Stock market crash	-0.33	-0.35
1990	Recession	-0.34	-0.29
2008	Great Recession	-0.50	-0.49

risk was 10% and the average stock return in the presence of an event risk was -0.40. According to Milan Comit Global, there were 6 of those events in 40 years, so the probability of an event risk was 12.50% and the average stock return in the presence of an event risk was -0.40. Different databases could offer alternative parameterizations or the probability associated to a large change in the stock prices may be affected by contingent events, such as political uncertainty, I do a sensitivity test both on the probability and the size of the event risk. The results show no significant difference relative to those in the baseline scenario.

4.9 Utility Function and Bequest Function

The risk aversion parameter γ takes a value of 5 and the discount factor takes a value of 0.96, as those parameter values are considered standard in the literature of portfolio choice. I calibrate three parameters, θ, $\phi(H = 1)$, and η, to match three moments, the weighted average homeownership rate for households aged 65 and over equal to 78.5%, the fraction of households owning a small-size house equal to 52.1% of the sample, and the weighted average financial assets after age 79 equal to about €13,500. Ex-ante, I do not have a strong prior for the value taken by the calibrated parameters. The parameter θ in the utility function represents the premium for the homeownership. A positive value means that households receive an additional utility from owning a home versus renting it, while a zero value means that households only receive utility from non-durable consumption. The parameter θ takes a value of 0.02 and, therefore, given the utility from non-durable consumption, it induces a significant shift in the total utility at high levels of non-durable consumption. Consistent with Attanasio et. al. (2012), homeownership could be, in that specific sense, considered a luxury. The additional additional utility from homeowneship could be associated with moral hazard issues, according to which homeowners have more control than renters over actions that influence the value of housing services. The parameter ϕ represents the preference for the house type. For renters, $\phi(H = 0)$ takes value 0, meaning that renters only derive utility from non-durable consumption goods. For owners of a big house, $\phi(H = 2)$ takes

value 1. For owners of a small house, $\phi(H = 1)$ takes a value in between 0 and 1. The calibrated parameter $\phi(H = 1)$ takes then a value of 0.685, implying that the extra utility from owning a big house versus a small house is about 30%. The parameter η captures the utility from leaving a bequest. η takes a positive value, equal to 3.55, implying that the retirees benefit from leaving some bequest to their heirs.

Table 5: Parameters

Parameter	Variable	Value
A. Preference Parameters		
γ	Risk Aversion Parameter	5
β	Discount Factor	0.96
θ	Housing Preference	2.14E-2
$\phi(H = 2)$	Housing Size Preference	1.00
$\phi(H = 1)$	Housing Size Preference	0.69
$\phi(H = 0)$	Housing Size Preference	0.00
η	Bequest Motive	3.55
$g(N_t)$	Equivalence Scale	$\sqrt{N_t}$
B. Retirement Income and Consumption		
$Y(N = 1, E = 1)$		€11,100
$Y(N = 1, E = 2)$		€15,930
$Y(N = 2, E = 1)$		€16,650
$Y(N = 2, E = 2)$		€23,340
C_{min}	Consumption Floor	€3,000
C. Housing Parameters		
$D(H = 2)$	Big House Value	€300,000
$D(H = 1)$	Small House Value	€135,000
$D(H = 0)$	Rent	€0.0
$\psi(H)$	Ordinary maintenance cost (% house value)	1.5%
λ_s	Moving cost for seller (% house value)	3.5%
λ_b	Moving cost for buyer (% house value)	8.5%
λ_r	Moving cost for renter (% house value)	one month
D. Financial Parameters		
r_F	Real Return on Safe Assets	1.20%
μ	Excess Premium	4.90%
σ_ι	Standard deviation of shocks to risky return	0.20
τ_F	Tax rate on Safe Assets	12.5%
τ_S	Tax rate on Risky Assets	20.0%

5 Results

In this section, I compare the model predictions with the data. First, I show the macroeconomic variables and, then, the life-cycle profiles.

Table 6 presents the average value of some macroeconomic aggregates both in the model and in the data. I use the 2010 SHIW data to compute a weighted average of homeownership rate, percentage of owners of small-size house, financial assets, share of safe assets, and consumption. Even though many of those aggregates are not explicitly targeted in the calibration, the model is able to capture quite well the retirees' behavior. The average homeownership rate is above 70 percent, about 50 percent of homeowners own a small-size house, the average house value is about €200,000. The fact that households have an average stock of liquid financial assets of about €15,000, highlights the fact that the amount of liquid assets in portfolio is just a minor part with respect to the fraction held in illiquid assets. Retirees detains a large fraction of their financial wealth in safe assets and consume on average about €18,000 yearly, which is financed almost entirely with their current income. Tatsiramos (2006) estimates Italian retirees residential mobility to be 1.5 percent per year. The model is also able to capture that empirical fact, since it predicts that about 1.96% of households choose to move out of their house.

Table 6: Baseline Statistics

	Model	Data
Homeownership Rate (Percentage)	72.0	78.5
Owners of Small House (Percentage)	50.1	52.1
House Value (€)	182,568	202,054
Financial Assets (€)	14,192	15,888
Share of Safe Assets (Percentage)	97.7	90.1
Consumption (€)	17,442	18,132
Mobility (Percentage)	1.96	1.50

To deepen the study of retirement behavior and to assess the validity of the model, using the 2010 SHIW data, I construct four groups of households that differ by their age and consist of about the same number of households. The first group includes households aged 65 to 69 (19% of the sample), the second group includes households aged 70 to 74 (26% of share sample), the third group includes households aged 76 to 80 (22% of share sample), the fourth group includes households aged 80 to 100 (33% of share sample). Given the limited number of observations for retired households, analyzing the households' behavior for four age classes allows to have smoother behavior.

Figure 2 shows the homeownership rate by age. Overall, in the data, the homeownership rate remains quite high (about 80%) and almost constant until age 80. It, then, tends to slightly decrease remaining around 70%. The model is able to capture quite well that data profile, as it predicts that households display a strong preference for homeownership also very late in life. As household choose not to sell their house to cash in some of the equity locked in it, I may conclude that households prefer a high level of housing consumption also at old ages, even thought that could imply giving up some non-housing consumption.

Figure 2: Homeownership Rate by Age

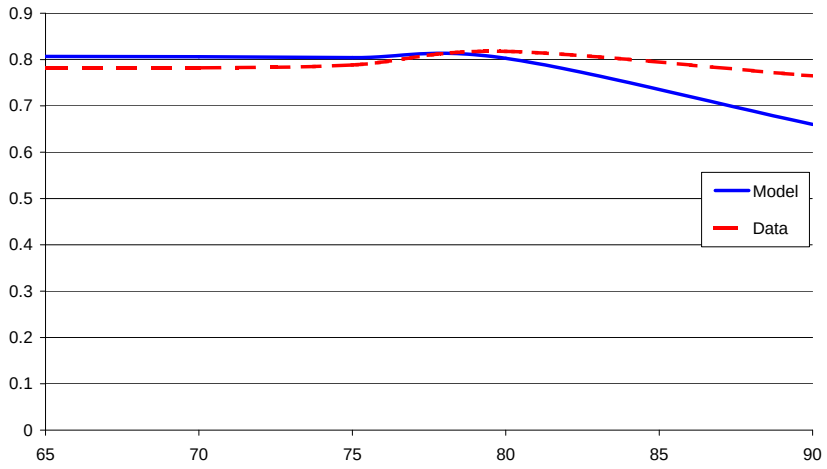


Figure 3 shows the average house value in 2010 euro, both in the data and in the model. The average house value tends to slightly decrease with age as some older households choose to live in a smaller house, while remaining homeowners. Households, who choose to downsize, benefit from liquidating some of the equity held in their house as well as from the lower per-period maintenance costs associated with the smaller houses. The figure also captures the fact that the fraction of homeowners that live in a small-size home increases with age, moving from about 50% of households younger than 70 to about 65% of households older than 79.

Figure 4 displays the average financial assets over the retirement period. The liquid assets, even though considerably lower than the average holding of illiquid assets, tend to remain at a positive level also at very old age. This means that households choose to maintain a buffer of savings that could either be used to pay for their age-related medical expenses or left as a bequest. As average consumption is slightly greater than average per-period income, some households use a small fraction of their liquid wealth to finance their per-period consumption.

Retirees, on average, choose to invest their liquidity in assets characterized by a low, but safe return. The average share of financial assets invested in safe assets is almost constant after age 65 and does not drop below 90%. Retirees that face medical expenditure risk and given the event risk choose to avoid taking other risks from investing in the financial markets.

Figure 3: Average House Value by Age

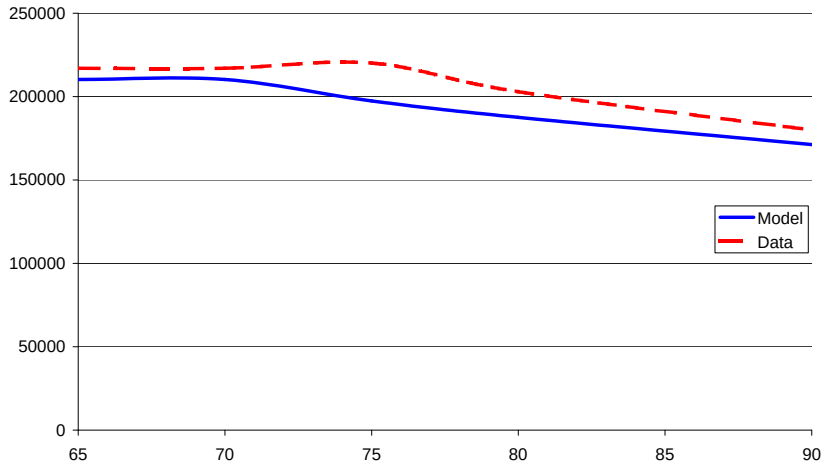


Figure 4: Financial Assets by Age

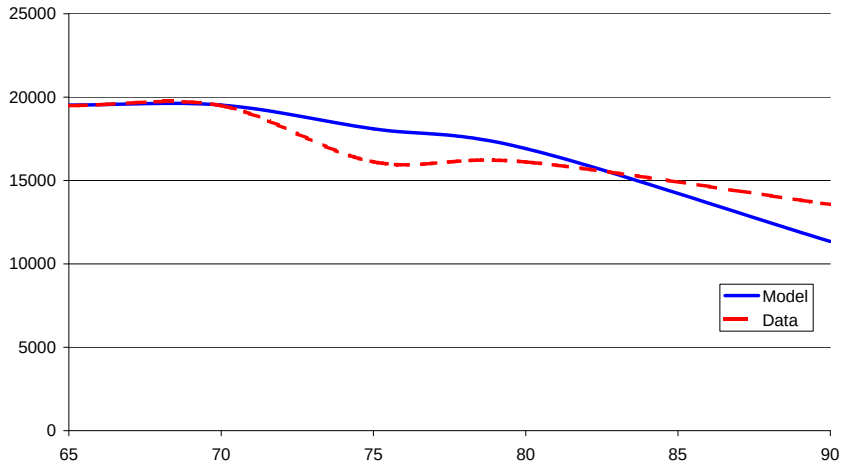


Figure 5: Share of Safe Assets by Age

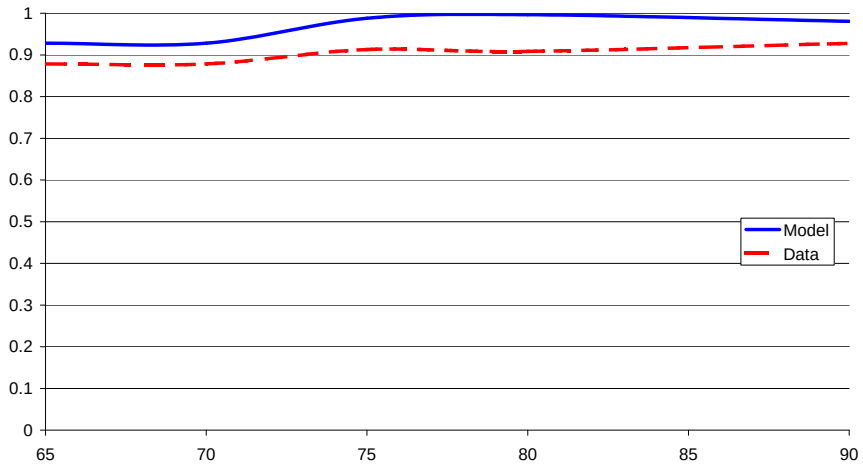
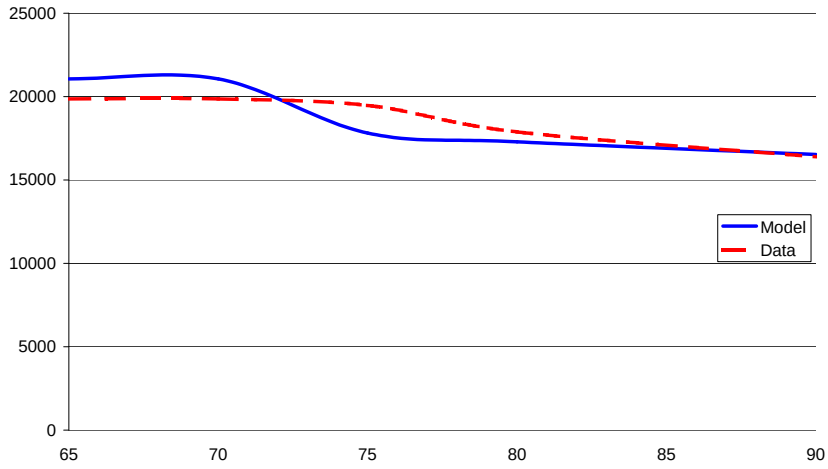


Figure 6 displays the average consumption, inclusive of housing costs, both in the model and in the data. Average consumption is about stable in retirement, averaging between €15,000 and €20,000. It tends to slightly decrease after age 80.

Figure 6: Consumption by Age



6 How Important is the Event Risk?

An event risk is a "tail risk"associated with an large change in the price of equity securities. Households facing that risk are less willing to invest in risky assets characterized by an uncertain and possibly very large negative return. As discussed by Liu, Longstaff, and Pan (2003), the household facing an event risk can expect a return from their portfolio equal to that of a buy-and-hold portfolio. Specifically, when facing a large negative shock to the portfolio return, the household may experience a change in its wealth before it can rebalance its portfolio. As the portfolio cannot be immediately reallocated without incurring in a significant loss, the event risk is comparable to a liquidity risk.[22]. The optimal portfolio choice in the presence of event risk may be quite different from the optimal portfolio choice without that risk. In the presence of an event risk, the investors optimally choose to reduce their investment in risky assets because they acknowledge that, if a separate negative shocks to their income occurs, they could need some liquidity to be able to sustain their consumption. This is particularly true for the elderly that face a large and persistent disability risk, while their retirement income, even though similar to a riskless bond, is just sufficient to sustain per period consumption. This mechanism is further strengthened by the elderly preference for homeownership. As the retirees' portfolio is largely tied up in illiquid positions, mostly housing, the optimal portfolio choice would be to reduce the exposure to

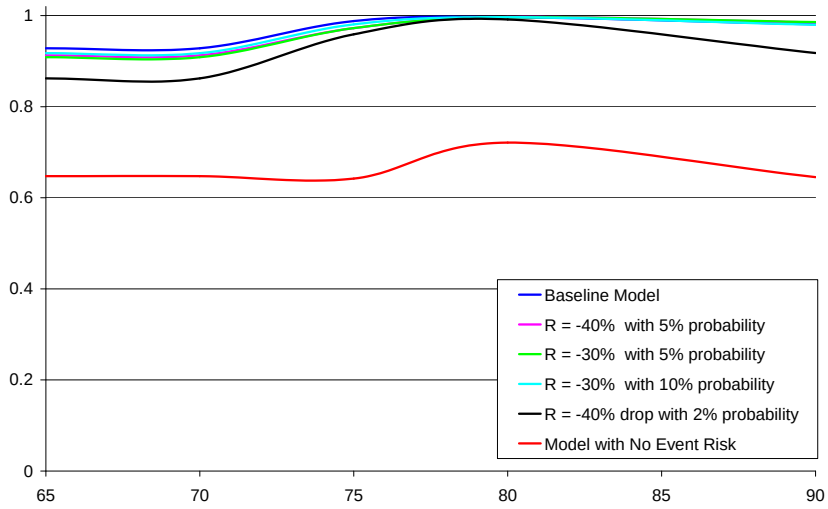
[22]Liu, Longstaff, and Pan (2003) also study volatility jumps. Even though they find that also those jumps affect households' portfolio choice, their effect is less relative to price jumps. In this paper, I will only focus on price jumps

liquidity risks by reducing their investment in stocks. Given that the household cannot predict with certainty the timing and the magnitude of the equity security price jumps, the decision to invest less in risky assets than it would be optimal under the standard assumptions of classical portfolio models appears to be the result of a rational behavior.

In order to evaluate the importance of the event risk, I re-calibrate the model without the event risk. In that case, the shocks to the return on risky assets are symmetric with standard deviation 0.28. In this scenario, the share invested in safe assets is, on average, equal to 65.58% and it is significantly lower that that observed in the data.

I also consider alternative parameterizations for the event risk, as different data provide alternative characterizations of the large shock to the return to risky assets and of the associated probabilities. Moreover, especially in periods characterized by high political uncertainty and volatility in the financial markets, the likelihood of a "tail risk" may increase in households's expectation. I re-calibrate the model, considering alternative large changes in the stock return: 1) a 40% negative stock return with a 5% probability; 2) a 30% negative stock return with 5% probability; 3) a 30% drop with 10% probability;4) a 40% drop with a 2% probability. Figure 7 shows that the existence of an event risk, regardless of the size and frequency, reduces by about 30 percent the share of financial assets invested in risky stocks relative to a model without event risk.

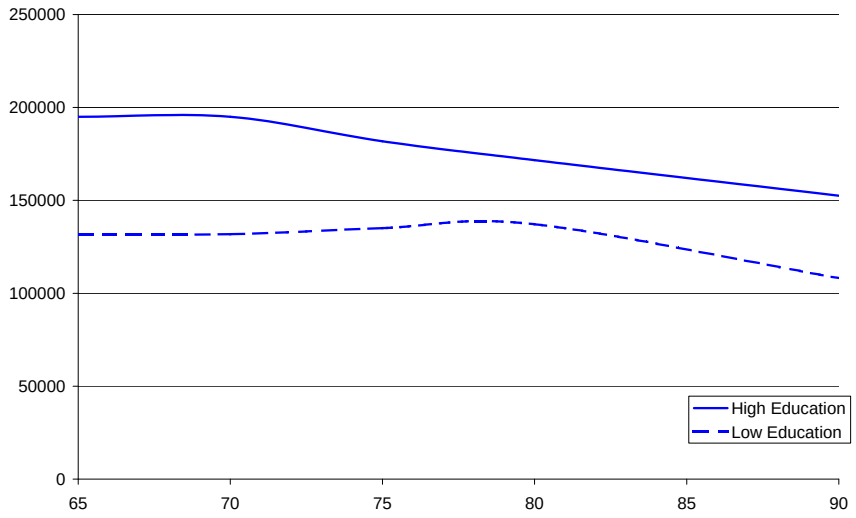
Figure 7: Share of Safe Assets by Age: Role of the Event Risk



7 Model Predictions by Education, Health, and Housing Tenure

In this section, I present the model predictions by education, health, and housing tenure. The education level, which affects the retirement income, is a major determinant of different economic behaviors among retirees. Consistently with the empirical data, households with a higher level of education live in larger houses. The difference between average house values shrinks with the increase of age, but it is still significant after age 80. Also the average consumption is higher for more educated households. The higher per-period retirement income allows more educated households to sustain larger per-period maintenance costs and consumption. Instead, with respect to investment in risky assets, the households' behavior does not display significant differences. While before age 70, more educated households have a slightly larger fraction of savings invested in risky assets, that difference disappears after age 80.

Figure 8: House Value by Education



The health status mainly drives the retirees' housing choices. Households in a bad health status with limited ability acknowledge the persistence of their medical condition and associated medical expenses. Relative to other households in a better health status, those households optimally choose to reduce their housing equity by about 5 percent to increase their liquid position. The reduction in homeownership occurs mostly after age 80, when the medical expenses increase significantly. The additional liquidity resulting from the sale of their house allows those households to maintain an average consumption equal to those of the other age groups. Health does not affect the share of safe assets held in portfolio.

Figure 9: Consumption by Education

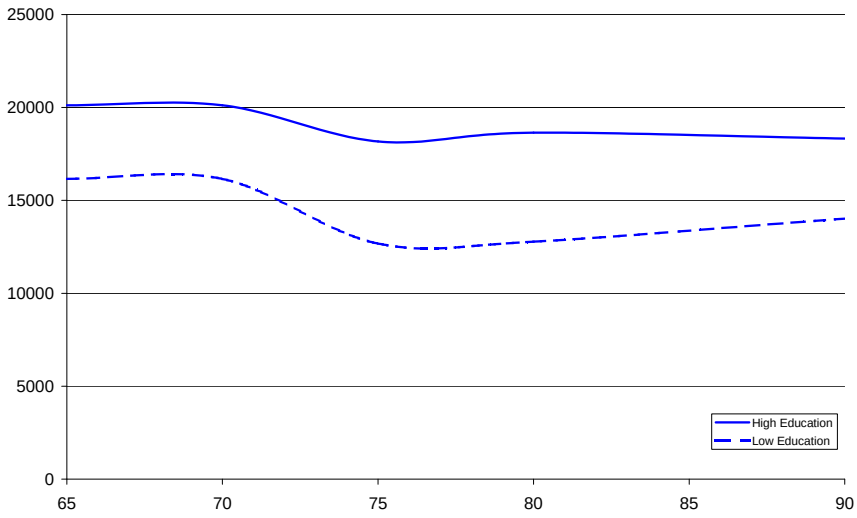


Figure 10: Share of Safe Assets by Education

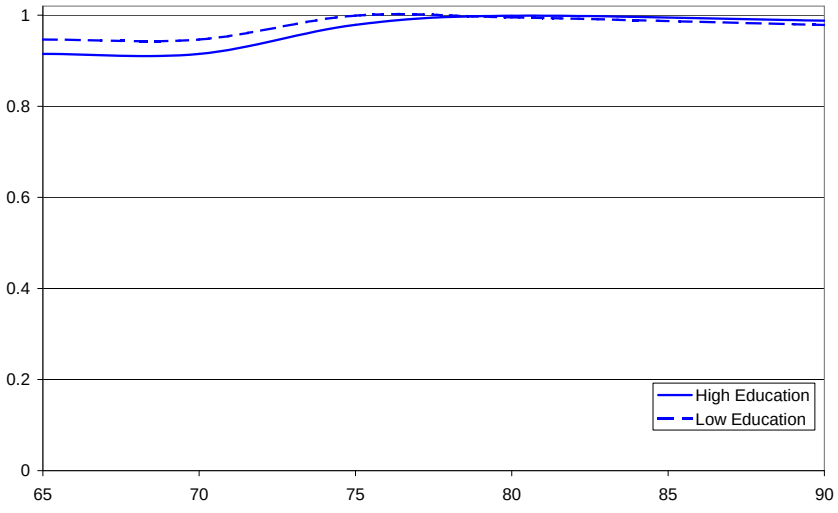


Figure 11: Homeownership Rate by Health Status

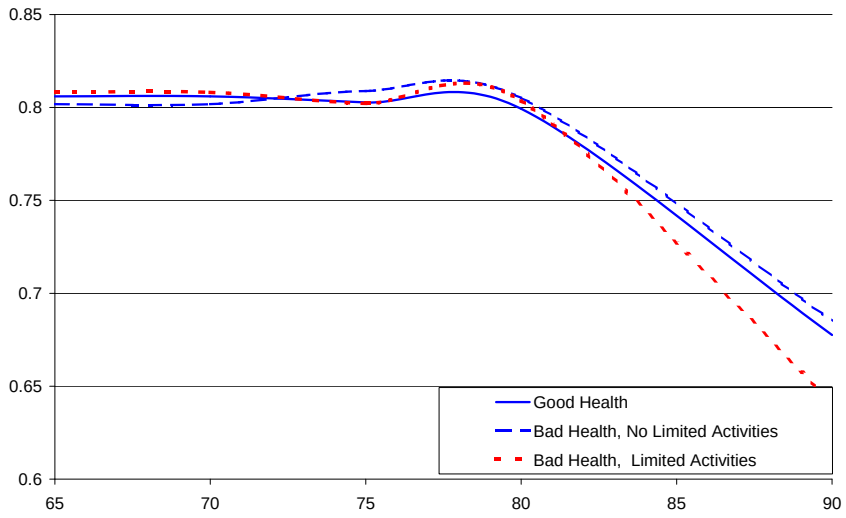


Figure 12: Share of Safe Assets by Health Status

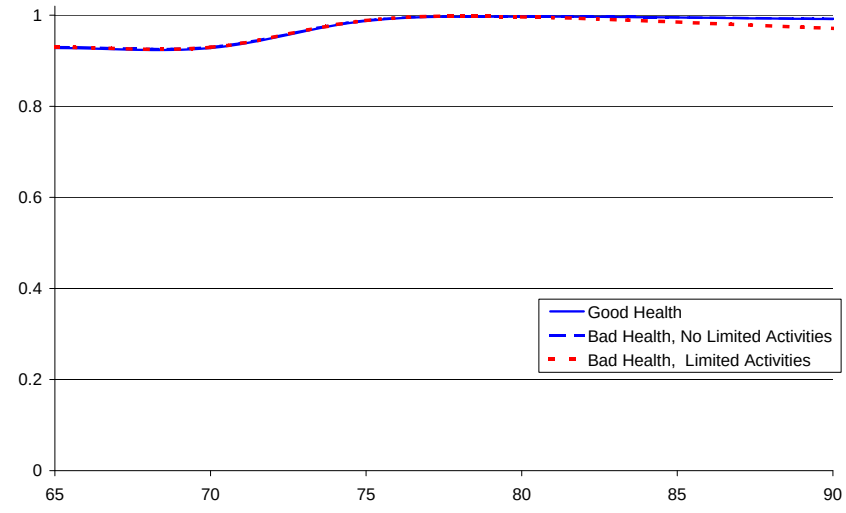
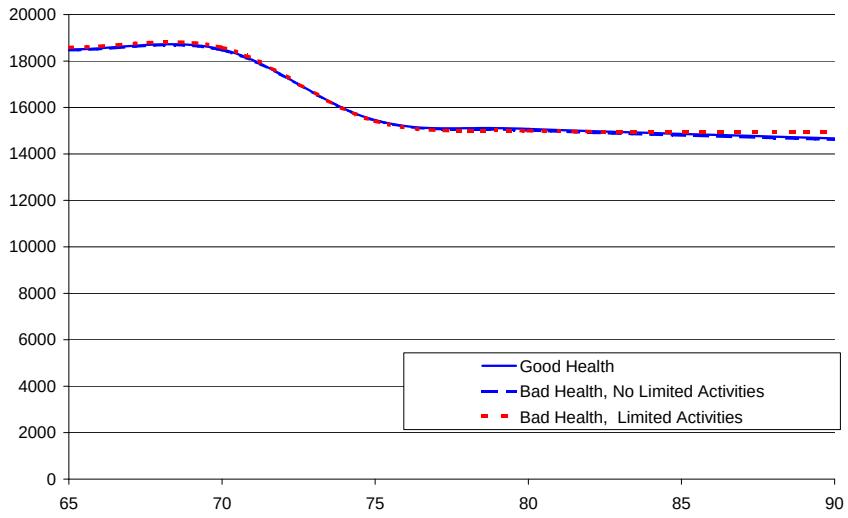


Figure 13: Consumption by Health Status



Housing tenure affects mainly the consumption level. Renters on average have a lower consumption than homeowners.

8 Policy Experiments

In this section, I evaluate how households' economic behavior changes relative to the baseline scenario when alternative policy scenarios are implemented.

8.1 Medical Expenses Cut in Half

One of the driving force of savings after retirement is the medical expense risk. In order to evaluate how much that risk affects the retirees' economic behavior, I assume that medical expenses are cut in half. That cut could result from an expansion of public medical coverage or from a reduction of the medical expenses for the elderly. The question is: Are those additional available financial resources invested or consumed? As shown in Table 8, the model predicts a larger fraction of homeowners as well as an increase in the number of small-size house owners. Given that households strongly prefer owning relative to renting, more households optimally decide to own a house. However, given the per-period

Figure 14: Share of Safe Assets by Housing Tenure

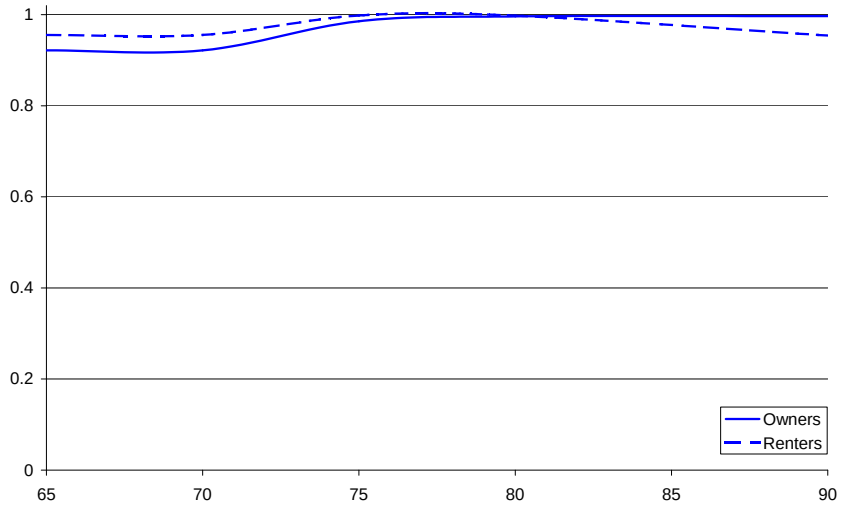
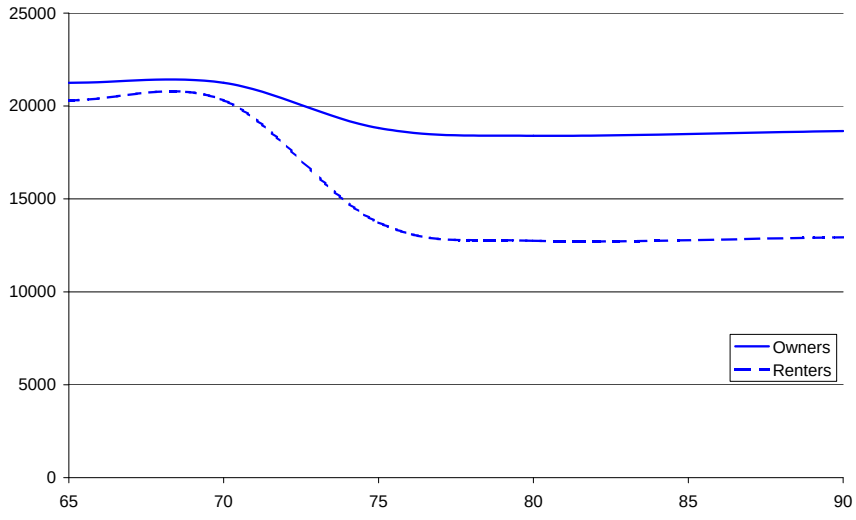


Figure 15: Consumption by Housing Tenure



costs, many of them optimally choose to own a small-size house. Specifically, as shown in table 9, households aged 80 and over, that in the baseline scenario optimally choose to sell their home and rent, optimally decide to remain homeowners when the medical expenses are halved. The average house value is higher than the baseline one, as households have more financial resources that could be used for paying housing costs and consumption. The share of the financial portfolio invested in risky assets is almost unchanged.

Most of those aggregate results are driving by households older than age 80. Households aged 65 to 79 are in a better health relative to older households and, on average, sustain lower medical expenses. A cut in the medical expenses induces those younger households to increase their housing consumption and reduce their buffer stock of precautionary savings. Instead, households age 80 and over, optimally choose to remain homeowners, but relative to the younger households, choose to live in smaller-size houses, that allows them to free some financial resources and increase their buffer stock of savings. Their consumption further increases as they shift their financial resources from the payment of medical expenses to consumption.

8.2 Caregivers

The Italian situation is changing with respect to twenty years ago. The elderly are living longer and an increasing fraction of them is not completely self-sufficient and requires long term care.

While in the past assistential services have been provided to the elderly by the close family or the neighbors, today the family cannot always take care of their elderly, mostly because of the involvement in job-related activities. The Italians often look at caregivers as new figures that can provide an answer to the elderly's need of assistance. The caregivers have been present in Italy in a significant number for about 15 years. It is not simple to estimate the exact number of caregivers in Italy, because a large fraction of them are employed without a regular job contract and because the Inps data do not distinguish between colf ("collaboratori domestici") and caregivers ("badanti"). In 2008, the number of caregivers in Italy was about 774.000 (Pasquinelli and Rusmini, 2008, who compute this estimate using official sources such as Inps, Istat, Agenas, together with a vast evidences collected on the territory). In Italy, about 6.6 percent of individuals aged 65 and over employ a caregiver, with a peak in the Northern regions of one in 10 individuals. This can be considered as a lower bound, as many cargivers take care of more than one senior.[23]. Even though there is some variation across regions, the employment of caregivers is the most common form of assistance to the elderly after the family. In Italy, very few seniors choose to go to a nursing home (according to an estimate of Istat 2007, it is about 2 percent). Moreover, the public or social assistance is still unable to cover entirely the needs of the non-self-sufficient elderly.

[23]In South Italy, the strongest family and friends ties cause a reduction in the use of caregivers for help.

For example, in Lombardia, only about 4 percent of the disable elderly have access to government transfers ("buoni sociali") and about 31 percent benefit from public assistance ("assistenza domiciale integrata delle ASL"). However, both the social assistance and the public domiciliary assistance consist of a maximum of 4-5 hours a day (Gori, 2006. Pesaresi, 2007). About 48 percent of the non-self-sufficients elderly benefit from the help of a caregiver.

Italian families' payment to caregivers have been estimated to be more than 9 billion, including both the regular and irregular workers. Only 1 in 3 caregivers is estimated to have a regular job contract. About 43 percent are illegal immigrants and the remaining 24 percent work without a regular contract (IRS, 2008).

Living together with the elderly is the most common kind of caregiver's assistance. Seven out of 10 caregivers offer this kind of assistance. However, this allocation between living together and working few hours a day is slightly changing over time as more caregivers offer a care by hour ("assistenza a ore"). One explanation for this change in tendency is, in addition to the higher autonomy for the caregiver, the fact that living together does not imply an important premium with respect to a job that involves working few hours a day. Table 7 shows the average monthly income by job and the percentage of caregivers in each income class.

Table 7: Net Monthly Income, by job

	Living together	Work at least 6 hours a day	Total
< 750 €	14.8	21.7	16.3
750-1000 €	73.3	52.5	70.2
>1000 €	11.5	25.7	13.5

Source: Irs, 2008

In the model, I assume that 5 percent of the retirees in bad health with limited ability and aged 85 and over need a caregiver, paying €9,000 yearly for the received assistance. I also assume that all households age 80 and over in bad health sustain medical expenses equal to those sustained by the same age class in bad health with limited ability. As shown by the second column in Table 8, given that the health-related expenses are very persistent, many households in bad health with limited ability optimally choose to sell their home and use the newly available financial assets to cover those health-related expenses. On average, the homeownership rate drops by more than 4 percent. Both the homeownership rate and the fraction of small house owners decline relative to the baseline scenario. As indicated by Table 9, the largest drop in homeownership rate occurs for households age 80 and over, who are those in need for a caregiver. The resources made available from the sale are mostly used to cover the health-related medical expenses and are not enough to prevent a decrease in average consumption. The stock of precautionary savings also decreases to contribute to the payment of medical expenses and consumption. The share of financial assets invested in safe assets does not change in a significant

way.[24]

8.3 No Moving Costs

In this experiment, I study the role played by the housing moving costs in preventing households from liquidating their house. As shown by the third column in Table 8, the homeownership rate remains basically unchanged. That prediction is motivated by the fact that households have a strong preference for homeownership and, if they are not liquidity constrained, choose to keep unchanged their housing status. Given that housing choice, all the other consumption and investment choices remain almost the same. This policy experiment shows that the housing transaction costs are not the main explanation for the observed persistence in households' housing tenure.

8.4 10 Percent Increase in Maintenance Costs for Homeowners

In this experiment, I study how an increase in the maintenance costs faced by homeowners affects households' economic behavior. For instance, that increase could capture a raise in the taxes levied on the first home. As shown by the fourth column in Table 8, the main effect is a drop by 2.5 percent in the homeownership rate. Moreover, among homeowners, there is an increase in those that opt for a smaller-size house. As indicated by fourth column of Table 9, both the homeownership rate and the average house value decrease for each age class, with the largest drop for older households. Average financial assets decrease by about 2 percent. However, there are differences for age classes. The youngest retirees experience an increase in their financial assets, because, at the announcement of the increase in maintenance costs, they immediately choose to downsize or sell-and-rent. Instead, older the retirees, that have already consumed part of their housing equity, experience a decrease in their available financial resources to support consumption. The share of safe assets in portfolio is almost unchanged. Consumption slightly increases for younger households that have chosen to change their housing status, however, it decrease for older households when the financial resources decrease.

8.5 10 Percent Cut in Retirement Income

A cut in retirement income has an impact on household budget similar to the increase in the maintenance cost. The main difference with the previous experiment is that the increase in maintenance cost affect only the homeowners, while the cut in retirement income affects any household. As showed by the fifth column in Table 8, the reduction on the homeownerhip rate is stronger and equal to about a 7 percent

[24]Even though the model is solved in partial equilibrium, one can infer that the increase in medical expenses at the end of life induces a change in house prices, under the assumption of a constant stock of housing. As retirees find optimal to sell their house, house prices may have to reduce to achieve an equilibrium.

decrease, on average. Among the homeowners, there is an increase in the fraction that choose to live in a small-size house and therefore a decrease in the average house value. Average liquid financial assets increase following the sale of the houses, however the average consumption drops. Older households experience the largest drop in homeownership rate, equal to about 12 percent, and in consumption, equal to about 8 percent (Table 9).

Table 8: Policy Experiments: Percentage Changes in the Aggregates

	(1)	(2)	(3)	(4)	(5)
Homeownership Rate	8.43	-4.42	-0.02	-2.50	-6.87
Small House Owners	7.96	-6.00	-0.31	5.19	4.01
House Value	0.91	1.01	0.18	-5.15	-7.58
Financial Assets	11.95	-2.74	0.11	1.82	32.66
Share of Safe Assets	0.37	-0.17	0.00	-0.29	-0.55
Consumption	1.80	-1.32	0.02	-1.25	-7.13

The experiments are the following:

(1) Medical Expenses are halved

(2) Caregivers

(3) No Moving Costs

(4) 10 Percent Increase in Maintenance Costs for Homeowners

(5) 10 Percent Cut in Retirement Income

Table 9: Policy Experiments: Percentage Changes by Age

	(1)	(2)	(3)	(4)	(5)
Homeownership Rate					
65-69	0.08	-1.16	0.00	-1.73	-0.97
70-74	0.31	-1.46	-0.01	-2.18	-1.19
75-79	0.52	-2.75	-0.01	-2.12	-1.17
80+	15.51	-6.71	-0.03	-2.92	-11.89
House Value					
65-69	1.15	0.21	0.00	-1.59	-3.36
70-74	4.58	-0.02	0.00	-2.03	-5.23
75-79	6.51	0.45	0.06	-1.97	-5.44
80+	-1.62	1.67	0.32	-7.87	-10.02
Financial Assets					
65-69	-5.29	1.35	0.11	12.37	27.68
70-74	-18.93	-2.19	0.17	6.84	20.59
75-79	-21.13	0.29	0.02	-1.70	4.75
80+	5.25	-5.71	0.12	-3.16	49.19
Share of Safe Assets					
65-69	-0.22	0.15	-0.11	-0.96	-2.31
70-74	-0.02	-0.12	0.01	-0.38	-0.86
75-79	0.06	-0.41	0.01	-0.10	-0.61
80+	0.67	-0.20	0.01	-0.17	-0.06
Consumption					
65-69	0.85	0.76	0.14	1.74	-6.08
70-74	-0.95	-1.12	0.02	0.35	-5.40
75-79	-1.08	-0.27	-0.02	-0.86	-8.04
80+	3.52	-2.26	-0.01	-2.67	-7.67

The experiments are the following:

(1) Medical Expenses are halved

(2) Caregivers

(3) No Moving Costs

(4) 10 Percent Increase in Maintenance Costs for Homeowners

(5) 10 Percent Cut in Retirement Income

9 Financial Innovation: Longevity Annuity

The data, the baseline model, and policy experiments show that households aged 80 and over are the most financial fragile among the elderly. Specifically, that age group has decumulated mostly of its liquid savings, tends to consume its per-period income, and, if a change in its medical expenses, maintenance costs, or retirement income occur, its budget constraint becomes binding and households are forced to sell their home to increase their liquid position. However, even after liquidating the house, many households have to reduce also their per-period consumption. This is particularly true for the renters.

Furthermore, the data and the simulations show that households have a strong preference for homeownership. Even in the absence of moving costs, they do not change their housing status. Households choose to downsize or to sell-and-rent only if they have exhausted their liquid assets and if their per-period expenditure exceed their per-period income. Financial restraints are particularly severe for households age 80 and over, whose rate of homeowneship drops.

Economists and the financial industry have evaluated alternative financial instruments that could alleviate the poverty among the very old and the renters. One financial instrument that did not received the expected success in the US and, similarly, that is not much widespread in Italy is the "reverse mortgage". One of the motivation for the unsuccess could be associated with the strong desire for homeownership, that is preferred to renting. Households that are not facing a binding liquidity constraint seem to prefer to reduce their own non-housing consumption. Households facing a binding liquidity constraint prefer to sell-and-rent. After all, it seems that, on average, households would not be willing to sacrifice their housing consumption to increase their non-housing consumption in retirement.

Also financial markets do not seem to be able to attract retirees' investments. In the presence of a reduction in the long-term interest rates, political uncertainty, and unpredictability in the financial markets, households' expectation of an event risk could increase and their willingness to invest in risky assets may decrease even more.

Visco (2002) and Elmendorf (2000) emphasize the growing budgetary pressure faced by many developed countries, resulting from the demographic change and the increasing spending in retirement programs. Fiscal policy reforms may be inevitable to put the budget on a sustainable path. Possibly retirees could have to face a reduction in their retirement income with disastrous consequences especially after age 80, when almost all the financial resources will be exhausted.

A financial innovation, which possibly could offer an hedge against longevity and disability risk, could be the longevity insurance. The longevity insurance is a particular kind of annuity that guarantees a stream of payments until death. However, differently from other form of annuity, it does not start until age 85. By that age, the retirees would have exhausted most of its financial savings and, at the same

time, it will possibly start facing an increase in health-related medical costs. That financial instrument could help retirees sustaining their old-age medical expenses and their consumption, also in light of a reduction of their per-period income without the sale of their home. The longevity insurance can be offered at a very affordable price relative to the conventional annuity, but the retiree has to buy it at age 65. This would imply that the retiree will not receive any money for the first 20 years of retirement.

The price for a longevity insurance that pays €20,000 yearly after age 84 should be determined under the assumption that the insurance is actuarially fair, namely the insurance company should have zero expected profits. Adverse selection should be limited given that the individual sustain the cost at age 65 and it will receive the payment after 20 years. I assume that only one household component buy the insurance. The formula for the total price of the longevity insurance P_L is:

$$P_L = \sum_{t=85}^{T} \left[\prod_{j=85}^{t} sp_j \right] L(1+i)^{(t-65+1)} \tag{10}$$

where sp_j is the conditional probability of being alive at time j conditional on being alive at time $(j-1)$. L is the per-period cash received by the households, i is the average interest rate over the life of the annuity, assumed equal to 5%. I also assume that there are no associated fees at the time of the purchase.[25] Using the weighted average survival probabilities provided by the ISTAT and assuming that a retiree would die by age 100, I found that a 65-year-old retiree that buys a €20,000-a-year annuity that starts immediately would pay about €235,000; while if it buys the longevity insurance that starts its payments at age 85, it would pay about €21,000.

I assume that all households buy a longevity insurance at age 65 and I evaluate the change in their housing choices, savings, and consumption. In the following figures, I compare two scenarios: the baseline scenario and the baseline scenario with longevity insurance. As shown in figure 16, a larger fraction of retirees can afford to remain homeowners. Without longevity insurance, a non-trivial fraction of households have to move out their home to sustain their consumption and medical expenses after age 80. That fraction of movers increases when caregivers are introduced in the model. Instead, with longevity insurance, households receive a constant and deterministic stream of income at the time in which all other liquid resources are almost exhausted and the medical costs are growing. That stream of income provide such an important source of income for the retirees that almost nobody choose to downsize or change housing tenure. Figure 16 shows that the homeownership rate remain about constant over the retirement periods.

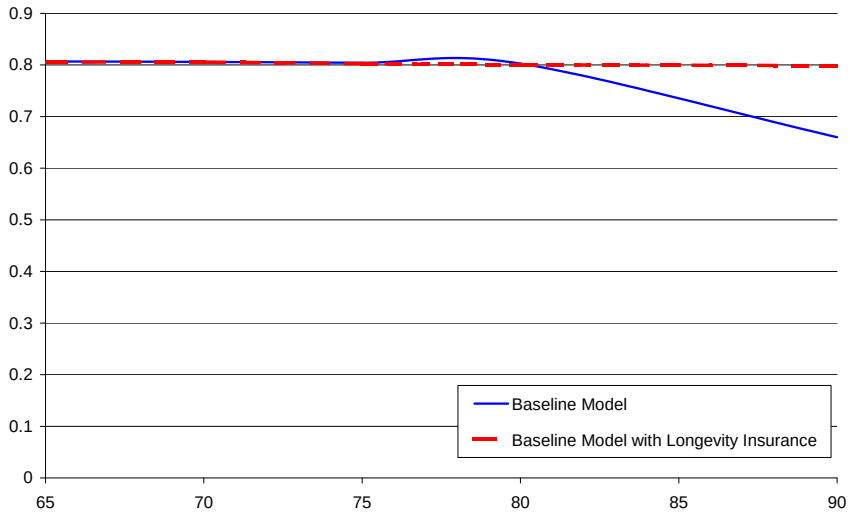
Figure 17 displays the financial assets with and without longevity insurance. With longevity insurance, the average financial assets are always lower than without. That model prediction follows from two facts. First, 65-year-old households use a fraction of their liquid assets to buy the longevity

[25] Alternative parameterization may alter the quantitative results, but qualitatively the results will still hold.

insurance. Second, retired households choose to accumulate less precautionary savings against medical expenditure shocks since they will receive a constant and deterministic stream of income to draw from in case of necessity. Even thought the implicit holdings of riskless assets increase, households do not choose to invest their financial resources in risky assets (Figure 18). The event risk still play a major role in explaining that model prediction.

Figure 19 shows that, in the baseline case, households reduce their consumption as they get older, because they do not have enough financial resources to sustain medical expenses, housing, and non-housing consumption. Instead, households that bought the longevity insurance experience a significant increase in their consumption after age 80. The goal of the longevity insurance would be to reallocate consumption from a period in life when it is relatively high (due to low medical expenses and relatively large buffer stock of savings) to a period when it is low (due to larger medical costs and lower buffer of savings)

Figure 16: Homeownership with and without Longevity Insurance



10 Conclusion

I am planning to improve this work in several directions. First, I plan to include house price uncertainty and evaluate households' choices in the presence of financial and housing investments characterized

Figure 17: Financial Assets with and without Longevity Insurance

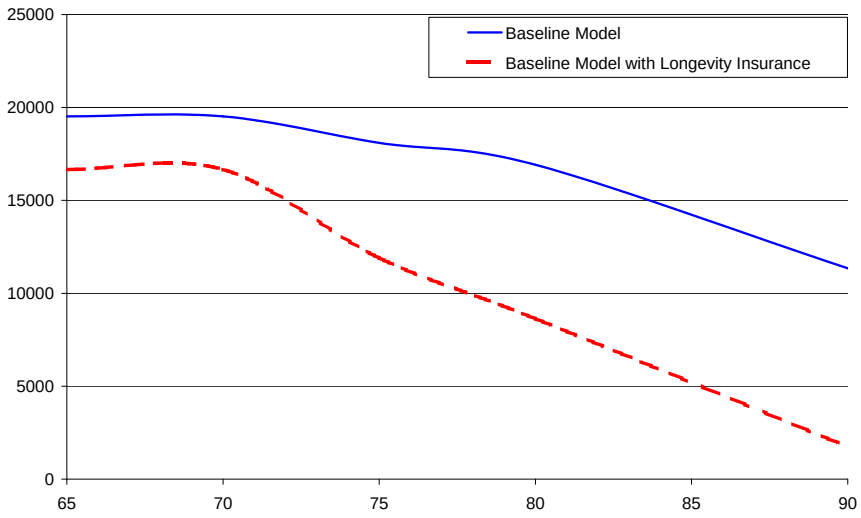


Figure 18: Share of Safe Assets with and without Longevity Insurance

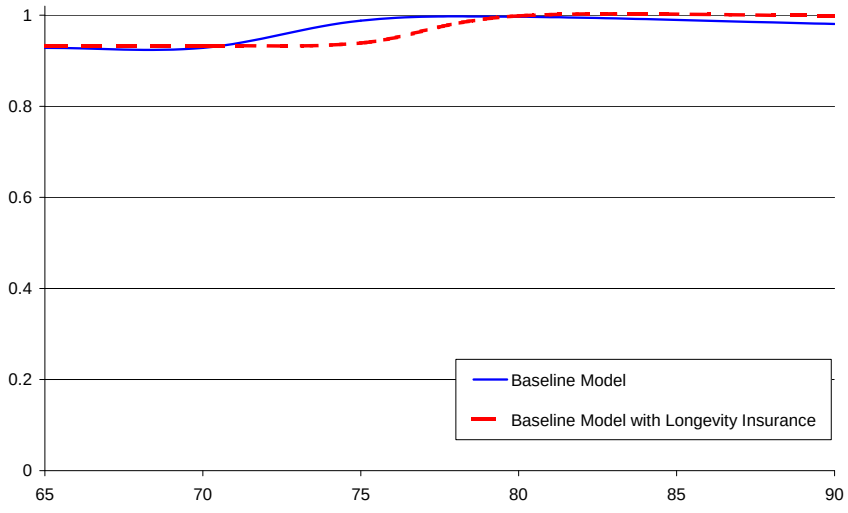
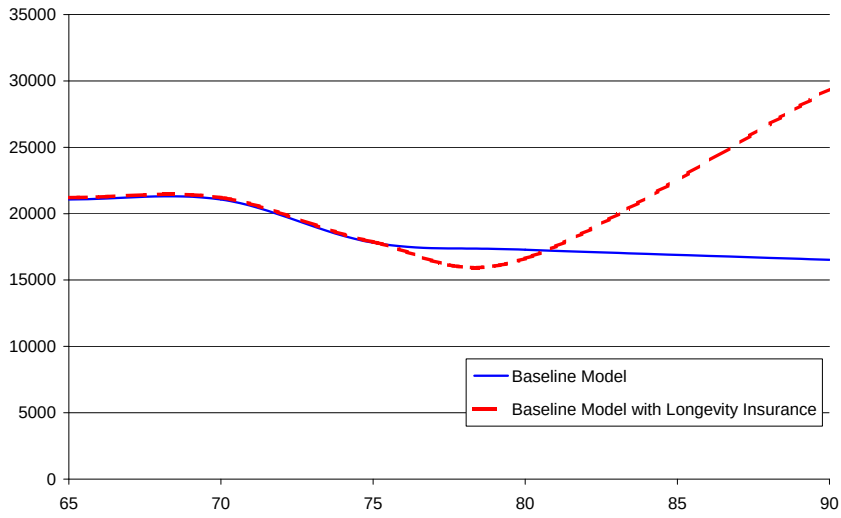


Figure 19: Consumption with and without Longevity Insurance



by different risks. Second, I plan to endogenize the choice over longevity insurance, to identify the households that would choose to buy it.

References

[1] Barro, J. R. Rare disasters and asset markets in the twentieth century, *The Quarterly Journal of Economics* 2006; 823-866.

[2] Brunetti, M, and C. Torricelli. Population Age Structure and Household Portfolio Choices in Italy, *The European Journal of Finance* 2010; 16 (6): 481-502

[3] Brugiavini, A., T. Jappelli, and G. Weber. The Survey on Health, Aging and Wealth, *Centro Studi in Economia e Finanza* 2002; Working Paper 86.

[4] Cagetti, M. Wealth Accumulation over the Life Cycle and Precautionary Savings, *Journal of Business & Economic Statistics* 2003; 21(3): 339-53.

[5] Campbell, J. Y., and J. F. Cocco. Household Risk Management and Optimal Mortgage Choice, *Quarterly Journal of Economics* 2003; 118: 1149-1194.

[6] L. Cannari, I. Faiella, R. Sabbatini, and F. Zollino. House prices in Italy: the statistics used at the Bank of Italy. *OECD-IMF Workshop on real estate price indexes* 2006.

[7] Carroll, C. D. Buffer-Shock Saving and the Life-Cycle/Permanent Income Hypothesis, *Quarterly Journal of Economics* 1997; 112, 1-55.

[8] Christelis, D., T. Jappelli, and M. Padula. Health Risk, Financial Information and Social Interaction: the Portfolio Choice of European Elderly Households, Working paper, University of Salerno 2005.

[9] Cocco, J. F. Portfolio Choice in the Presence of Housing, *Review of Financial Studies* 2005; 18(2): 535-567.

[10] Cocco, J. F., F. Gomes, and P. Maenhout. Consumption and Portfolio Choice over the Life Cycle, *Review of Financial Studies* 2005; 18(2): 491-533.

[11] De Nardi, M., E. French, and J. B. Jones. Why Do the Elderly Save? The Role of Medical Expenses, *Journal of Political Economy, University of Chicago Press* 2010; 118(1): 39-75, 02.

[12] Draghi, M. Household wealth in central bank policy analysis. *Remarks by Mario Draghi* Rome, 6 July 2007.

[13] Elmendorf, D. W., and L. M. Sheiner. Should America Save for its Old Age? Fiscal Policy, Population Aging, and National Saving, *Journal of Economic Perspectives* 2000; 14(3): 57-74.

[14] Fornero, E., M. C. Rossi, and M. C. U. Brancati. Explaining why, right or wrong, (Italian) households do not like reverse mortgages. *Netspar Discussion Paper* 2011; 86.

[15] Gomes, F., and A. Michaelides. Optimal Life-Cycle Asset Allocation: Understanding the Empirical Evidence, *Journal of Finance* 2005; 60(2): 869–904..

[16] Gourinchas, P. O., and J. A. Parker Consumption over the Life Cycle, *Econometrica* 2002; 70(1), 47-89.

[17] Guiso, L., and T. Jappelli. Household Portfolios in Italy. *Centro Studi in Economia e Finanza* 2000; Working Paper n. 43

[18] Guiso, L., M. Haliassosand, and T. Jappelli. Household Portfolios: An International Comparison. *Centro Studi in Economia e Finanza* 2000; Working Paper 48

[19] Guiso, L., M. Haliassosand, and T. Jappelli. Household Stockholding in Europe: Where Do We Stand and Where Do We Go? *Centro Studi in Economia e Finanza* 2002; Working Paper 88

[20] Hubbard, G., J. S. Skinner, and S. Zeldes. The Importance of Precautionary Motives for Explaining Individual and Aggregate Saving, *Carnegie-Rochester Conference Series on Public Policy,* 1994; 40, 59-125.

[21] Hurd, M. Mortality Risk and Bequests, *Econometrica* 1989; 57, 779-813.

[22] Judd, K. L. *Numerical Methods in Economics* 1998; MIT Press.

[23] Kotlikoff, L.J. What Determines Savings? The MIT Press, Cambridge, MA, 1989

[24] Kotlikoff, L. J., and L. H. Summers. The Role of Intergenerational Transfers in Aggregate Capital Accumulation, *Journal of Political Economy* 1981; 86, 706-732.

[25] Michelangeli, V. Does it Pay to Get a Reverse Mortgage? Working Paper 2010.

[26] Michelangeli, V. Should you Pay your Mortgage or Invest? Working Paper 2011.

[27] Pailla, M. Does wealth affect consumption? Evidence for Italy. *Journal of Macroeconomics* 2007; 29: 189-205.

[28] Palumbo, M. Uncertain Medical Expenses and Precautionary Saving Near the End of the Life Cycle *Review of Economic Studies* 1999, 66, 395-422.

[29] Skinner, J., and S. P. Zeldes. The Importance of Bequests and Life-Cycle Saving in Capital Accumulation: A New Answer, *American Economic Review* 2002; 92 (2): 274-278.

[30] Tatsiramos K. Residential Mobility and Housing Adjustment of Older Households in Europe. IZA Discussion Paper 2435, 2006.

[31] United Nations, Department of Economic and Social Affairs, Population Division (2011): World Population Prospects: The 2010 Revision. New York

[32] Visco, I. Ageing populations: Economic Issues and Policy Challenges. *Economic Policy for Aging Societies* ed. H. Siebert 2002; 9-47. Berlin: Springer.

[33] Yogo, M.Portfolio Choice in Retirement: Health Risk and the Demand for Annuities, Housing, and Risky Assets, NBER Working Paper 15307, 2009.