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Medical Expenses and Saving in Retirement: The Case of U.S. and Sweden☆

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Abstract

Many U.S. households have significant wealth late in life, contrary to the predictions of a simple life-cycle model. In this paper, we document stark differences between U.S. and Sweden regarding out-of-pocket medical and long-term-care expenses late in life, and use them to investigate their role in discouraging the elderly from dissaving. Using a consumption-saving model in retirement with significant uninsurable expense risk, we find that medical expense risk accounts for a quarter of the U.S.-Sweden difference in retirees' dissaving patterns. Furthermore, medical expense risk affects primarily financial assets, while its impact on housing is limited.

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1. Introduction

In the United States, households have, on average, significant positive wealth late in life. In the U.S. Health and Retirement Study, the median net worth of a household at age 90 was about $75,000 in 2006. The large literature on the subject, sometimes referred to as the "retirement saving puzzle" (RSP), has offered a number of possible explanations for why retirees do not spend down wealth quickly. These explanations have included, among other things, longevity risk, bequest motives, precautionary motives and medical expense risk, housing, public long-term-care aversion, and public

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policy such as Medicaid and Social Security. However, it is acknowledged in the literature that it is difficult to identify relative strengths of different motives, in particular bequest and precautionary motives, based on data from a single country.

In this paper, we make progress toward solving this problem using evidence from multiple countries. In particular, we investigate the impact of out-of-pocket (OOP) medical and long-term-care (LTC) expense risk on saving in retirement, using evidence from several countries that differ in the extent of that risk. We choose Sweden as a case study for comparison to the U.S., but we document that Sweden is not an outlier with respect to the facts that we highlight. Specifically, using the Health and Retirement Study in the U.S. and the Survey of Health, Aging, and Retirement in Europe, we document that while in Sweden and the U.S. households start retirement with comparable levels of net worth relative to income, in subsequent years retirees in Sweden spend down their wealth, particularly their financial wealth, more quickly than U.S. retirees. We also document that the level and uncertainty of OOP medical and LTC expenses are significantly higher in the U.S. than in Sweden.

Motivated by these empirical findings, we employ a simple consumption-saving model in retirement and investigate how much of the difference in dissaving behavior among retirees in the two countries may be driven by the differences in OOP medical and LTC expenses that we observe. We calibrate the model to match U.S. net worth profiles by age to study this question as well as to test a leading alternative hypothesis of bequest motives as a motivator for saving late in life. We find that OOP expense risk plays a large role in accounting for retirees' wealth decumulation patterns. Specifically, OOP medical and LTC expense risk accounts for about a quarter (26%) on average of the difference in U.S. and Sweden's net worth profiles, with the proportion explained by medical and LTC expense risks increasing with age. If we also take into account differences in the distribution of economic and demographic characteristics at age 65 between the two countries, the model can account for more than 90% of the observed differences in the decumulation pattern. Further, while we do not have evidence that bequest motives in the two countries differ, we find that bequest motives in the model could generate at most 16% of the observed differences in wealth decumulation between the U.S. and Sweden.

Next we extend our model by introducing housing, so that we can conduct the analysis separately for financial and housing assets. Most authors in the literature focus on the net worth of retirees. Instead, in previous work (Nakajima and Telyukova (2013)), we have shown that housing plays a major role in discouraging retirees from dissaving.[3] In our extended model, we still find that OOP medical and LTC expense risks can account for about a quarter (23%) of the observed differences in wealth decumulation patterns of the two countries. However, we find a significantly different impact on housing and financial asset decumulation. More than two-thirds (69%) of the two countries' differences in financial asset decumulation profiles can be accounted for by the OOP medical and LTC expense risk, while the effects on housing asset decumulation are limited. Consistent with previous studies, we find that retirees are strongly attached to their home, which makes the decumulation pattern of housing assets less sensitive to risks that retirees face, while homeowners cannot easily borrow against the value of their house. On the other hand, financial assets are more aggressively used as precautionary assets, which makes the impact of the medical and LTC risks significant.

[3]The role of housing had previously been studied empirically, for example, by Venti and Wise (2004).

This paper offers four key contributions. The first is to document in detail the data comparison of saving in retirement in the U.S. and Sweden. To demonstrate that Sweden is not an outlier, we document the core facts for a number of other Northern European countries as well. While we have documented a few of these facts in a previous paper (Nakajima and Telyukova (2016)), here we dive deeper into the two-country comparison in order to be able to use a structural model to learn about the motivation for saving in retirement. The second contribution is to document the differences in OOP medical and LTC expenses in the two countries using survey data. Comparing medical expenses across the two countries allows us to measure and compare the risk that households face in retirement in the two countries. The third contribution is to use these facts in a consumption-saving model in retirement to demonstrate the overall impact of OOP medical and LTC expense risk on net worth decumulation. The fourth is to extend the simple model to distinguish housing and financial assets, and to use this model to document that financial saving in retirement is driven primarily by precautionary motives, but that housing assets are not significantly impacted. The last two contributions are important because understanding the relative importance of different motivations for saving in retirement is essential in order to design policies and programs affecting the elderly, which remains a crucial policy issue in the U.S. and globally as the population ages.

Our work is related to several strands of literature. The first is the aforementioned literature that provides explanations for the retirement saving puzzle using data on net worth in retirement. For example, Hurd (1989) studies the role of bequest motives and finds them to be small, Hubbard et al. (1995) find that government-provided social insurance should create a motive to dissave in retirement, Ameriks et al. (2011) study the relative importance of bequest motives and public care aversion for the related annuity puzzle, and Palumbo (1999) and De Nardi et al. (2010) emphasize the role of OOP medical expense risk in motivating the elderly to save. Lockwood (2012) considers the low demand for long-term-care insurance as evidence of the relative importance of bequest motives versus precautionary motives. Finally, we abstract from risky asset returns or portfolio allocation decision of retirees with health risks (except for financial versus housing assets), which Yogo (2016) studies. Instead, we focus more on differences in the medical and LTC expense risk between the U.S. and Sweden.

In addition, we contribute to the body of work that considers cross-country evidence on household portfolios, particularly among older households. Examples are Nakajima and Telyukova (2016), a companion paper in which we describe cross-country differences in housing in retirement across 12 countries, Angelini et al. (2011), who characterize homeownership throughout the life cycle using the retrospective SHARELife survey, and Christelis et al. (2013), who characterize differences in the composition of entire household portfolios in a previous wave of the data that we use, and decompose the reasons for these differences into influences of institutions versus household characteristics. Blundell et al. (2016) compare the asset decumulation patterns of U.S. and U.K. households.

The rest of the paper is organized as follows. In Section 2, we present relevant data facts for the U.S. and a selection of Northern European countries, and then focus on the comparison of U.S. and Sweden along some detailed dimensions. In Section 3, we present data facts on medical expenses in retirement in the U.S. and Sweden, and show how we convert these data into our model calibration. In Section 4, we present our basic model. Section 5 discusses the calibration of the model. In Section 6, we present our main results. In Section 7, we extend the model to include housing and discuss the differences in medical expense risk's impact on housing and financial assets. We conclude in Section 8.

2. Data Facts on Wealth after Retirement

2.1. Data Sources

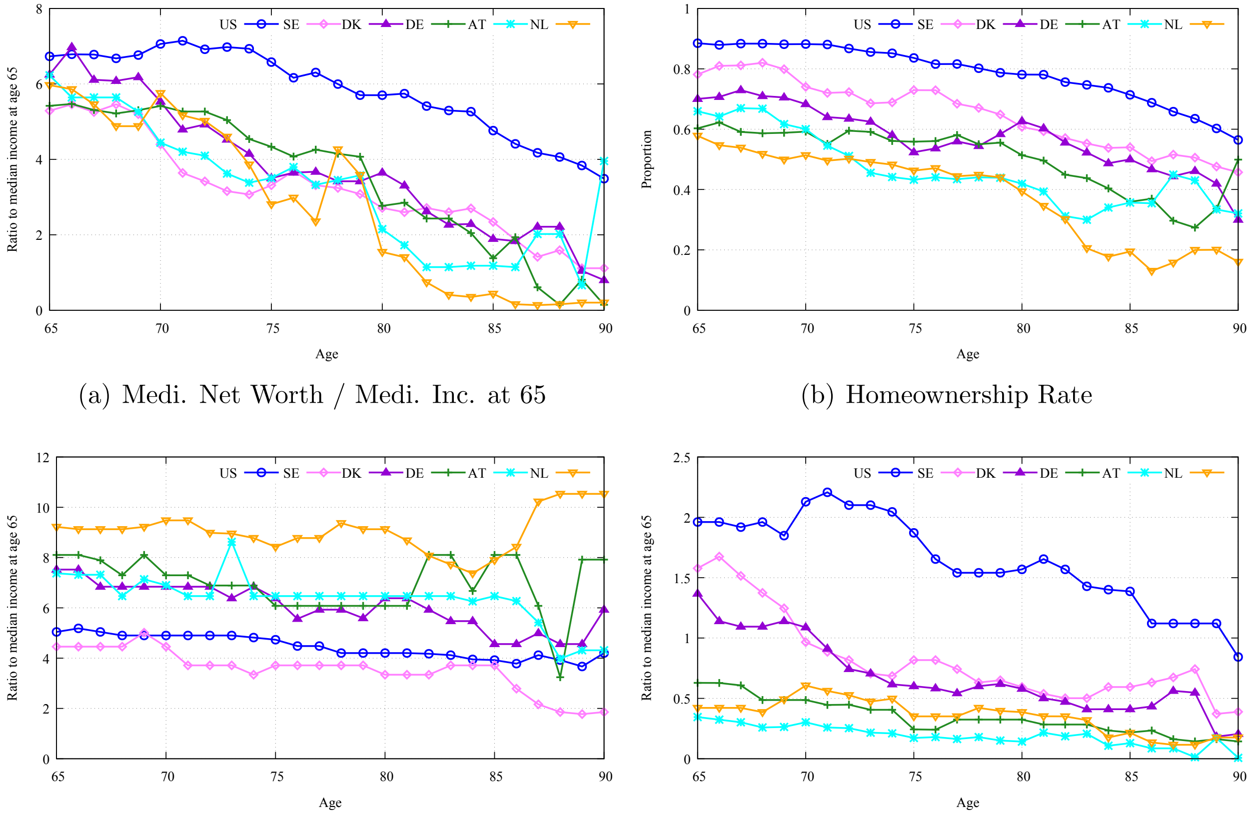
We use two household surveys in our analysis. The first is the U.S. Health and Retirement Study (HRS), which incorporates a large sample from the Asset and Health Dynamics among the Oldest Old (AHEAD). The second survey is the Survey of Health, Aging, and Retirement in Europe (SHARE), which covers a cross section of European countries, including Sweden. Both surveys are biennial and longitudinal: the HRS was started in 1992 and SHARE in 2004. Because the panel dimension of SHARE was short at the time of analysis, we could not usefully construct life-cycle analyses of individuals or cohorts from it. Therefore, for easy comparison across countries, and unlike our previous work with the HRS in Nakajima and Telyukova (2013), we study the 2006 *cross-sectional* age profiles of the desired variables, keeping in mind that inference can be affected by important composition and cohort effects.

We use the RAND versions of the surveys. To augment the RAND data, we added a significant amount of raw information from SHARE, incorporating it into a data set comparable to that of RAND HRS. A direct comparison of the data is possible across most variables, upon conversion of currencies into 2000 U.S. dollars using real exchange rates and PPP adjustment. Compared to the HRS, SHARE has sparse coverage of respondents who are in nursing homes, but in the case of Sweden, this limitation is likely not crucial, because as we will show, Swedish policy provides for near-universal coverage of LTC expenses.

We limit the sample only to those who report being mostly or fully retired in the two surveys, in order to remove variation in labor supply and labor income. In constructing the age profiles, we stop at age 90. The reason is that the SHARE data set has small country sample sizes, and unlike HRS, it does not oversample the oldest old. As a result, the sample sizes of the oldest retirees get too small to construct reliable moments. To smooth noise in the data for other ages, in both surveys we put households into 5-year centered age bins, so that age 65 is actually a bin of ages 63-67. Thus, each household is categorized into five different age groups, of its actual age as well as minus/plus two years. The resulting sample sizes in 2006 are 1,663 age-65 retirees in the HRS and 1,991 at age 69. This increase happens because for age bin 65, those of ages 63 and 64 are predominantly not retired and get dropped out of the data set. In SHARE's Sweden sample, there are 369 retirees in age bin 65, and the number increases to 399 at age 69. The sample sizes at age 89 are 452 for the U.S. and 59 for Sweden. The age-65 samples for other countries are 282 for Austria, 442 for Germany, 374 for the Netherlands, and 319 for Denmark.

2.2. Assets in Retirement: U.S. and Northern Europe

For this analysis, in order to control for cross-country income differences, we normalize all wealth variables by median income of the age-65 group. Figure 1 presents the data facts regarding wealth decumulation in the U.S. and Sweden, as well as other Northern European countries, including Denmark, Germany, Austria, and the Netherlands. We show additional countries here to highlight the differences between the target countries, while demonstrating that Sweden is not an outlier among the countries of Northern Europe in terms of these differences. We do not include Southern European countries and focus on Northern European countries here because the former vary significantly in the amount of public provision of health and LTC services, while the latter have health insurance policies comparable to Sweden, as we show in Nakajima and Telyukova (2016). We plot



(a) Medi. Net Worth / Medi. Inc. at 65

(b) Homeownership Rate

(c) Medi. Housing Assets /Medi. Inc. at 65

(d) Medi. Financial Assets / Medi. Inc. at 65

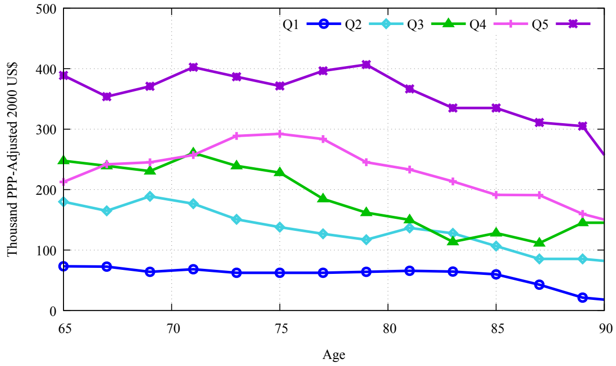
Figure 1: Age Profiles, U.S. and Northern Europe.

the age profiles of median net worth, housing, and financial assets normalized by income, as well as homeownership rates.

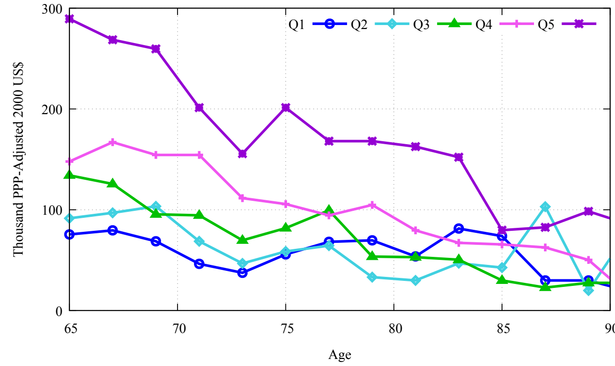
The key takeaways for our purposes are as follows. First, net worth decumulation among retirees is slower in the U.S. than in all the sample Northern European countries (panel (a)). For example, the ratio of median net worth at age 90 to that at age 65 is 52% in the U.S., 21% in Sweden, 12% in Denmark, 10% in Austria (measured at age 89, due to an outlier at age 90), 3.4% in the Netherlands, and 2.7% in Germany. Second, this wealth decumulation difference is pronounced in financial assets (panel (d)), with European retirees decumulating financial wealth steadily and to zero toward the end of life, unlike in the U.S. Third, dissaving in housing assets is more similar in the U.S. and Northern Europe, after controlling for the initial level of homeownership rate, with relatively flat age profiles of median housing assets among homeowners, notwithstanding small-sample noise for European countries after age 85 (panels (b) and (c)).

2.3. Assets in Retirement: Additional Facts for U.S. and Sweden

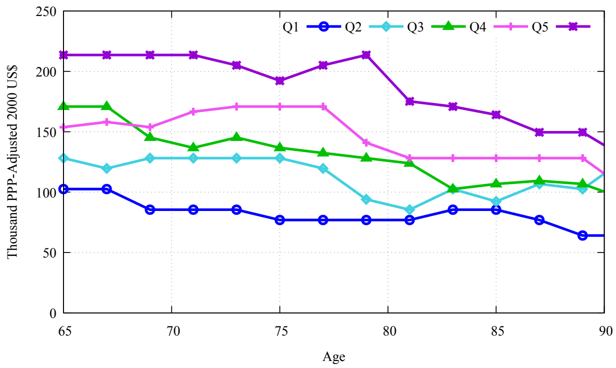
Focusing on just the U.S. and Sweden, we break down the patterns of wealth decumulation into additional moments. First, we look at the wealth distribution by plotting age profiles of unnormalized median net worth by income quintile for both countries. Panels on the left are for the U.S. and those on the right are for Sweden (see panels (a) and (b) of Figure 2). There is more wealth dispersion in the U.S. than in Sweden. The differences in the patterns of wealth



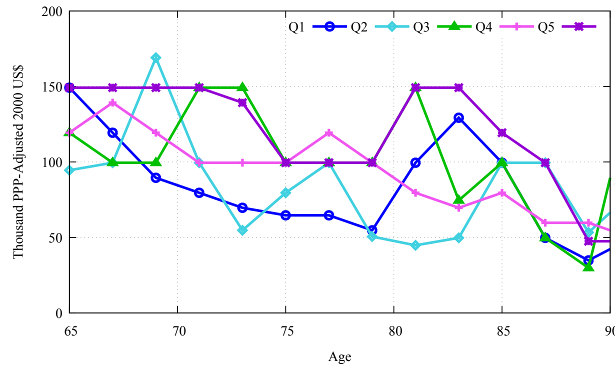
(a) U.S., Median Net Worth



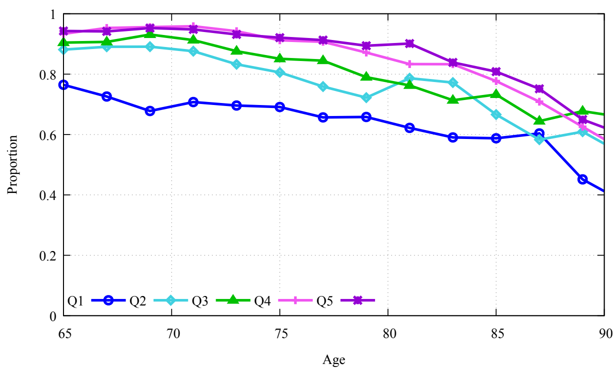
(b) Sweden, Median Net Worth



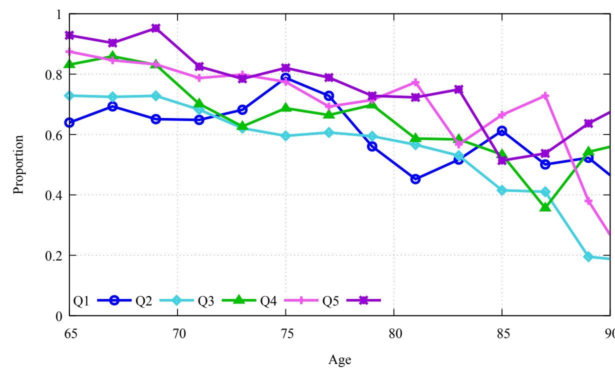
(c) U.S., Median Housing Assets



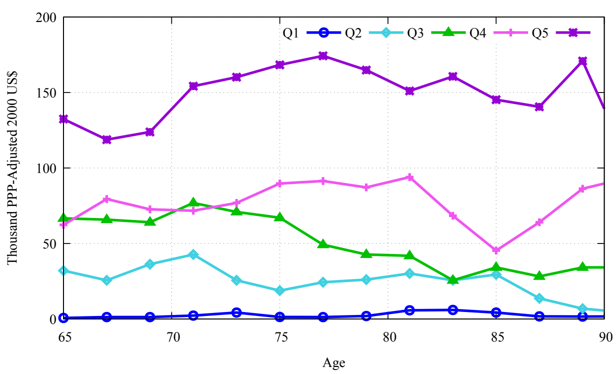
(d) Sweden, Median Housing Assets



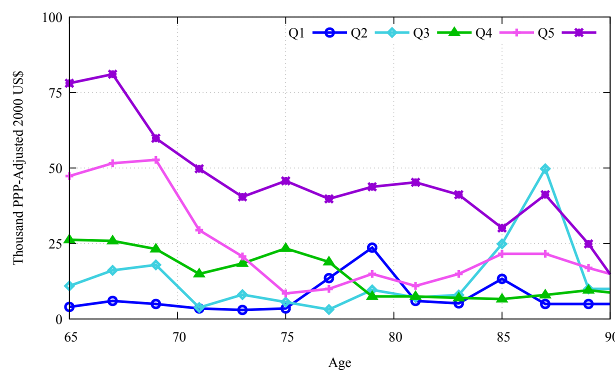
(e) U.S., Homeownership Rate



(f) Sweden, Homeownership Rate

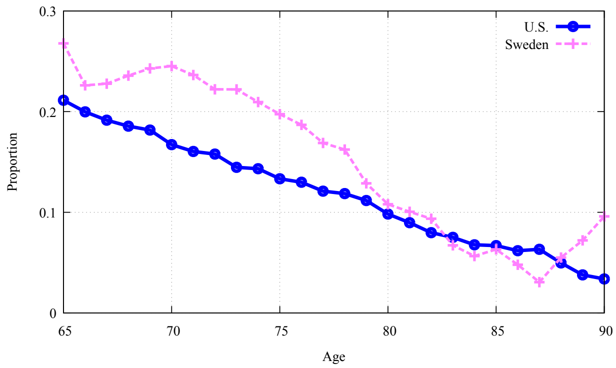


(g) U.S., Median Financial Assets

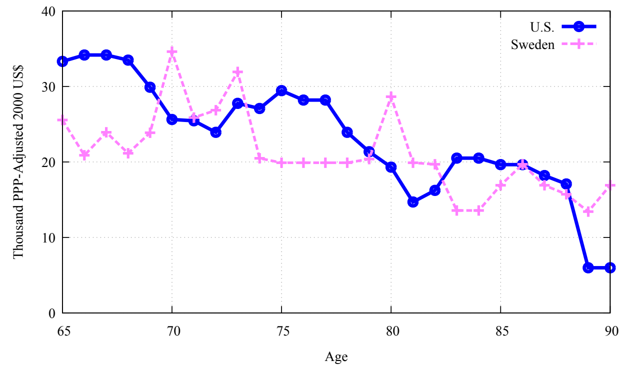


(h) Sweden, Median Financial Assets

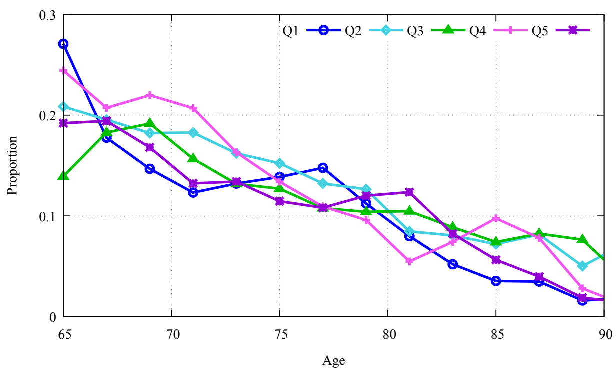
Figure 2: Asset Profiles by Income Quintile, U.S. vs. Sweden.



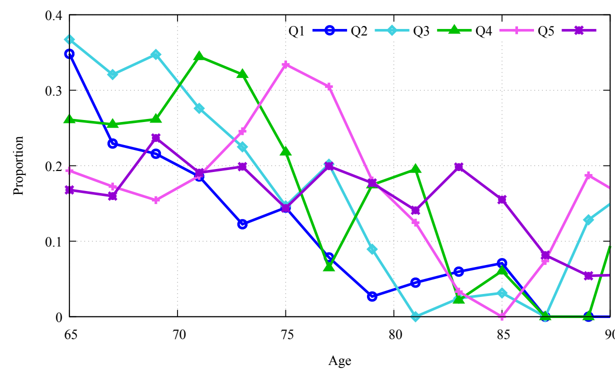
(a) Proportion in Debt, U.S. vs. Sweden



(b) Median Debt, U.S. vs. Sweden



(c) U.S., Prop in Debt by Income Quintile



(d) Sweden, Prop in Debt by Income Quintile

Figure 3: Debt Profiles, U.S. vs. Sweden

decumulation between the U.S. and Sweden — faster decumulation in Sweden than in the U.S. — are observable for all income quintiles and especially notable for the top income quintile. Next, we look at housing and financial assets separately, in panels (c)-(h). Median housing assets among homeowners (panel (c) for the U.S. and panel (d) for Sweden) remain approximately flat in both countries, while the decumulation of housing assets occurs with the extensive margin (panels (e) and (f)). However, the declining pattern of homeownership rates is similar in the two countries and across income quintiles. On the other hand, there are stark differences in the patterns of financial asset decumulation (panels (g) and (h)). For the U.S., the median financial asset holdings remain stable between ages 65 and 90 for all income groups, while retired households decumulate financial assets consistently in Sweden for all income groups.

In terms of the age profile associated with debt, Figure 3 shows that there is no significant difference between the U.S. and Sweden.[4] Panel (a) compares the overall proportion of households with a net negative financial asset position (net financial debt) for the U.S. and Sweden. Panels (c) and (d) show the proportion for each quintile for the two countries. In both countries, the proportion steadily declines, although the profiles are noisy in Sweden due to a smaller sample. Panel (b) compares median net financial debt among debtors for the two countries. The U.S. median debt

[4]Appendix A contains additional figures comparing the U.S. and Sweden regarding debt.

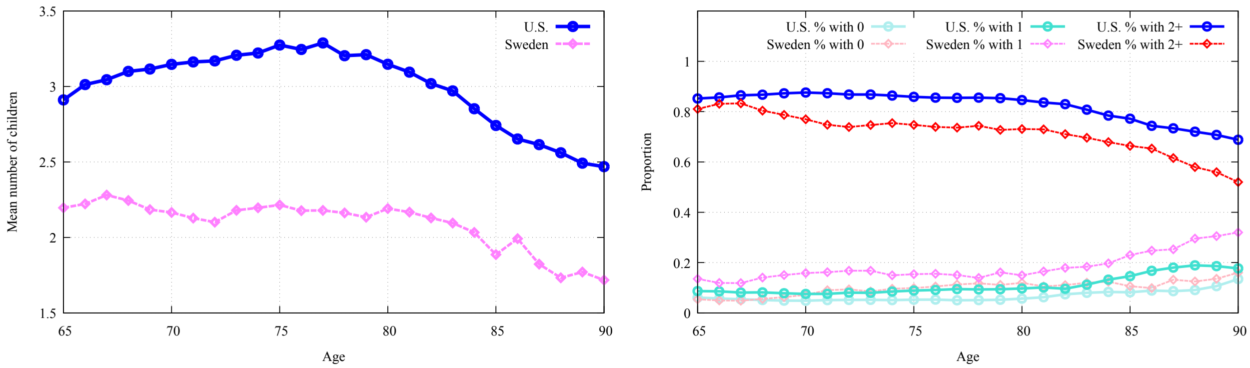


Figure 4: Number of Children per Household, U.S. vs. Sweden.

is decreasing in age, while the Swedish profile seems slightly flatter than the U.S. profile, but the difference is not large.

2.4. Number of Children

As discussed, one of the drivers of saving in retirement is thought to be the strength of bequest motives. A potential way to gauge whether there may be a difference in bequest motives in the two countries is to look at the number of children by age in the U.S. and Sweden; if the numbers are very different, they could imply different bequest motives and thus could explain the difference in the wealth decumulation patterns documented above. The number of children is at best an imperfect proxy for the bequest motive (see, e.g., Hurd (1987)) because people leave bequests to spouses, siblings, nieces, nephews, and other loved ones. Still, it could be an informative starting point. Figure 4 shows the mean number of children by age in the left panel and the shares of households with 0 children, 1 child, and more than 1 child in the right panel. The average number of children in the U.S. is about 3, while in Sweden it is closer to 2. This finding might imply a weaker bequest motive in Sweden than in the U.S. However, the distribution plot implies that the shares of retirees with *one or more* children is about the same in both countries at every age. While it may be reasonable that having kids, rather than the number of kids, might be a determinant of the bequest motive strength, to the extent that differential bequest motives could be at play, we will examine this alternative within our model.

3. Out-of-Pocket Medical and Long-Term Care Expenses and Health Transitions

Unlike in the U.S., medical care across Europe tends to be insured by some combination of government-provided and mandatory private insurance (Allin et al. (2005)), resulting in low OOP spending on health care for households of any age. According to Mossialos et al. (2016), in Sweden the tax-based universal health care system is compulsory for the entire population, and it covers all expenses, with stringent mandated caps on OOP expenses. Participation in additional private insurance is voluntary; it accounts for less than 1% of all health care expenditure in the country and is associated mainly with occupational health services. In 2015, approximately 10% of Swedish working adults ages 15-74 had purchased private coverage. In the U.S., in 2013, about 66% of U.S. residents received private health insurance, according to the same source. Public insurance in the U.S. is most prevalent in retirement and is provided by Medicare, with Medicaid available as a supplement for the poorest households. Medicare benefits are extensive but also rationed, and as we will show below, result in significant OOP expenses.[5]

As has been pointed out before by, for example, Brown and Finkelstein (2011), there is a lot more variation in Europe in *long-term-care* coverage. Sweden is among the countries that have the most comprehensive public coverage of LTC (OECD (2005)). Coverage is universal, that is, not means-tested, and provides benefits for both home and institutional care. Services are provided by municipalities and regulated by federal law. According to Fukushima et al. (2010), users pay moderate monthly fees that are capped by the government. In 2007, the annual cap on LTC fees was SEK 19,344 (i.e., approximately $2,900) and this cap is further adjusted for income level. For example, in 2006, 19% of home care recipients received the entire service for free. As a policy, Sweden has emphasized aging in place since the early 1990s, although providing more institutional care has been in discussion in more recent years. Municipalities can choose to provide institutional and home care by purchasing from public or private providers, but by law the local authorities retain the ultimate responsibility for supplying and maintaining all the care services as well as the level of care. Less than 5% of the total cost of LTC was financed privately in 2007, with the rest financed publicly.

In contrast, in the U.S., long-term care is covered by Medicare and private plans, and by Medicaid for the poorest, but access to benefits leaves room for significant OOP spending for many households. For example, under Medicare, home nursing care is initially free of charge, but skilled nursing care is only covered up to 20 days; for nursing home stays or skilled nursing care between 20 and 100 days, a patient is charged $105 per day, and above 100 days, the user pays 100% of the cost. Medicaid is means-tested and requires a co-pay based on the financial status of the recipient. As one expression of differences in the system, in 2000 in Sweden, about 7% of the elderly were using nursing home care, and an additional 9% employed in-home nursing care. Compare this to 4.3% of the elderly using institutional care and 2.8% using home care in the U.S. at the same point in time.

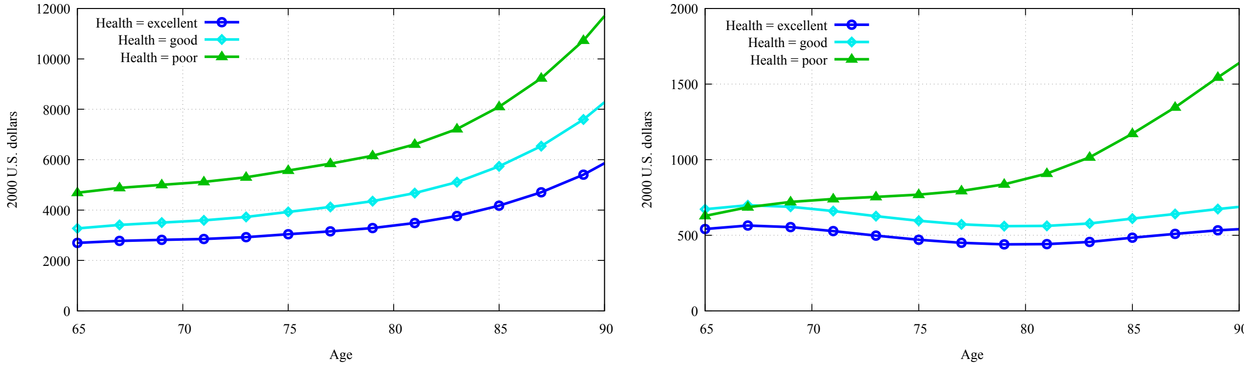
In both the HRS and SHARE, we observe OOP medical and LTC expenses directly. These include OOP expenses on prescription drugs, doctor visits, hospital stays and nursing homes. The HRS is more thorough in measuring these expenses as it has a more detailed set of questions for residents of nursing homes. While SHARE does not provide the same coverage for this population, in Sweden this is not a significant handicap, since very little of the cost of care comes out of pocket.

We first document OOP medical and LTC expenses in the U.S. and Sweden in Section 3.1. We then compare transition probabilities of health status of the two countries in Section 3.2. Health status is informative, since it directly affects the distribution of OOP medical and LTC expenses. Since health is self-reported and the transition dynamics are somewhat different between the two countries, we treat the transition probabilities of health status as linked to OOP medical and LTC expense uncertainty. In other words, the main model experiment will be to change OOP medical and LTC expense risk, *including* health transition probabilities, from U.S. to Swedish calibration and investigate how wealth decumulation patterns are affected.

3.1. Measuring Medical Expense Risk

To measure OOP medical expenses and the extent of uncertainty in these expenses in the two countries, we estimate the distribution of log-OOP medical expenditures in the data by age,

[5] See De Nardi et al. (2016) for detailed information about Medicaid.



(a) U.S. (b) Sweden

Figure 5: Expected OOP Medical Expenses by Health, Median-Income Singles, 2000 US$

health, income quintile, and household size (single or couple). The mean, standard deviation, and probability of zero expenses are estimated as quartics in age and include interaction terms between age and the other three variables. Under the assumption of log-normality, we can compute the expected OOP medical expenses.

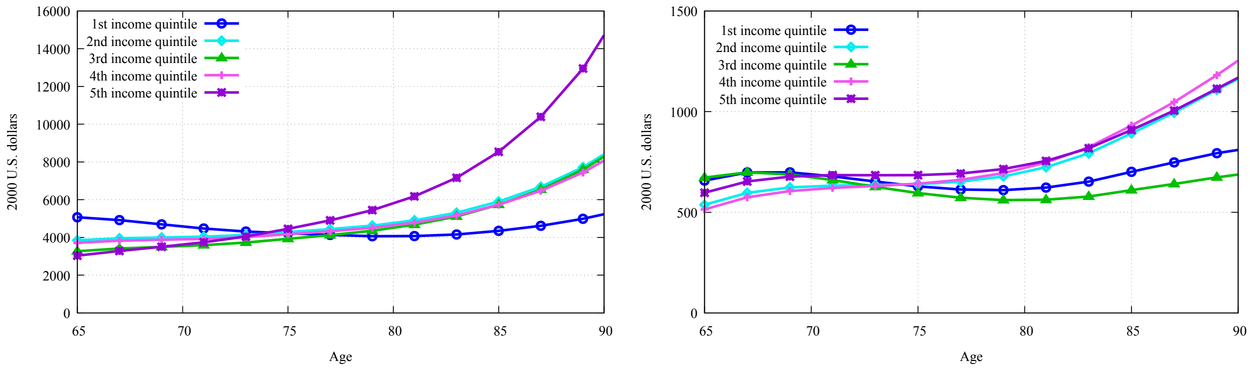
We show two possible cuts of the data here. Figure 5 shows expected OOP medical and LTC expenses for a single person of median income by health status for the U.S. and Sweden.[6] Note the vastly different scales in the graphs. As we would expect, people in both countries who are in the worst health pay the most. However, the orders of magnitude of the expenses are markedly different at all ages. For example, at age 90, a person of median income in poor health might expect to spend about $12,000 in the U.S. in OOP medical expenses, measured in 2000 US dollars. A similar person in Sweden would spend, on average, just over one-tenth of that.[7]

Figure 6 presents expected OOP medical expenses for singles of good health by income quintile. First, the degree of inequality in medical OOP spending is markedly different in the two countries. In Sweden, with universal non-means-tested public coverage of both health care and LTC, everyone pays roughly similar amounts out of pocket, regardless of income. Even at age 90, the distribution ranges between $700 and $1,200. This is consistent with the evidence presented in Mossialos et al. (2016), who show, for example, annual OOP spending caps in Sweden of $123 for doctors' visits and $246 for prescription drugs in 2015. In the U.S., inequality in spending is much higher, with the highest quintile at age 90 spending on average about $5,000 more than the next quintile down, at about $15,000, and that difference is exacerbated later in life. Second, again, the total mean spending in Sweden is about one-tenth of what it is in the U.S.

Figure 7 presents the log-standard deviation of medical expenses for the U.S. and Sweden for single households in the middle-income quintile by health. Conditional standard deviation of medical

[6]Health status is self-reported, but the choices given to respondents to describe health status are harmonized between the HRS and the SHARE; more details are in Section 3.2.

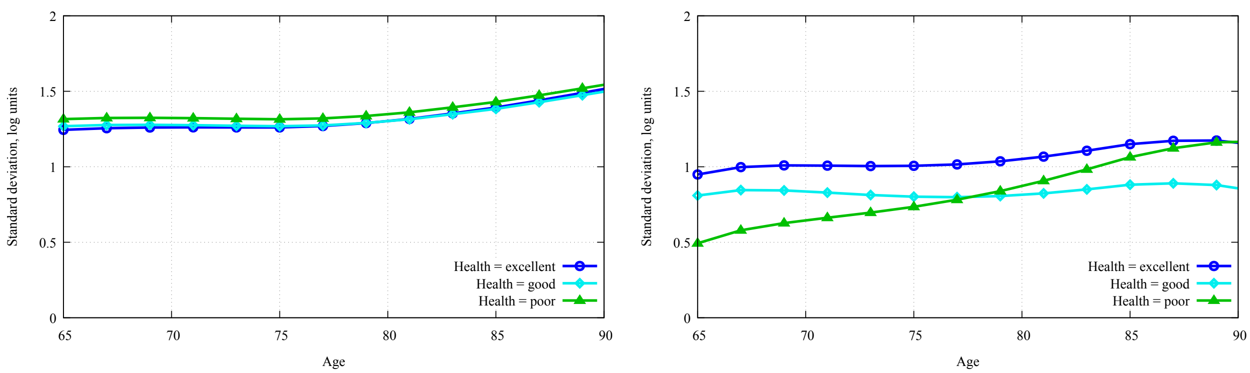
[7]We cannot reliably measure expenses for persons above age 90 in Sweden because of small sample sizes, and this may raise concerns that we are underestimating expenses for the oldest old. While this is a concern, universal coverage of both health care and long-term care in Sweden is a strong form of insurance, and we rely on that information to assume that there is no hidden spike in expenses past age 90. In fact, in our data we find a *reduction* in OOP medical expenses past age 90.



(a) U.S.

(b) Sweden

Figure 6: Expected OOP Medical Expenses by Income, Good-Health Singles, 2000 US$



(a) U.S.

(b) Sweden

Figure 7: Log S.D. of OOP Medical Expenses, Mid-Income Singles by Health, 2000 US$.

expenses, which shows the magnitude of uncertainty that retirees face in the two countries, is lower in Sweden than in the U.S. for all health categories, although the standard deviation for households with poor health increases more with age in Sweden than in the U.S. In sum, these measurements imply that both average medical expenses and the medical expense risks are lower in Sweden, especially in the later part of life.

After discretizing the log-normal OOP medical expense shocks, the implications of the log-normal distribution as described here are that a single individual of age 91 in the U.S., with median income and in poor health, has a 5.7% chance of spending \$99,768 out of pocket per two years, in 2000 U.S. dollars. A similar individual at age 95 has a 5.6% chance of spending \$150,398, while a 95-year-old with high income has a 6% chance of spending \$328,327 in two years. These numbers are in line with the findings in Ameriks et al. (2011) in the U.S. data. The log-normal distribution captures the tail of medical expenses well. Compared with the significant tail risk of the U.S. OOP medical expense, the Swedish tail risk is not as severe. For example, a single individual of age 91 with median income and poor health has a 6.7% chance of spending just \$9,061. A 95-year-old with high income has a 6.4% chance of spending \$15,421.

3.2. Health Status and Mortality Risk

In both the HRS and SHARE, households are asked to self-report their health status. For use in the model, we estimate age-dependent probabilities of health change in both countries. We group health into three categories: excellent (1), good/average (2), and poor (3). We also add death (0), so the resulting transition matrix incorporates both health transition and mortality probabilities. We also condition the transition probabilities on income by computing them separately for each of the five income bins.[8] For the U.S. (HRS), we take any pair of consecutive survey waves (1996-1998, 1998-2000, 2000-2002, etc.) and assuming stationarity, pool them together to create two pooled consecutive waves. For Sweden (SHARE), we use the 2004-2006 consecutive waves. See Appendix B for more detail. Table 1 presents the resulting probabilities for the U.S. and Sweden for three selected age groups (65, 75, 85) of median income (income bin 3) and for the highest (bin 1) and lowest (bin 5) income bins at age 75.

The measured transition probabilities in Sweden are noisier than those in the U.S. because of smaller sample sizes for older ages, particularly given the conditioning by income. Some resulting irregularities and nonmonotonicity aside (e.g., occasional zero probabilities for Sweden), the transition probabilities of both countries share logical tendencies. The probability of death increases in age and is higher the worse the respondent's health. Health deteriorates with age and is less persistent with age, owing to a higher probability of death. Finally, in general, higher-income individuals have lower mortality rates, although this correlation is weaker in Sweden than in the U.S., due to a small-sample bias and smaller dispersion of income in Sweden.[9]

We validate our survey-based health transition probabilities using population mortality rates for each country. For the U.S., our computed health transition probabilities imply a mortality rate of 2% at age 65, with the data counterpart of 1.5% based on U.S. life tables averaged between 1997 and 2006 (Anderson (1999), Arias (2010)). For other ages, the HRS-implied mortality rates and the corresponding data numbers are 2.8% (2.3% in the data) at age 70, 4.2% (3.6%) at age 75, 6.4% (5.8%) at age 80, 9.4% (9.4%) at 85, and 15.0% (14.8%) at 90. Another way to validate our health transition probabilities is to compare life expectancy. Our estimated health transition probabilities imply that the average life expectancy at age 65 is 82.5, using the type distribution in 2006. According to the OECD, the average life expectancy at age 65 is 83.6 in 2006. It is not surprising that our model implies a slightly lower life expectancy, since we use cross-sectional data to estimate health transition probabilities. For Sweden, the mortality rates implied by our health transitions based on SHARE and their data counterparts are 1.4% (1.2% in the data) at age 67, 5.2% (2%) at age 72, 4.2% (3.5%) at age 77, 9.2% (6.7%) at age 82, and 10.2% (12.2%) at age 87 (Lundström (2010)). The larger discrepancy is due to the smaller sample size for Swedish data, but comparison of life expectancy at age 65 indicates that our health transition probabilities are on average consistent with the OECD data. Our Swedish health transition probabilities imply that the average life expectancy at age 65 in 2006 is 82.3, which is slightly lower than the OECD estimate of 84.3. Note that we do not condition health transitions on gender. In effect, we take a weighted average of health transitions for men and women. This is valid in the context of our model, since we do not model gender specifically, which would render the model intractable. However, since we use

[8] Using the HRS, Pijoan-Mas and Ríos-Rull (2014) find that longevity is significantly affected by the socioeconomic background, in particular, educational levels, of individuals in the U.S.

[9] We also estimate the income-independent health transition probabilities and implement the same analysis, but the main results are found to be robust to this difference.

Table 1: Health Status Transition, Selected Age and Income Groups (Percent)

U.S.					Sweden				
Age 65, Median income					**Age 65, Median Income**				
	Dead	Excellent	Good	Poor		Dead	Excellent	Good	Poor
Excellent	1.6	69.5	22.8	6.1	Excellent	0.0	78.0	15.9	6.1
Good	2.8	27.5	51.6	18.0	Good	4.7	27.5	38.3	29.4
Poor	10.0	5.9	19.7	64.4	Poor	0.0	8.6	26.9	64.6
Age 75, Median Income					**Age 75, Median Income**				
	Dead	Excellent	Good	Poor		Dead	Excellent	Good	Poor
Excellent	3.9	58.6	28.8	8.6	Excellent	11.6	52.4	8.2	27.8
Good	6.2	22.4	48.2	23.2	Good	1.6	20.9	35.5	42.1
Poor	15.3	5.8	20.3	58.5	Poor	23.0	9.1	13.1	54.8
Age 85, Median Income					**Age 85, Median Income**				
	Dead	Excellent	Good	Poor		Dead	Excellent	Good	Poor
Excellent	11.6	52.8	25.7	9.9	Excellent	15.8	27.3	20.4	36.6
Good	12.3	16.1	40.2	31.4	Good	11.3	8.1	23.4	57.2
Poor	27.4	3.2	15.2	54.2	Poor	16.0	0.0	23.0	61.0
Age 75, Low Income					**Age 75, Low Income**				
	Dead	Excellent	Good	Poor		Dead	Excellent	Good	Poor
Excellent	4.3	58.7	26.7	10.3	Excellent	18.2	51.6	12.8	17.5
Good	6.8	20.4	47.0	25.8	Good	0.0	24.7	35.1	40.2
Poor	16.0	3.9	16.5	63.6	Poor	13.3	22.8	8.9	55.0
Age 75, High Income					**Age 75, High Income**				
	Dead	Excellent	Good	Poor		Dead	Excellent	Good	Poor
Excellent	3.0	65.1	24.6	7.2	Excellent	0.0	53.5	23.7	22.8
Good	6.5	21.5	47.6	24.4	Good	1.2	13.5	43.1	42.2
Poor	15.9	5.1	19.1	59.8	Poor	20.4	7.2	11.2	61.3

Note: Individuals are grouped into five equal income bins with low income = bin 1, median income = bin 3, and high income = bin 5. Sources: HRS 1996-2006, SHARE 2004-2006.

respondent weights in the data, our calibration reflects the appropriate gender mix of the average pools of couple and single households at each age.

4. Model

In this section, we present a simple consumption-saving model of retirement, similar to the model in De Nardi et al. (2010). The model allows us to measure the role of differences in medical expense risks and other differences between the U.S. and Sweden in explaining the observed differences in the net worth decumulation pattern. Net worth includes both financial and housing (non-financial) assets, net of all debt. In other words, we do not distinguish between housing and financial assets/debt. In Section 7, we extend the model by introducing both housing and financial assets, based on our previous work in Nakajima and Telyukova (2013), and investigate how various differences in U.S. and Sweden affect the decumulation pattern of housing and financial assets differently.

In the models as in the data, we focus on retired households, so that we can avoid dealing with the labor supply decision of the elderly.[10] Thus, a household in the model starts out at age 65 and lives until maximum age 99 but faces a probability of death each period. Each period, a household decides how much to consume and how much to save, and is unable to borrow. In addition to the mortality shock, households are subject to two other types of idiosyncratic shocks: a health status shock and a shock to OOP medical expenditures. As we discussed in Section 3, all shocks are conditioned on age, health status, and income. Households receive pension income, as well as interest income from their financial assets, if any. Pension income is different across households and changes with age. The age-dependent component reflects the change in the average household size over the life cycle, with two-adult households receiving more pension income than one-adult households. We also assume that households have access to a government-provided consumption floor, which captures social insurance programs for the impoverished, such as Medicaid in the U.S.[11] We assume that households have a warm-glow bequest motive.

Formally, a household is characterized by (t, y, m, x, a): its age, income, health status, medical expenses, and its asset holding. Below is the recursive formulation, using primes to denote the next period:

$$V(t, y, m, x, a) = \max_{a' \geq 0} \left\{ u(c, t) + \beta \sum_{m'>0, x'} \pi^m_{t+1,y,m,m'} \pi^x_{t+1,y,m',x'} V(t+1, y, m', x', a') + \beta \pi^m_{t+1,y,m,0} v(a') \right\} \quad (1)$$

$$\text{s.t. } \tilde{c} + a' + x = (1+r)a + \psi_t y \quad (2)$$

$$c = \begin{cases} \max\{\psi_t \underline{c}, \tilde{c}\} & \text{if } a' = 0 \\ \tilde{c} & \text{otherwise} \end{cases} \quad (3)$$

The household of state (t, y, m, x, a) chooses the level of assets to carry over to the next period (a') to maximize the sum of three components (equation (1)). The first component is the period utility from consumption c. Age (t) affects the period utility as well, since we assume that consumption is shared by household members, and the household size is assumed to change deterministically with age. The second component is the discounted expected future value conditional on surviving to the next period $(m' > 0)$. Notice that y does not change. The expectation is formed with respect to two shocks: (i) the health status shock, whose transition probability π^m depends on (t, y, m) (age, income, and health); and (ii) the medical expense shock, whose distribution π^x depends on (t, y, m) in the next period. The third component is the utility from bequests, where $m' = 0$ indicates death. In case of death, savings a' are bequeathed, and the household gains utility from leaving a'. Equation (2) is the budget constraint, and r is the interest rate for assets. The parameter ψ_t multiplying income y is a scaling parameter that adjusts the pension income depending on the current age, reflecting changes in the average household size with age. The term x is the current realization of the medical expense shock. Equation (3) represents the lower bound of consumption guaranteed to the household through the social insurance program. The consumption floor is available only when the household exhausts its savings $(a' = 0)$. Then the government transfers the difference between $\tilde{c}$ and $\psi_t \underline{c}$ so that the household can consume $\psi_t \underline{c}$.

[10]For a study on this issue using SHARE, see Erosa et al. (2012).

[11]De Nardi et al. (2016) model Medicaid for retirees in a similar way and investigate how benefits of Medicaid are distributed across heterogeneous households.

5. Taking the Model to the Data

We use the model presented above to evaluate the extent to which differences in OOP medical and LTC expense level and risk, as measured in Section 3, can account for U.S.-Swedish differences in saving in retirement documented in Section 2. As the first step, we calibrate our model to the U.S. data; we refer to this as the "U.S. model." Our calibration proceeds in two stages, as in Gourinchas and Parker (2002): in the first stage (Section 5.1), we calibrate the parameters that are directly observable in the data; this includes OOP expenses and health transition matrices that we already described. In the second stage (Section 5.2), we estimate the remaining parameters to match the empirical age-asset profiles of the U.S., using simulated method of moments (SMM). Appendix D.1 contains sensitivity analysis of the estimated parameter values.

5.1. First Stage

Since both HRS and SHARE are biennial surveys, most variables are measured at that frequency, so we choose the model period to be two years. We allow the model retirees to live stochastically up to age 99, as specified by the health transition matrix described above; if they survive up to age 99, they die with certainty after the end of the period. Health transition probabilities $\pi^m_{t,y,m,m'}$ and the distribution of OOP medical and LTC expenses characterized by $\pi^x_{t,y,m,x}$ depend on age, income, and the current health status, as discussed in Section 3.2.

We also need to pin down age-dependent adjustment factors for income (ψ_t) and consumption (ξ_t). The factor ψ_t is used to adjust the amount of pension income and consumption floor according to average household size at age t. We first construct the age-t distribution of one-adult and two-adult households in the HRS. Second, we measure that pensions of two-adult households are on average 1.48 times higher than those of one-adult households. Thus, we construct ψ_t by taking the weighted average of 1 (normalized income of one-adult household) and 1.48, using the proportion of one- and two-adult households for each age. The factor ξ_t is used to compute per-adult consumption at age-t. It is constructed similarly, using an estimate of family equivalence scale of 1.34 for a two-adult household (Fernández-Villaverde and Krueger (2007)).

As another input into the model, we construct the initial distribution of households across all the state variables at age 65: income, health status, and asset holdings. We treat income as fixed with age, as it incorporates pension and social security income and does not vary with the life cycle of a given cohort in our data. We classify households into income quintiles.[12] To compute total assets, we add the value of housing, if any, to financial assets, net of all debt. The distribution is weighted by appropriate respondent weights in each survey. Table 2 shows the distribution of health status at age 65 in the U.S., and for comparison, in Sweden. The self-reported health distribution at age 65 is similar but slightly better for the U.S. than Sweden. Table 3 shows income levels for each quintile. Dispersion in pension income is larger in the U.S. than in Sweden.

Finally, we set the saving rate to 2.6% per year. This is the average real interest rate on the 10-year Treasury bond during the 1996-2006 period, deflated using CPI.

5.2. Second Stage

We set the utility function to a standard CRRA form with risk aversion parameter σ. A household gains utility from leaving warm-glow bequests: when a household dies with wealth a, its utility

[12] We normalize income by household size, using the adjustment factor of 1.48 for a two-adult household.

Table 2: Health Status Distribution at Age 65

	U.S.	**Sweden**
1 (excellent)	0.445	0.377
2 (good)	0.323	0.331
3 (poor)	0.231	0.292

Sources: HRS 2006 and SHARE 2006.

Table 3: Initial Distribution at 65 – Income Bins

	1	2	3	4	5
U.S.	6,858	12,404	17,948	25,918	42,722
Sweden	8,027	11,214	13,352	17,425	27,352

Note: Annualized after-tax income. 2000 PPP-adjusted U.S. dollars. Sources: HRS 2006 and SHARE 2006.

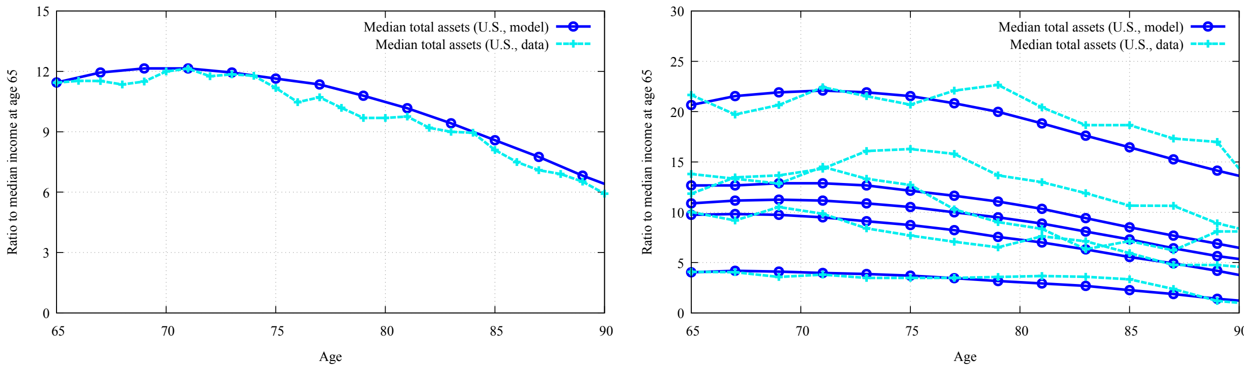
function takes the form $v(a) = \gamma \frac{(a+\zeta)^{1-\sigma}}{1-\sigma}$. Parameter γ captures the strength of the bequest motive, and ζ affects the marginal utility of bequests, that is, the threshold of wealth at which a household finds it valuable to leave a bequest. In effect, ζ determines whether bequests are a luxury good. We assume that the curvature of the bequest and period utility functions is the same.[13] $\underline{c}$ represents the government-provided consumption floor per adult.

Thus, there are five parameters to be estimated: β, σ, γ, ζ, and $\underline{c}$. β is the time discount factor. We estimate the parameters to match the median net worth age profile, as well as net worth profiles by income bin, as shown in Figure 8. The level of asset holdings is normalized to the median income at age 65. The estimation procedure minimizes the weighted sum of squared distance between these age profiles in the model and the data. The median profile has twice the weight in the SMM weighting matrix of the profiles by income bin. Figure 8 confirms that the model matches the data in the median profile, as well as the profiles for all income groups, very closely, with the exception of the fourth income quintile, where the asset profile in the data is higher than in the data.

The discount factor β is estimated to be 1.023 annually. Multiplying it by the mortality probability results in the adjusted β of 0.963. The coefficient of risk aversion σ is 1.84, which is within a standard range in life-cycle models. The estimated strength of the bequest motive is $\gamma = 0.60$, and the curvature of the utility from bequests is $\zeta = 33,685$. To understand the properties of the bequest motive parameters, we use the transformation proposed by Lockwood (2012). We compute the level of wealth in the last period of life at which a household starts leaving positive bequests and the marginal propensity to bequeath.[14] In our estimated model, the threshold level of wealth at which a household starts leaving bequests is \$43,202, while the marginal propensity to bequeath is 0.43. For comparison, parameters estimated by De Nardi et al. (2010) imply a threshold wealth level of \$36,000, fairly similar to ours, while the marginal propensity to bequeath is 0.88. The

[13]De Nardi et al. (2010) assume the same functional form for utility from bequests and equality of the CRRA parameters for utility and bequest functions.

[14]See Appendix C for details.



(a) Median Net Worth

(b) Net Worth by Income Quintile

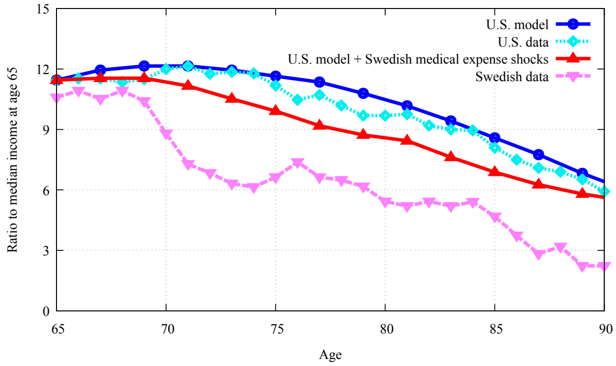
Figure 8: Model Fit to the U.S. Data: Net Worth Decumulation Profiles

estimated consumption floor $\underline{c}$ is \$1,465, which is about one-half of the estimate in De Nardi et al. (2010) in a similar model of \$3,339 per year in 2006 dollars, and the maximum allowable resources for Medicaid eligibility of \$3,746, which Palumbo (1999) uses to calibrate $\underline{c}$. Our estimate of $\underline{c}$ is lower than that in De Nardi et al. (2010) because we use both singles and couples in the sample, unlike their sample of only single households. Since we use both types of households, savings are higher on average. In particular, median assets of singles in the lowest income bin are virtually zero after age 84, which requires a more generous consumption floor, especially with the relatively high risk aversion of 3.81 in De Nardi et al. (2010). In our data, even median households in the lowest income bin keep a modest amount of assets until the end of life (see Figure 8). This difference in target life-cycle profiles results in a lower $\underline{c}$.

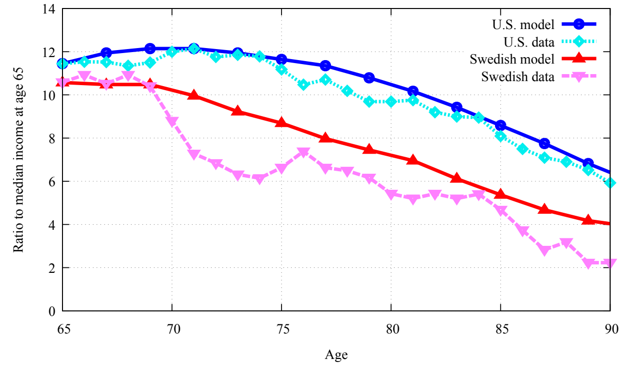
6. Medical Expense Risk and Dissaving in Retirement

In the empirical sections above, we documented a significant difference in the asset decumulation patterns in retirement between the U.S. and Sweden, showing that Swedish retirees dissave more quickly than U.S. retirees. Further, we demonstrated that OOP medical and LTC expenses in retirement are much higher and more uncertain in the U.S. than in Sweden. To investigate our hypothesis that the two facts may be linked, in the first experiment, we introduce medical expense risks and health transition probabilities estimated for Sweden into our model calibrated to the U.S., while keeping everything else fixed. This allows us to isolate the influence of medical expenses on net worth decumulation. Panel (a) in Figure 9 shows that medical expense risk plays a role in creating faster dissaving in retirement. Medical expense risk calibrated to Sweden alone accounts for 26.4% of the differences between the U.S. and Sweden on average, for 16.4% of the differences for the group aged 65-75, 35.6% for the 75-85 group, and 28.1% for the 85-90 group.[15] Even though U.S. households on average pay more OOP medical and LTC expenses, which could drain their savings more quickly, U.S. retirees decumulate their savings more slowly for precautionary reasons. If they faced expense risks at the level of Sweden, they would dissave significantly faster. Finally, we

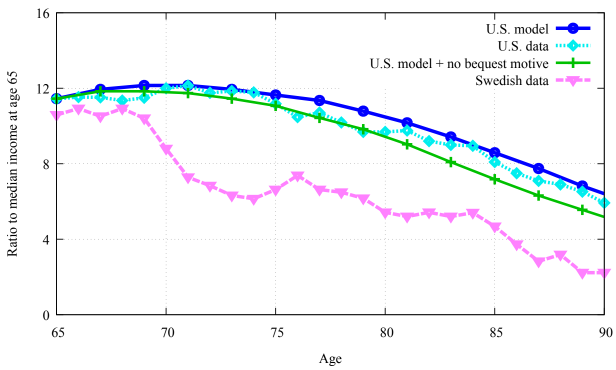
[15]These percentages are calculated in a similar way as the Gini index — by dividing the area created by the differences in the decumulation profiles between the U.S. and Sweden in the model by the empirical counterpart, for a given age interval.



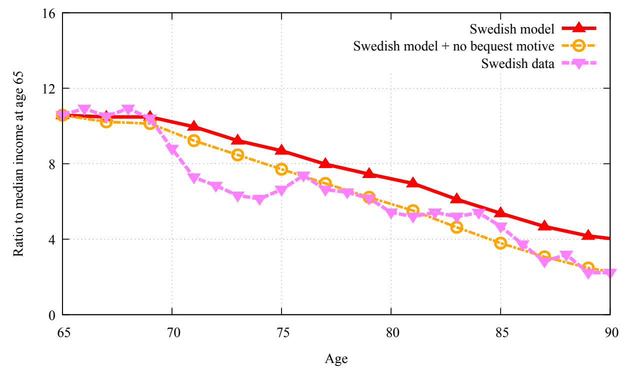
(a) Role of OOP Medical and LTC Expenses



(b) Role of Other Swedish Factors



(c) Role of Bequest Motives, U.S.



(d) Role of Bequest Motives, Sweden

Figure 9: Model Experiments, Median Net Worth

find that OOP medical expense risk affects decumulation patterns of all income quintiles similarly. See Appendix D.2 for more details.

In the second experiment, in panel (b) of Figure 9, we also change other aspects of the calibration to resemble Sweden; this is the "Swedish model."[16] This experiment allows us to examine some of the other factors that might be responsible for the differences in retirees' decumulation patterns. For this experiment, in addition to medical expenses and health transitions, we change the initial distribution of 65-year-old households and the age profile of average household size to the values we measured in the Swedish data. We hold preference parameters at their U.S. values. A comparison to panel (a) shows that the additional factors create more decumulation in net worth than medical expenses and health transitions alone. This additional difference in asset profiles is generated primarily by the Swedish initial distribution, which shifts down the median net worth profile. On average across ages, the Swedish model accounts for 90.2% of the differences in net worth profiles between the two countries.

Third, we experiment with bequest motives. As documented in Section 2.4, Swedish retirees have fewer children on average than U.S. retirees. As we discussed, this does not guarantee that Swedish retirees have weaker bequest motives; however, this is a plausible alternative mechanism

[16] Appendix D.3 studies further decomposition to disentangle the effects of different Swedish elements on net worth.

for why retirees save more in the U.S., and our model allows us to investigate this hypothesis separately. We conduct the bequest motive experiment in two ways: first, by shutting down the bequest motive in the U.S. benchmark model, and second, by shutting down the bequest motive in the Swedish model. Note that turning the bequest motive off completely is an extreme experiment that will exaggerate any difference in bequests between the two countries, since it in effect assumes that Swedish retirees have no bequest motive. However, it is a clean experiment, given that it is not possible to quantify the potential difference in bequest motives using just the difference in the number of children. The first of these experiments shows the influence of bequests on dissaving in isolation in the U.S. model (panel (c) of Figure 9); the second, incrementally to all the other factors in the Swedish model (panel (d)). The bequest motive generates 16% of the differences between U.S. and Swedish asset profiles on average, which can be seen as the difference between the two solid lines in panel (c). The experiments suggest that the potential difference in bequest motives in the two countries may be an additional mechanism to account for differences in saving behavior, but a weaker one than medical expense risk even at the upper bound. Relative to OOP medical expense risk, bequest motives have a greater impact on the savings of older retirees. As retirees age, the uncertainty about future medical and LTC expenses diminishes, while the importance of bequests remains the same. Thus, the relative importance of bequest motives becomes larger as retirees age.

In interpreting the impact of medical expense risk on saving in retirement, we abstract from the fact that it may affect saving *prior* to retirement as well. We take the initial distribution of retirees in the two countries as given without accounting for this pre-retirement effect. One would expect that with lower OOP expense risk uncertainty, households would save less prior to retirement, and this may account for some of the difference in median asset holdings in the two countries at age 65. If this is true, then the differences in medical expense uncertainty in the two countries account for more of the differences in savings than our benchmark suggests; panel (b) would be more reflective of the true impact. A formal analysis of this mechanism is beyond the scope of this paper, since it would require modeling the full life cycle, as well as the income uncertainty that households face earlier in life.

7. Extended Model with Housing

7.1. Model

We extend our simple model presented in Section 4 by introducing housing. The asset position of a household is now characterized by (h, a), where h is housing asset holding and a is financial asset position. The variable a can be positive (savings) or negative (secured debt). A household is either a renter or a homeowner. We abstract from the decision of a homeowner to move to a different house or the decision of a renter to buy a house, both of which are relatively rare in the data among retirees. A renter's problem is similar to the one in our simpler model presented earlier. The only additional decision for a renter is the size of the rental property. Renters are not able to borrow; this is motivated by the observation in our data that the median amount of unsecured debt among retirees is small in both countries.

A homeowner decides whether to remain in the same house or sell the house and become a renter. Homeownership provides utility benefits, in addition to consumption services from the house; these capture factors such as attachment to one's house and neighborhood, the ability to modify one's house to individual taste, but also some financial benefits of ownership that are not explicitly in the model, such as house price appreciation, tax exemption of imputed rents of owner-occupied housing, mortgage interest payment deduction, insurance against rental rate fluctuation, and the social support network of living in one's own neighborhood as one ages (Sinai and Souleles (2005)). In addition, homeowners are able to borrow against their home equity, subject to an age-dependent collateral constraint. This is a reduced-form way of modeling the cost of borrowing against home equity that increases with age, which we study in detail in Nakajima and Telyukova (2017); this parsimonious approach is most appropriate for our cross-country comparison where we are not focused on differences in housing policies.

Formally, the state variables of a household are (t, y, m, x, h, a): its age, income, health status, medical expenses, amount of housing, and financial assets. In order to save notation, we use $h = 0$ to represent a renter, while $h > 0$ means that a household is a homeowner with a house size of h. A renter's recursive problem is shown below. This problem differs from the problem of a household in Section 4 in four ways. First, the period utility function depends on consumption of housing services ($\tilde{h}$) and housing tenure status ($o = 0$ for a renter). Second, house size in the next period remains zero ($h' = h = 0$), since we abstract from renters purchasing a house. Third, the costs of renting a property ($r_h\tilde{h}$) are in the budget constraint. Fourth, the consumption floor is applied to the sum of non-housing consumption expenditures and the cost of renting.

$$V(t, y, m, x, 0, a) = \max_{\tilde{h}, a' \geq 0}$$
$$\left\{ u(c, \tilde{h}, t, 0) + \beta \sum_{m'>0, x'} \pi^m_{t+1,y,m,m'} \pi^x_{t+1,y,m',x'} V(t+1, y, m', x', 0, a') + \beta \pi^m_{t+1,y,m,0} v(a') \right\} \tag{4}$$
$$\text{s.t. } \tilde{c} + a' + r_h\tilde{h} + x = (1 + r)a + \psi_t y \tag{5}$$
$$c = \begin{cases} \max\{\psi_t \underline{c} - r_h\tilde{h}, \tilde{c}\} & \text{if } a' = 0 \\ \tilde{c} & \text{otherwise} \end{cases} \tag{6}$$

A homeowner chooses between staying in the current house (V_1) or selling the house and becoming a renter (V_0): $V(t, y, m, x, h, a) = \max\{V_0(t, y, m, x, h, a), V_1(t, y, m, x, h, a)\}$. The problem of the owner who decides to sell and become a renter is

$$V_0(t, y, m, x, h, a) = \max_{a' \geq 0}$$
$$\left\{ u(c, h, t, 1) + \beta \sum_{m'>0, x'} \pi^m_{t+1,y,m,m'} \pi^x_{t+1,y,m',x'} V(t+1, y, m', x', 0, a') + \beta \pi^m_{t+1,y,m,0} v(a') \right\} \tag{7}$$
$$\text{s.t. } \tilde{c} + a' + x + (\kappa + \delta)h = h + (1 + r + \mathbb{1}_{a<0}\iota_m)a + \psi_t y \tag{8}$$

and (3). Relative to the renter's problem above, first, the current tenure status is a homeowner ($o = 1$) with the house size of h in the period utility function. Second, the budget constraint (8) does not include rent but includes income from selling the house h, net of the current maintenance cost (δh) and the selling cost (κh). Third, the interest rate is different depending on whether the homeowner is a net saver (in this case, the interest rate is r) or a net borrower (the interest rate is $r + \iota_m$); $\mathbb{1}$ is an indicator function that takes the value 1 if the attached condition holds and 0 otherwise. Fourth, the household is eligible for the consumption floor if $a' = 0$. The household begins the next period as a renter ($h' = 0$). Finally, the timing assumption is that a homeowner who chooses to sell does so at the end of the period, so that she still has to pay for maintenance costs in the current period, and if government assistance is received, it does not have to cover a rent payment. Finally, the problem of a homeowner who decides to stay in his house is characterized by

$$V_1(t,y,m,x,h,a) = \max_{a' \geq -h(1-\lambda_t)} \{u(c,h,t,1)$$
$$+ \beta \sum_{m'>0,x} \pi^m_{t+1,y,m,m'} \pi^x_{t+1,y,m',x'} V(t+1,y,m',x',h,a') + \beta \pi^m_{t+1,y,m,0} v((1-\kappa)h + a')\} \tag{9}$$
$$\text{s.t. } \tilde{c} + a' + x + \delta h = (1 + r + \mathbb{1}_{a<0}\iota_m)a + \psi_t y. \tag{10}$$

A stayer homeowner can borrow home equity up to a fraction $1 - \lambda_t$. In the case of death, the estate is the consolidated asset position, which now includes the value of housing after paying the selling cost ($(1-\kappa)h$). The budget constraint includes the maintenance cost (δh). Finally, a stayer homeowner cannot benefit from the government consumption floor.

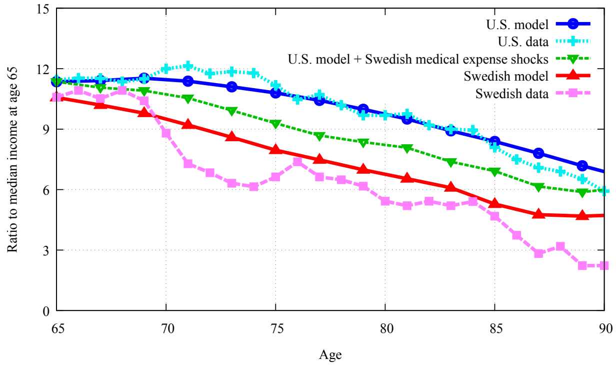
7.2. Taking the Model to the Data

To calibrate the extended U.S. model with housing, we again employ the two-stage procedure. In the first stage, the calibration of health and medical expense transitions, initial type distributions, and the saving rate remain as described above. To these parameters, we add and calibrate housing costs. The mortgage interest premium is $\iota_m = 1.7\%$ above r, which is the difference between the average real mortgage rate and the risk-free rate during the 1996-2006 period, for a total mortgage interest rate of 4.3%. The maintenance cost of a house is 1.7% per year of the house's value, based on the depreciation rate of residential capital. The selling cost of a house is 6.6% of the house's value and captures all the financial and time costs associated with the process of selling a house (Greenspan and Kennedy (2007)). The rental rate is set 6.0% per year, which is the sum of the mortgage interest rate and the maintenance cost of a house. This is consistent with the historical average of the price-to-rent ratio.

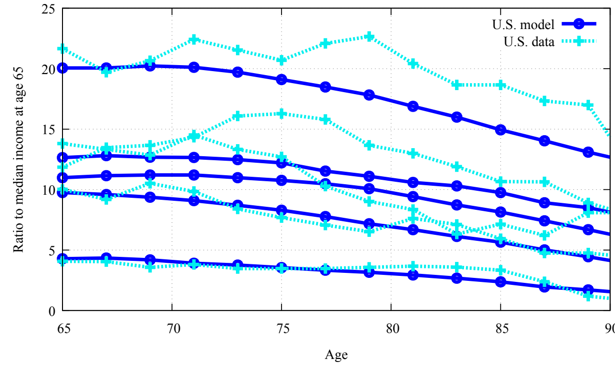
In the second stage, we estimate the same five parameters in the benchmark model without housing, along with seven more parameters. Two new parameters are associated with preferences. We still use the CRRA period utility function with a consumption equivalence scale built in as in our simple one-asset model, but over the aggregated consumption between non-housing c and housing h consumption goods. In particular, the aggregation takes the form of $c^\eta(\omega_o h)^{1-\eta}$, where η is the aggregation parameter, ω_o takes the value of 1 for renters (normalization) and ω_1 for homeowners. ω_1 represents benefits of homeownership, which we discuss more below. The remaining five parameters characterize age-dependent collateral constraint: λ_t for ages 65, 73, 81, 89, and 99. For ages in between, we use linear interpolation. We pin down those 12 parameters to maximize the fit of the model according to the U.S. age profiles of median net worth and the median net worth for each income quintile, as in the one-asset model. In addition, we target median housing and financial wealth, the homeownership rate, and the net debt rate. We process the data so that "financial assets" are the sum of all financial assets net of debt, and "debt" is the negative net financial asset position, in order to make the data consistent with the model.

To assess the fit of the model, Figure 10 contains the six targeted age profiles in the U.S. data and in the model, as well as median debt profiles.[17] The other three lines are the U.S. model with

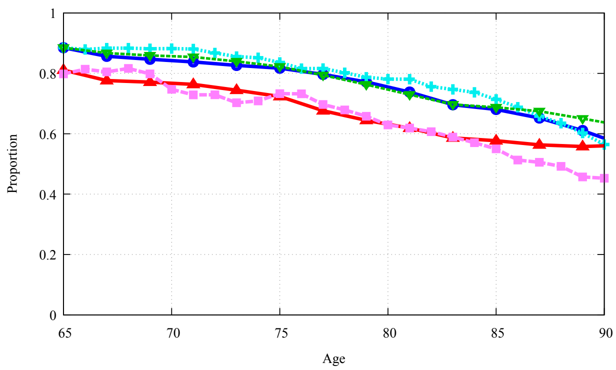
[17]Attaching positive weights to the median debt profile does not change the estimation results significantly. This



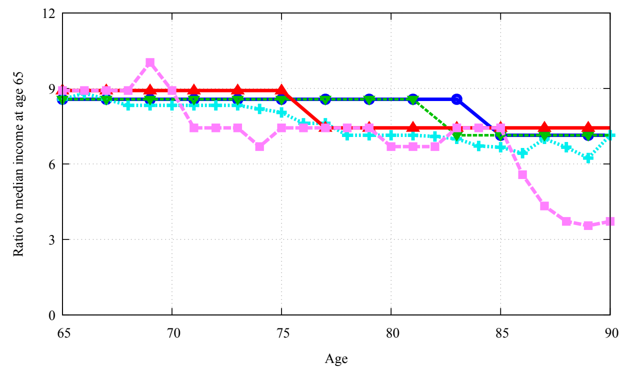
(a) Median Net Worth



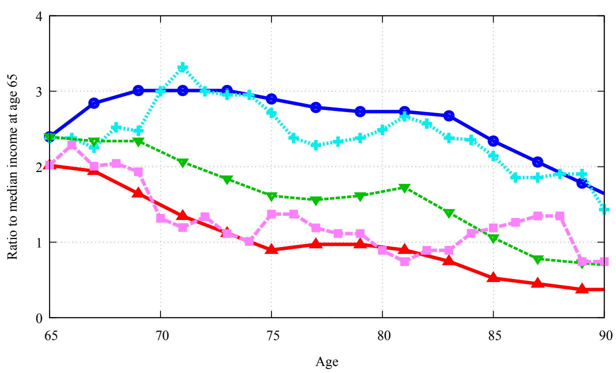
(b) Net Worth by Income Quintile



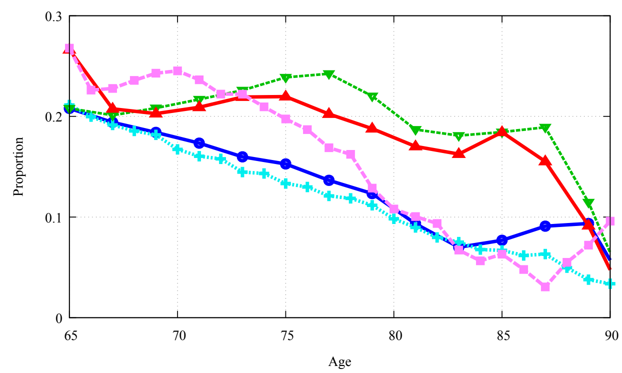
(c) Homeownership Rate



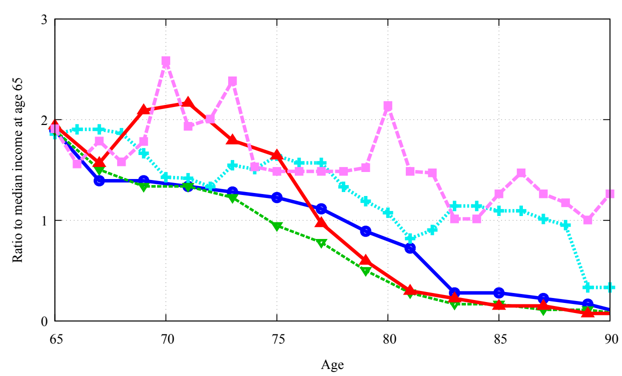
(d) Median Housing Assets



(e) Median Financial Assets



(f) Proportion in Debt



(g) Median Debt

Figure 10: Model with Housing: Model Fit and Experiments

Swedish health and OOP medical and LTC expense shocks, the model with Swedish shocks and initial distribution, and the Swedish data, which we come back to later. The model matches the age profiles of median net worth (panel (a)), homeownership (c), housing (d) and financial assets (e), indebtedness rate (f), and the decline of median debt per debtor (g). The model generates faster decumulation of median net worth for the top income quintile than in the data (panel (b)), but captures the slow pace of decumulation for the other income quintiles.

The median housing asset profile is slightly flatter in the model than in the data, but the extent of decline in the median profile is matched well. This relative flatness happens partly because in the model, there are only 11 house values possible, due to discretization, while in the data housing is a continuous variable. Households in the data can also let the house value depreciate by adjusting the intensity of maintenance, which is not possible in the model. Homeowners do not sell their homes in the model for a variety of reasons, chief of which is the utility of homeownership, which as we discussed above captures a variety of financial and non-financial benefits of homeownership. The net worth distribution is also fairly well matched, although the model somewhat understates the amount of wealth in the top two quintiles between the ages of roughly 70 and 88 while matching the overall extent of decumulation over retirement.[18]

In terms of estimated parameter values, we obtain $\beta = 0.999$, $\sigma = 1.42$, $\gamma = 0.54$, $\zeta = 40,250$, $\underline{c} = 1,792$, $\eta = 0.793$, $\omega_1 = 6.642$, $\lambda_{65} = 0.417$, $\lambda_{73} = 602$, $\lambda_{81} = 0.957$, $\lambda_{89} = 0.997$, and $\lambda_{99} = 1.000$. The values of the parameters that are also in the one-asset model are similar. The estimates imply that living in an owned home gives retirees 6.7 times the utility benefit of being a renter living in a house of the same size. This high utility of ownership helps generate slow decumulation of housing assets for older households, even with a realistically calibrated high moving cost. The λ_t parameters are pinned down mainly by the percentage of retirees who are in debt, which is one of our estimation targets. The parameters imply that retirees at age 65 are able to borrow up to 58% of their home equity, but as they age, they become increasingly constrained, so that by age 89, they can no longer borrow. This is a parsimonious way to capture the fact that borrowing becomes very costly for the elderly. Some of this cost comes from the supply side: elderly borrowers do not have easy access to traditional equity borrowing instruments because they fail the inherent income requirement for mortgage repayment (Caplin (2002)). The market that exists for reverse mortgages — instruments targeted at elderly borrowers — appears thin, which is driven by both demand- and supply-side factors.[19] Without the collateral constraint that tightens with age, the model cannot match the decreasing profile of indebtedness.

7.3. Medical Expense Risks and Asset Decumulation in the Model with Housing

As we have shown in previous work and above, wealth decumulation patterns by retirees are different in housing and financial assets. The housing asset and homeownership profiles in the U.S. and Sweden are similar in terms of slopes, but Swedish retirees draw down their financial wealth more quickly than their U.S. counterparts. We use the model with housing to shed light on this

is easily understood by the fact that the model naturally generates the observed downward profile of median debt without targeting.

[18]Through additional experiments (results not included), we find that alternative explanations, such as a high moving cost or an expensive rent, are not as important as the utility of ownership.

[19]See Nakajima and Telyukova (2017), where we explicitly model the debt-to-income requirement of standard mortgage contracts.

issue and test how the differences in medical expense risks have a different impact on housing and financial wealth. For this purpose, we again compare our U.S. model with a version where we replace OOP medical and LTC expense shocks and health transition probabilities with the Swedish calibration. Appendix E contains additional results.

The panels in Figure 10 show the effects of OOP medical and LTC expense risk and health transition probabilities on various age profiles. First, net worth decumulation (panels (a) and (b)) is affected similarly as in the benchmark model with housing. More interestingly, it is apparent that the impact is largely concentrated in financial assets (panel (e)), while housing asset decumulation (panels (c) and (d)) is largely unaffected. Specifically, the model with Swedish medical expense shocks accounts for 23.5% of the average difference between the U.S. and Swedish age profiles of median net worth, for 5.1% of the difference in the housing asset profiles, and almost nothing in terms of homeownership rate, but for more than two-thirds (69.2%) of the differences in financial asset profiles. The differences in medical expense risks generate 14.3% of net worth differences between U.S. and Sweden for ages 65-75, 29.3% for 75-85, and 30.4% for 85-90; they generate 50.7% of the difference in financial assets for the 65-75 group, 72.2% for the 75-85 group, and over 100% of the differences for the 85-90 group. Thus, OOP medical and LTC expense risk plays a role in motivating saving behavior in retirement without much impact on housing assets. Our model experiments indicate that medical expense risk is a significant reason why U.S. retirees hold financial wealth at the end of life, but does not explain why U.S. retirees die, on average, with housing wealth. In other words, housing is held primarily for reasons other than precautionary motives. In the model, the main such reasons are bequest motives and the financial and non-financial benefits of living in one's own house, captured in the model through the utility of ownership.

Looking at the effects of OOP medical and LTC expense risk on different income quintiles, the effect on speed of decumulation appears stronger for the top income quintile, especially with financial assets.[20] For lower income quintiles, the effects seem weaker, as they hold less financial wealth. Interestingly, smaller OOP expense risk allows homeowners to keep the house longer while decumulating financial assets faster. This effect seems stronger for the lowest income quintile, who are more likely to be borrowing constrained.

Moreover, as shown in the panels in Figure 10, if we introduce other differences between the U.S. and Sweden, primarily the differences in initial type distribution, the model captures quite well the Swedish decumulation pattern of total and financial assets. Quantitatively, 85% of the differences in the total asset decumulation patterns between the U.S. and Sweden, and more than 100% of the differences in the financial asset decumulation patterns, are captured by the model with all the Swedish factors. The model captures the differences in the homeownership rate also, except for after age 85, but the data are too noisy for older households in Sweden.

Although the impact of medical expenses on net worth decumulation is found to be similar between the models with and without housing, the model with housing indicates slightly weaker effects of bequest motives on the decumulation pattern.[21] Because of the strong attachment to housing, housing asset decumulation is not significantly affected by the strength of the bequest motive, while households either exhaust financial assets (Sweden) or keep some financial assets to cope with the medical expense risks (U.S.); the overall resulting impact on net worth is smaller than

[20]See Appendix E.1.

[21]See Appendix E.2 for details.

in the model with a single asset. This is consistent with our findings in earlier work that modeling housing and financial assets separately is important for cleaner identification of the different motives for saving in retirement.

Finally, the same caveat as in Section 6 applies: as we discussed above, the OOP medical and LTC expense risk could have an impact on overall saving prior to retirement, and also affect allocation between housing and financial asset holdings. For example, U.S. households may choose to buy and hold on to a house until retirement in part as insurance against possible OOP expenses late in life, since a house could be sold in case of need, and houses are exempt from the Medicaid qualification threshold and thus can act as a form of insurance.

8. Conclusion

In this paper, we study how saving and dissaving in retirement are affected by out-of-pocket medical and long-term-care expense risk. We do this in the context of a life-cycle model of saving in retirement. We use the U.S. and Sweden as a case study of two countries with large differences in public insurance of medical and LTC expenses late in life, and demonstrate that OOP expenses are an important reason why retirees in the U.S. have significant net worth that they do not spend down late in life. We find that a quarter of the differences in dissaving patterns during ages 65-90 can be attributed to the differences in the OOP medical and LTC expense risks between the two countries.

We further extend our model to investigate the impact of the differences of medical and LTC expense risks between the U.S. and Sweden on housing and financial assets. Our model indicates that medical expense risks mostly affect saving in financial assets, while the impact on housing assets is limited. This finding is consistent with the observed sizable differences between the U.S. and Sweden in terms of financial asset decumulation, together with the observed similarity of housing asset profiles between the two countries. While it appears that financial wealth holding is driven primarily by precautionary channels, more work is needed to understand why retirees retain their housing wealth until the very end of life, without downsizing or spending down a portion of that wealth. We addressed that question to an extent in Nakajima and Telyukova (2017) and leave further investigation of this question and related questions to future work.

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Appendix to Medical Expenses and Saving in Retirement: The Case of U.S. and Sweden

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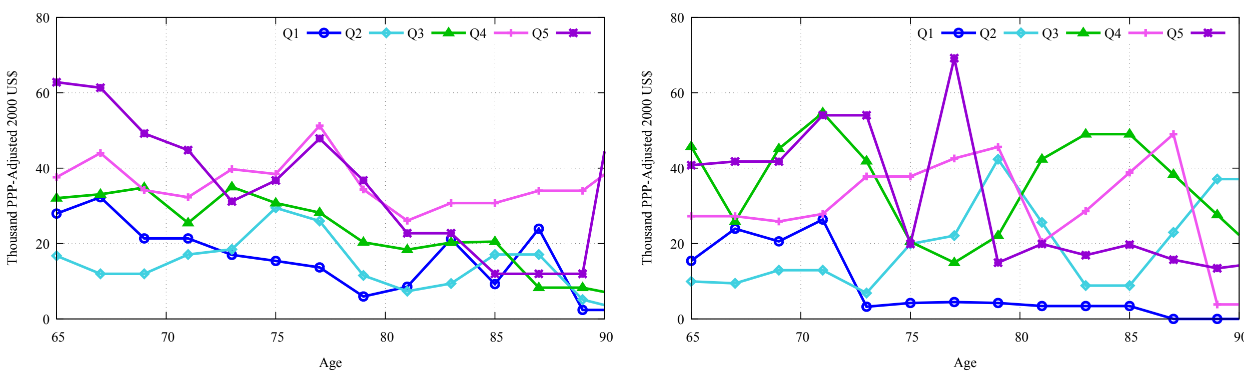
Abstract

Appendix A contains additional data facts for the U.S. and Sweden. Appendix B provides additional details about the health transition probabilities. Appendix C discusses interpretation of estimated parameters associated with bequest motives. Appendix D contains additional results of the benchmark model without housing. Finally, Appendix E includes additional results of the extended model with housing.

Appendix A. Additional Facts for the U.S. and Sweden



(a) U.S., Median Debt by Income Quintile (b) Sweden, Median Debt by Income Quintile

Figure A.1: Median Debt by Income Quintile, U.S. vs. Sweden

This appendix contains figures of the U.S. and Swedish data that are not in the main text. Figure A.1 shows median debt among debtors in each income quintile group. For the U.S. (panel (a)), the median debt is generally decreasing in age for each income quintile. For Sweden, it is hard to

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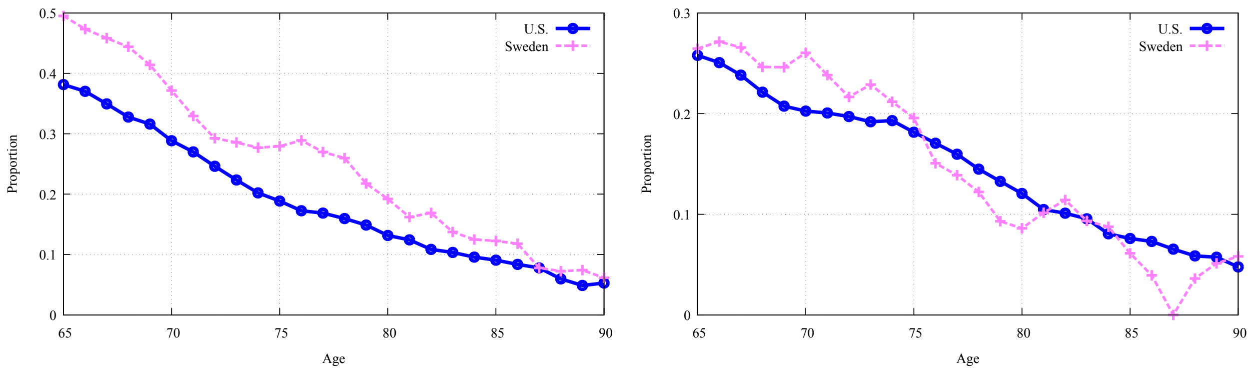


(a) Proportion with Secured Debt (b) Proportion with Unsecured Debt

Figure A.2: Debt Profiles, U.S. vs. Sweden

see a general tendency because of the small sample number of households if each income quintile is separately observed. As for Figure A.2, remember that we define debt as negative net asset position and show that, in general, debt defined that way is declining in age. Figure A.2 shows that the declining profile of debt is not due to the definition of debt we use, by showing the proportion of households with gross secured debt (panel (a)) and with gross unsecured debt (panel (b)) in the U.S. and Sweden. In both countries, the proportion with gross secured debt and that with unsecured debt are decreasing in age.

Appendix B. Calibration of Income-Dependent Health Transitions

When measuring health status transitions, we condition on income bin in both countries, since the literature has shown that higher-income individuals tend to be of better health and live longer. The general procedure is to group, in our consecutive-wave pooled sample, the individuals in the first wave into five income bins and then record, within each income and health bin, the numbers of individuals transitioning to each health state.

For the U.S. sample, this is reasonably straightforward because the sample size is sufficient. For the Swedish sample, the challenge is greater because of smaller sample size in the survey. To mitigate this issue, we implemented two kinds of pooling in the Swedish sample. First, we use those in income groups 1-3 to calculate the health transition probabilities, which we then assign to income groups 1 and 2 for the model. We use those in income groups 2-4 to compute the health transition probabilities for income group 3 in the model. To compute the health transition probabilities for income groups 4 and 5 in the model, we use those in income groups 3-5 in the data. Second, we pool households of age x or older across ages in an income group, when the number of households in an income group of just age x falls below 5. This generally implies that we pool households of each income group above age 90 together. We also tried more aggressive pooling among older households, but the results turned out to be similar. Even with the small sample size to start with for the case of Sweden, implications of income-dependent health transition probabilities are consistent with what we expect (and confirmed by literature). For example, life expectancy as of age 65 is generally increasing in income level, in both the U.S. and Sweden. The slope is steeper for the U.S., probably because the difference in income is more spread out in the U.S. than in Sweden.

Appendix C. Interpretation of Bequest Parameters

In this appendix, we follow De Nardi et al. (2010) and present a way to interpret bequest-related parameters.[3] In particular, we compute (i) the minimum level of wealth where households start leaving bequests and (ii) the marginal propensity to bequeath, once the level of wealth goes above the minimum level.

We use the one-asset model for demonstration of the approach. Assume a single (one-adult) household of age-I (last year of life). In the last year of life, by assumption, future value consists only of the utility of bequest. The problem of such a household can be represented as follows:

$$\max_{c,e} \frac{c^{1-\sigma}}{1-\sigma} + \beta\gamma \frac{(e+\zeta)^{1-\sigma}}{1-\sigma} \tag{C.1}$$

subject to

$$e = (x-c)(1+r), \tag{C.2}$$

where c is last period consumption, x is the wealth holding at the beginning of the last period (after paying medical expenses), e is the amount of bequests, and r is the saving interest rate. By taking the first order condition with respect to consumption, we can derive the following decision rule for the optimal amount of bequests:

$$e^* = \frac{1+r}{1+r+\Lambda}(\Lambda x - \zeta), \tag{C.3}$$

where $\Lambda = (\beta\gamma(1+r))^{\frac{1}{\sigma}}$. From Equation (C.3), we can easily see that the optimal amount of bequests is positive if $x \geq \frac{\zeta}{\Lambda}$. Moreover, the marginal propensity of bequests can be calculated as

$$\frac{\partial \frac{e^*}{1+r}}{\partial x} = \frac{\Lambda}{1+r+\Lambda}. \tag{C.4}$$

In our benchmark calibration of the one-asset model, we have $r = 0.026$, $\beta = 1.023$, $\sigma = 1.845$, $\gamma = 0.602$, and $\zeta = 33,685$. From these parameter values, we can obtain the threshold value of x of $\$43,202$ and the marginal propensity to bequeath of 0.43, as discussed in the body of the paper. In the two-asset model, we have $r = 0.026$, $\beta = 0.999$, $\sigma = 1.413$, $\gamma = 0.540$, and $\zeta = 40,250$. This implies a threshold value of wealth for leaving bequests of $\$61,054$ and a bequest propensity of 0.39.

For the estimated model of De Nardi et al. (2010), $r = 0.02$, $\beta = 0.970$, $\sigma = 3.84$, $\gamma = 2,360$, and $\zeta = 273,000$. These parameters imply that the threshold value of wealth is $\$36,225$ and the marginal propensity of bequeath is 0.881. In both our benchmark model and the estimated model of De Nardi et al. (2010), the threshold value of wealth is high, which is consistent with a small fraction of (wealth-rich) households that actively leave bequests. On the other hand, the marginal propensity to bequeath is different between our benchmark model and the estimated model of De Nardi et al. (2010).

[3] To be precise, Appendix D of a working paper version of their paper.

Appendix D. Benchmark Model without Housing: Additional Results

This appendix contains additional results for the benchmark model without housing. Appendix D.1 describes the sensitivity analysis of estimated parameter values. Appendix D.2 shows the effects of the experiments that we study in the main text (Section 6) on the wealth distribution. Appendix D.3 conducts some additional experiments not covered in the main text.

Appendix D.1. Benchmark Model without Housing: Sensitivity of Parameter Values

In the sensitivity analysis, we test the parameters that we estimate in the second stage of our calibration, that is, the simulated method of moments stage. To do this, we change one second-stage parameter at a time and reestimate the remaining parameters to see how the fit of the model changes.

First, in order to study the sensitivity of the estimated parameter values, Figure D.3 shows overall median net worth and the median net worth for each income quintile group, for models with different calibration strategies. We test the importance of the precautionary motive, bequest motive, and the strength of government-provided insurance. In particular, in panels (a) and (b), we impose $\sigma = 3.81$, which is the value estimated by De Nardi et al. (2010), and reestimate the remaining parameters using the same strategy as the benchmark model without such a constraint. This experiment is intended to show the sensitivity of the estimated parameter value of σ. The fit of overall median net worth is similar between the alternative model and the benchmark model, with the model with $\sigma = 3.81$ exhibiting a better fit for earlier ages and a worse fit for the later ages. However, the fit turns out to be significantly worse for the top and the bottom income quintiles with $\sigma = 3.81$. Specifically, households in the top income quintile do not dissave much even if the bequest motive is completely shut off (γ is estimated to be near zero when σ is set to 3.81, as De Nardi et al. (2010) also found). Households in the bottom income quintile dissave significantly more than the data, and median net worth reaches zero at about age 90.

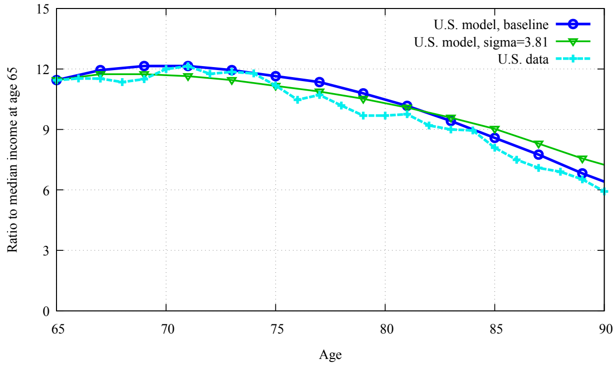
In panels (c) and (d), we impose $\gamma = 0$ in our benchmark and again reestimate the remaining parameters. Since the bequest motives are estimated to be mild in the benchmark model, the differences between the two models turned out to be minor, except for the very end of the life cycle (not shown). In particular, the model without bequest motives generates a decumulation profile that is too steep compared with the target profile in the 90s. As a result overall, the model without bequest motives performs worse with the overall median net worth.

In panels (e) and (f), we compare the benchmark model with the alternative model in which a higher consumption floor (same level as in the estimated value of De Nardi et al. (2010)) is imposed while the remaining parameters are reestimated. The alternative model performs slightly worse, in particular with the overall median total asset profile and median net worth profile among the lowest income group, although the alternative model performs better in the top income quintile.

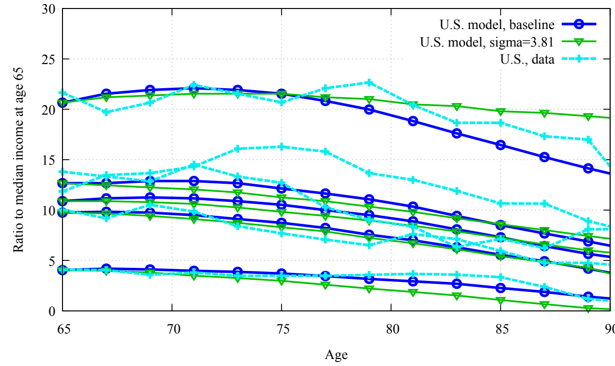
These sensitivity experiments show that model parameters in the benchmark model are tightly estimated, since changing any one worsens some aspect of the model performance relative to the benchmark.

Appendix D.2. Benchmark Model without Housing: Heterogeneous Effects

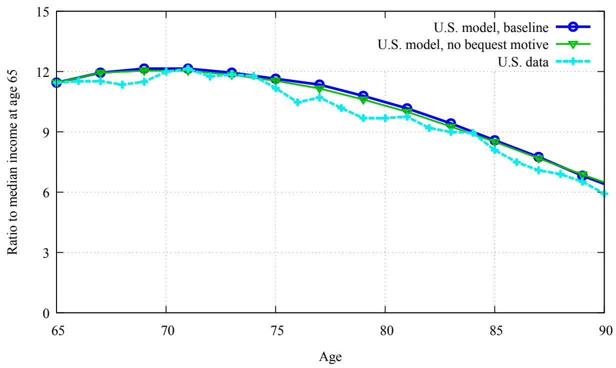
In this section, we show the effects of the experiments conducted in Section 6 on different income quintiles, since in Section 6, we focus only on the overall median profiles. The four panels of Figure D.4 correspond to the four panels in Figure 9. Panel (a) shows that the effect of Swedish



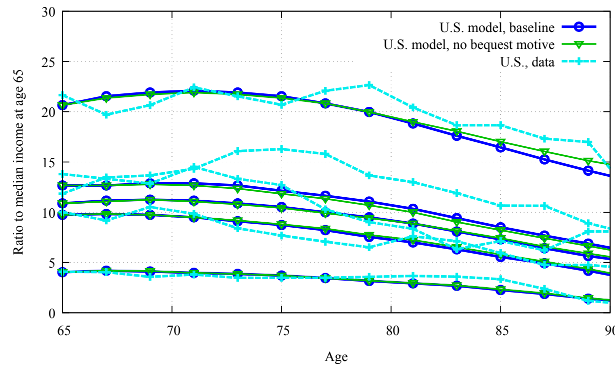
(a) $\sigma = 3.81$: Median Net Worth



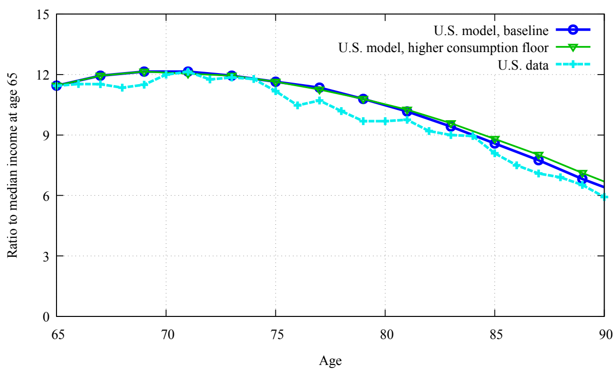
(b) $\sigma = 3.81$: Medi Net Worth by Income Quintile



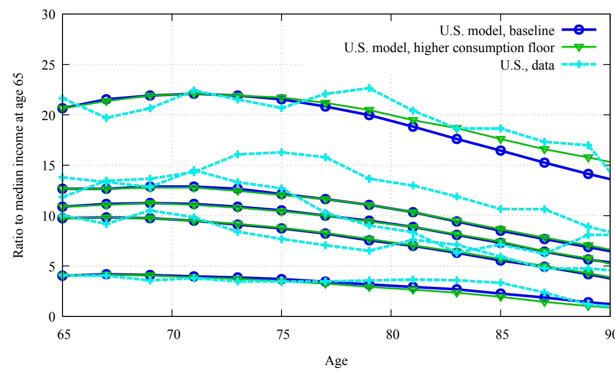
(c) $\gamma = 0$: Median Net Worth



(d) $\gamma = 0$: Medi Net Worth by Income Quintile



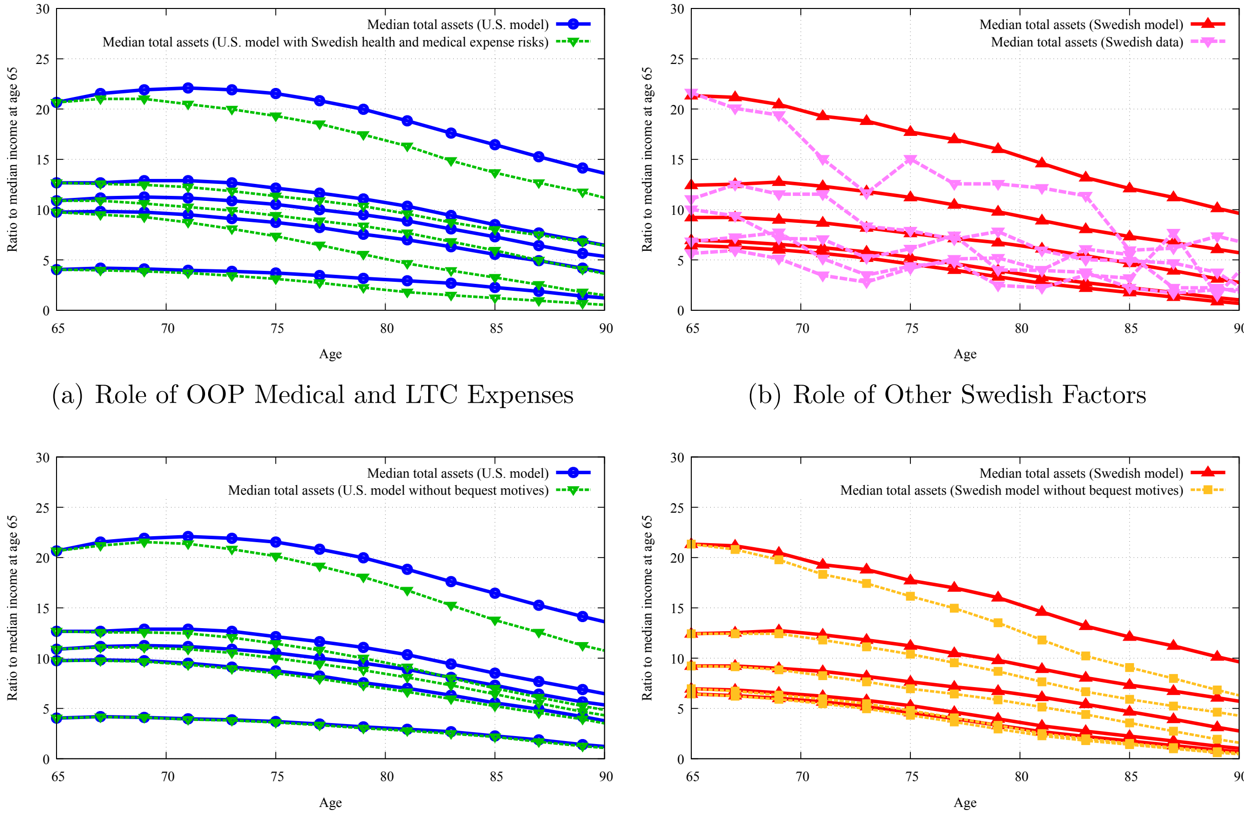
(e) Higher $\underline{c}$: Median Net Worth



(f) Higher $\underline{c}$: Medi Net Worth by Income Quintile

Figure D.3: Benchmark Calibration vs. Alternative Calibrations

OOP medical and LTC expense risk encourages faster decumulation of net worth across income groups. Panel (b) compares the Swedish data and what we call the Swedish model, in which Swedish OOP medical and LTC expense risks, Swedish health transition probabilities, and the Swedish type distribution at age 65, together with the Swedish age profile of household size, are introduced while keeping the parameters estimated with the U.S. data intact. The Swedish model exhibits faster decumulation of net worth compared with the U.S. model (and the U.S. data). Although the Swedish data are noisy due to the small sample size, especially when each income



(a) Role of OOP Medical and LTC Expenses

(b) Role of Other Swedish Factors

(c) Role of Bequest Motives, U.S.

(d) Role of Bequest Motives, Sweden

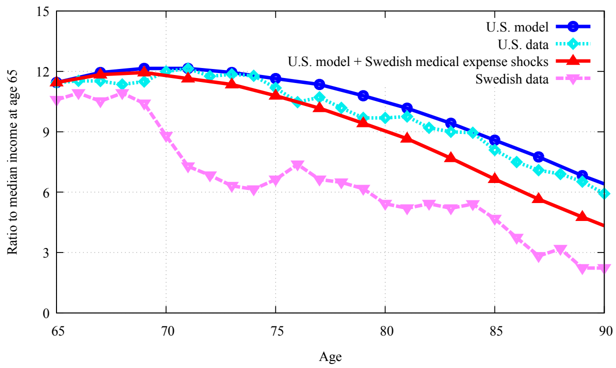
Figure D.4: Benchmark Model without Housing: Heterogeneous Effects

quintile is looked at separately, the model profiles are generally consistent with the data, except for the top income quintile. For the top quintile, the data exhibit faster net worth decumulation than the model prediction.

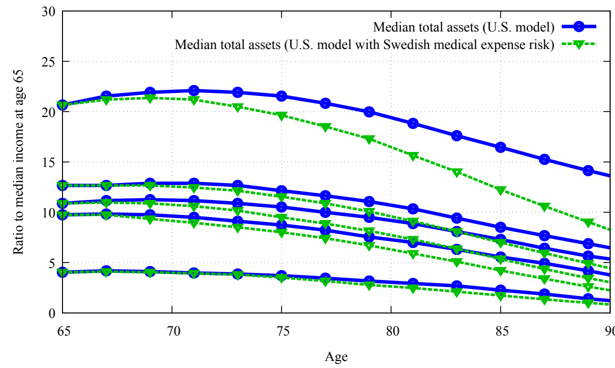
In panel (c), the model calibrated to the U.S. with no bequest motive ($\gamma = 0$) is shown. The effect of a zero bequest motive is mostly visible for higher income quintiles, while it is negligible for the lowest income quintile, since the bequest motive is stronger among wealthier households. In the U.S. model, households in lower income groups dissave slowly, seemingly to deal with OOP expense risks. We do the same experiment of shutting down the bequest motives with the Swedish model in panel (d). Interestingly, the effects of shutting down bequest motives in the Swedish model are more noticeable for all income quintiles. Since the medical expense risk is smaller for Swedish households, the effect of bequest motives seems to be slightly stronger for households in the lower income groups.

Appendix D.3. Benchmark Model without Housing: Additional Experiments

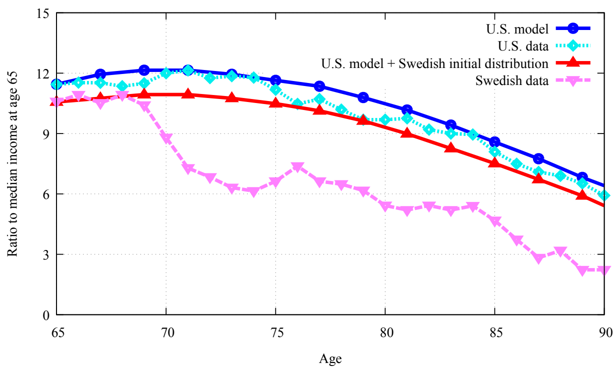
Figure D.5 shows additional experiments, designed to investigate the role of different Swedish elements in the benchmark model. Panel (a) shows the effects on overall median net worth of only introducing the Swedish OOP medical and LTC expense risk, without changing the health transition probabilities. Panel (b) shows the effects on median net worth of each income quintile. Compared with panel (a) in Figure 9, one can see that the speed of decumulation is faster when the



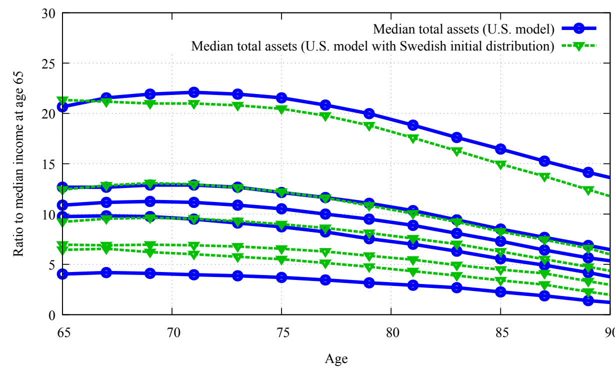
(a) Only Swedish Medical Risk, Medi Net Worth



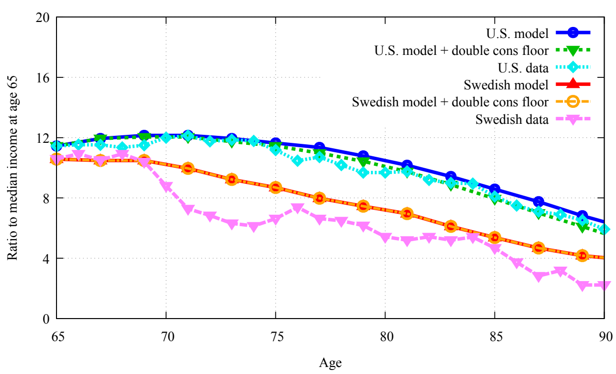
(b) Only Swedish Medical Risk, By Inc. Quintile



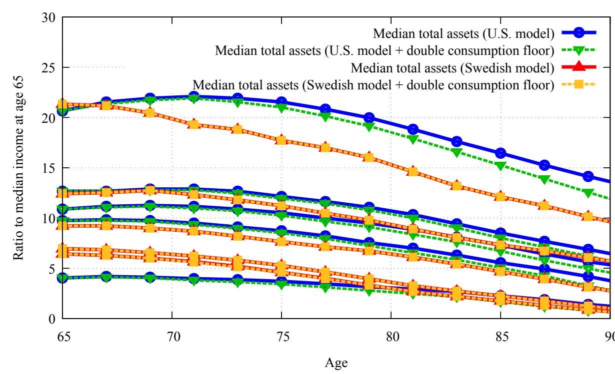
(c) Swedish Initial Dist., Median Net Worth



(d) Swedish Initial Dist., By Inc. Quintile



(e) Higher $\underline{c}$, Median Net Worth



(f) Higher $\underline{c}$, Each Income Quintile

Figure D.5: Benchmark Model without Housing: Extra Experiments

U.S. health transition probabilities are used. This is because Swedish households are pessimistic in the sense that they tend to report poorer health status than U.S. households. Therefore, if we use the U.S. health distribution with Swedish medical expense risk, households are healthier on average and fewer households are exposed to higher expense risk, so that households can decumulate faster. This experiment confirms the importance of using shocks to self-reported health status as part of OOP medical expense risk.

In panels (c) and (d), we use the Swedish type distribution at age 65, leaving the shocks and the parameters at their U.S. values. Panel (c) shows the overall median net worth profile, while panel (d) shows the median net worth for each income quintile. We find that the Swedish initial distribution shifts the net worth age profile downward in parallel, for both overall median and for each income group. The initial type distribution does not seem to change the slope of the net worth decumulation profile. Of course, as we discussed in the main text, the difference in the initial distribution might be a reflection of the different saving patterns *before* retirement — U.S. households save more than Swedish ones to prepare for higher OOP medical expense risk after retirement.

Finally, in panels (e) and (f), we explore the effects of doubling the estimated consumption floor to age profile of overall median net worth and median net worth for each income quintile, respectively. If we use the benchmark U.S. model, a higher consumption floor implies a slightly faster decumulation of net worth for all income groups. Even with moderate risk aversion, households dissave slowly partially for precautionary motives, and thus a more generous consumption floor allows households to release some of their precautionary savings. On the other hand, if we use the Swedish model for the same experiment, the effects of introducing a more generous consumption floor are virtually zero. Since OOP medical expense risks are already small, households do not need a more generous consumption floor.

Appendix E. Model with Housing: Additional Results

This appendix provides additional results for the extended model with housing, constructed in Section 7. Appendix E.1 shows the effects of the experiments conducted in the main text on different income quintiles. Appendix E.2 shows the results from additional experiments.

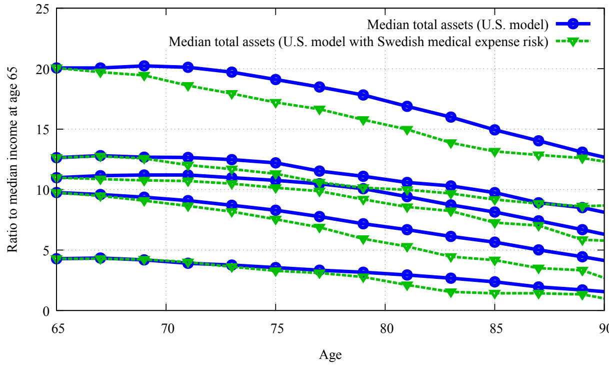
Appendix E.1. Model with Housing: Heterogeneous Effects

Figure E.6 shows the effects of introducing Swedish OOP medical and LTC expense risk together with Swedish health transition probabilities (left panels) and introducing all the Swedish elements, including the age-65 type distribution and the age profile of household size (right panels), into the model with housing estimated to the U.S. data, to each income quintile. The figure corresponds to Figure 10 in the main text. The top panels show median net worth decumulation profiles for each income quintile. The second row is for median housing asset profiles among homeowners, while the third row is associated with homeownership rate. The bottom panels show median financial asset profiles for each income quintile. As with the overall median asset profiles and overall homeownership rate shown in Section 7, introducing Swedish OOP medical and LTC expense risk induces retirees to decumulate net worth, especially financial assets, faster.

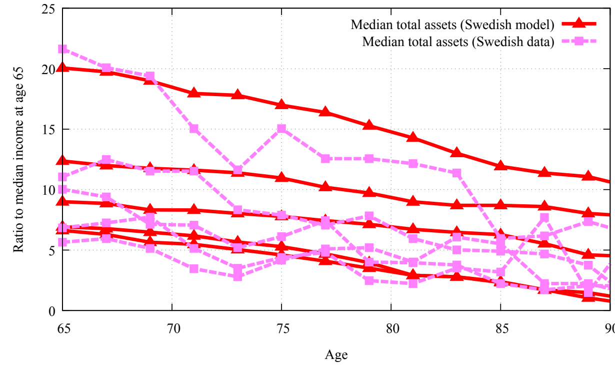
Appendix E.2. Model with Housing: Additional Experiments

In this appendix, we show the results of additional experiments using the extended model with housing. In Figure E.7, we shut down bequest motives by setting γ to zero and investigate how asset decumulation patterns are affected. We implement the experiment for the model calibrated to the U.S. economy as well as the Swedish model. The left panels show the effects on overall median asset profiles and homeownership rate. Shown in each panel are the benchmark U.S. model, the Swedish model, the U.S. data, the Swedish data, and the experiments with zero bequest motives, in the U.S. model and the Swedish model, respectively. The right panels of Figure E.7 look at effects on each income quintile, only for the U.S. model. These panels corresponds to panels (c) and (d) of Figure 9 for the benchmark model without housing. The effect on overall median net worth decumulation is slightly smaller than that in the benchmark model without housing, since the effect on housing assets is limited, although larger effects to financial assets compensate. The effects are larger for higher-income households, and limited for lower-income ones, similar to the benchmark model without housing. Again, this is because bequest motives have a greater impact on wealthier households.

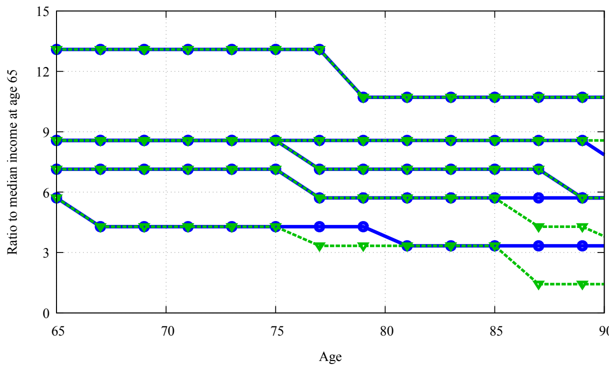
In Figure E.8, we double the value of the consumption floor $\underline{c}$. The lines are similar to those in Figure E.7, but the experiments are associated with a higher consumption floor. As in the benchmark model without housing, the higher consumption floor does not affect the median profiles in the Swedish model, since the OOP medical and LTC expense risk is small anyway, while there is modestly faster decumulation in the U.S. model, in particular, with respect to financial assets. The left panels, which look at the effects of a more generous consumption floor on the U.S. model, show that the effects are similar for all income quintiles.



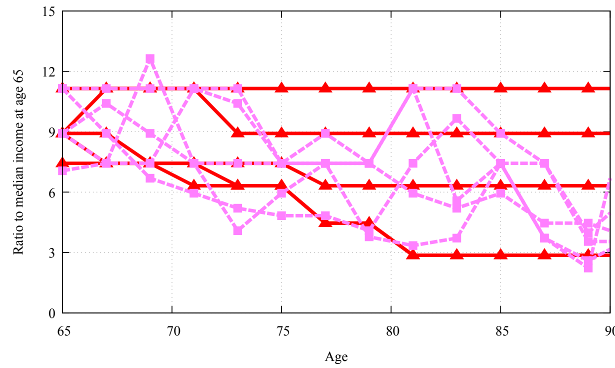
(a) Role of OOP Expenses: Net Worth



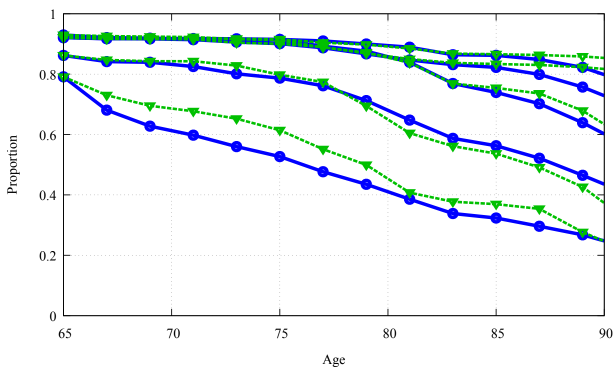
(b) Swedish Model & Data: Net Worth



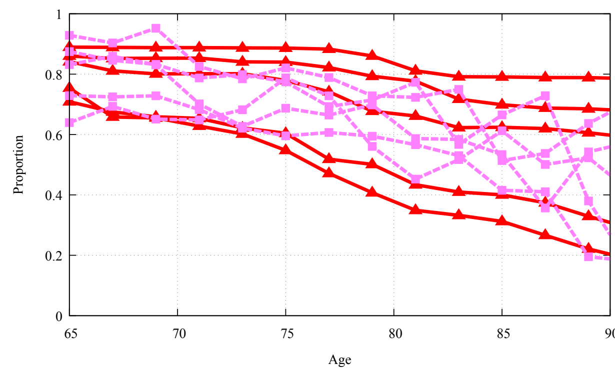
(c) Role of OOP Expenses: Housing Assets



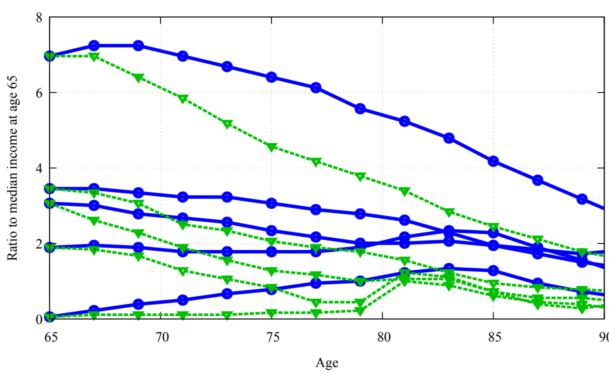
(d) Swedish Model & Data: Housing Assets



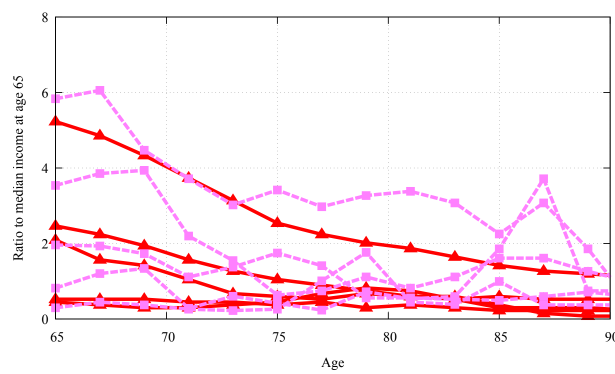
(e) Role of OOP Expenses: Homeownership Rate



(f) Swedish Model & Data: Homeownership Rate

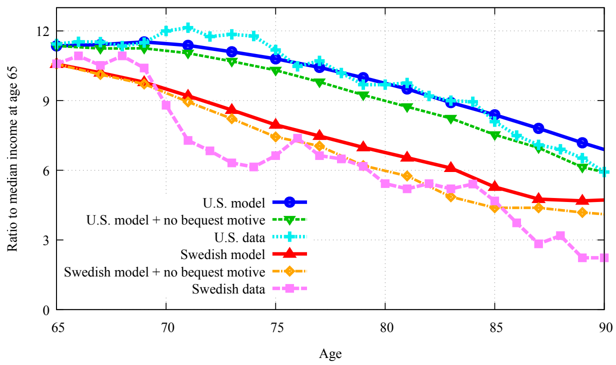


(g) Role of OOP Expenses: Financial Assets

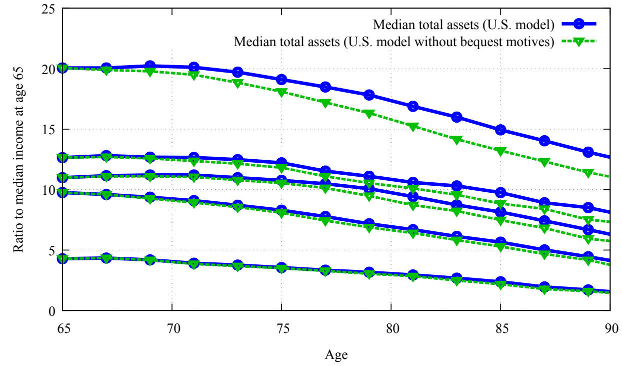


(h) Swedish Model & Data: Financial Assets

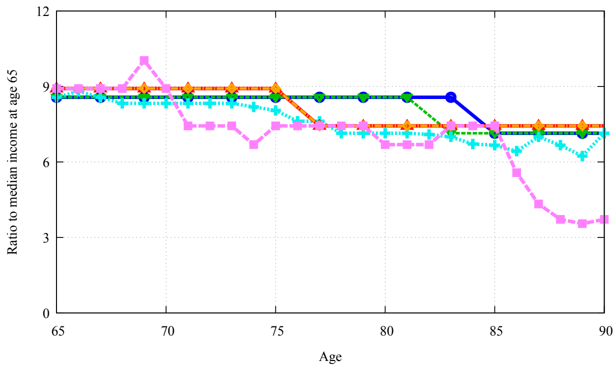
Figure E.6: Model with Housing: Heterogeneous Effects



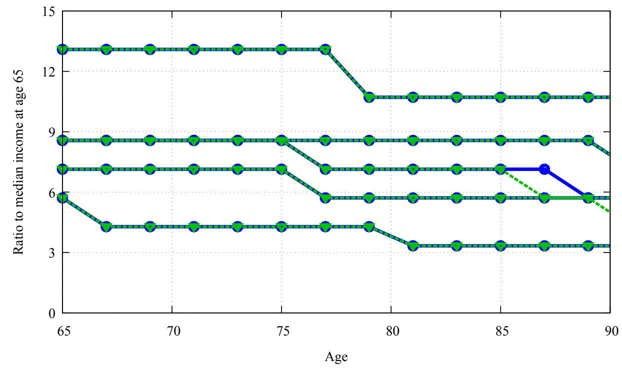
(a) Median Net Worth



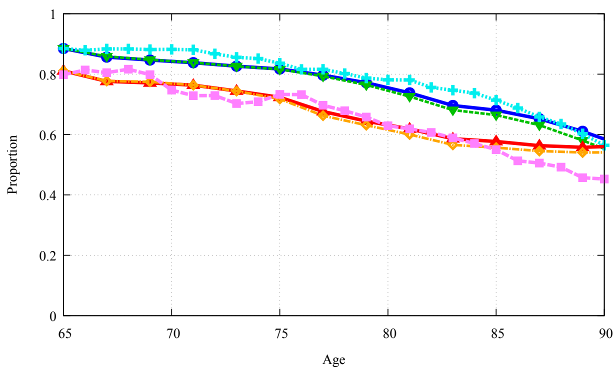
(b) Net Worth for Each Income Quintile



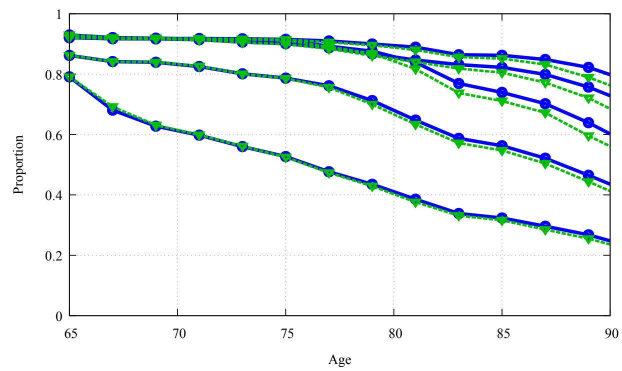
(c) Median Housing Assets



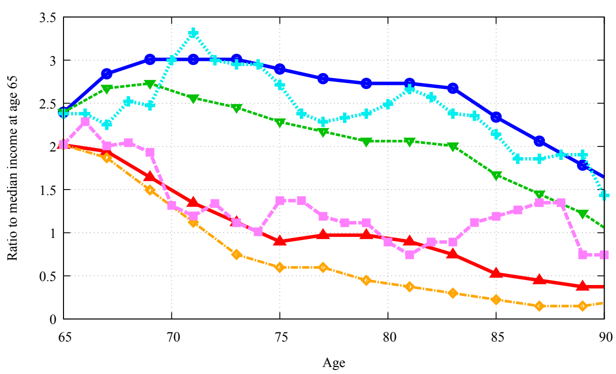
(d) Housing Assets for Each Income Quintile



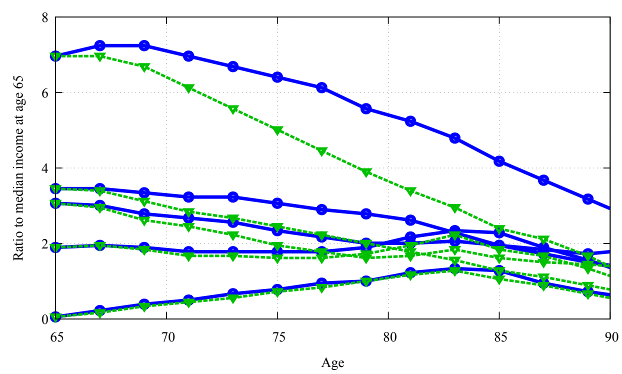
(e) Homeownership Rate



(f) Homeownership Rate for Each Income Bin

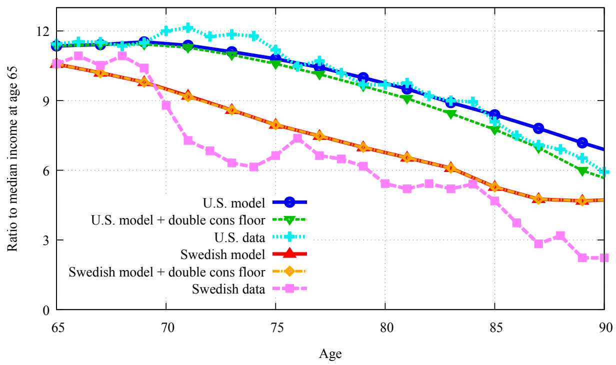


(g) Median Financial Assets

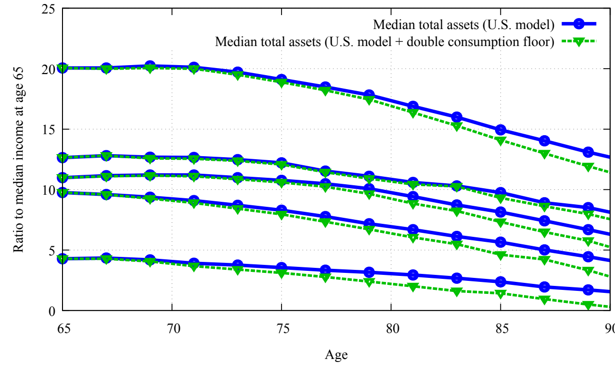


(h) Financial Assets for Each Income Quintile

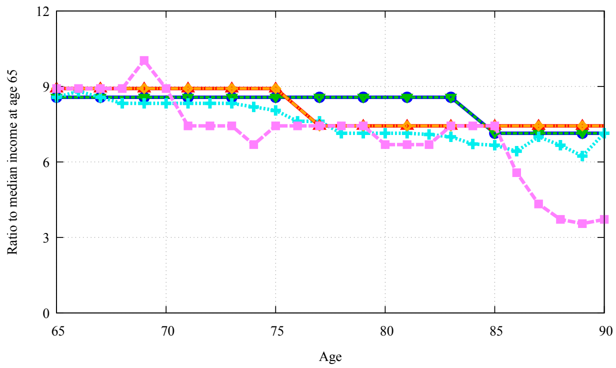
Figure E.7: Model with Housing: Role of Bequest Motives



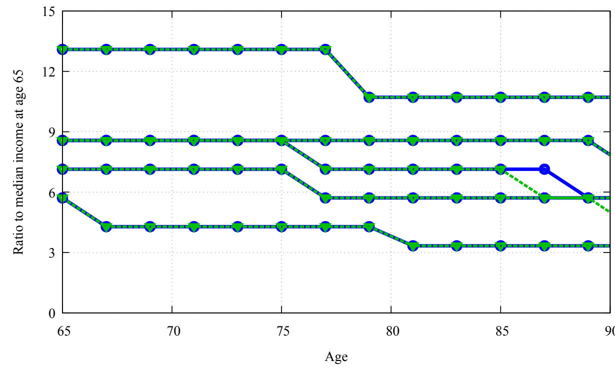
(a) Median Net Worth



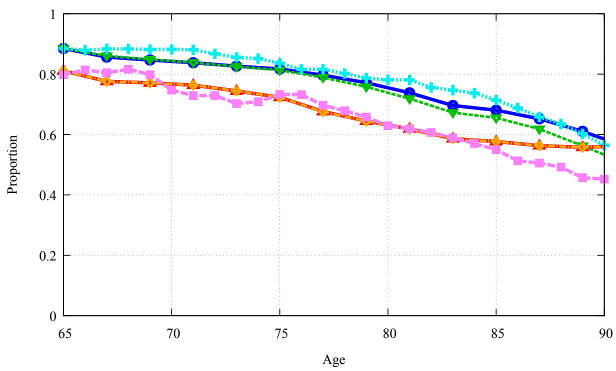
(b) Net Worth for Each Income Quintile



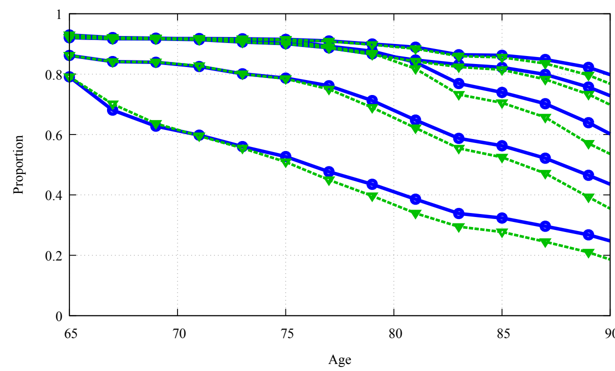
(c) Median Housing Assets



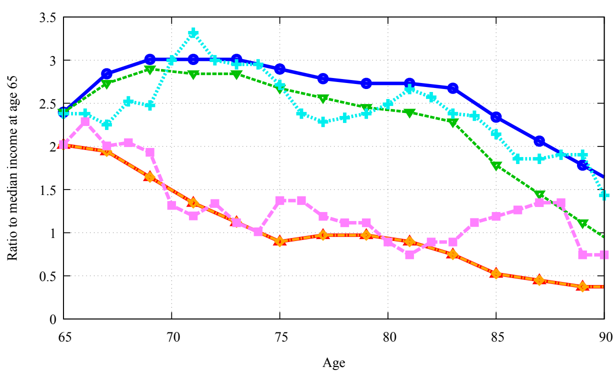
(d) Housing Assets for Each Income Quintile



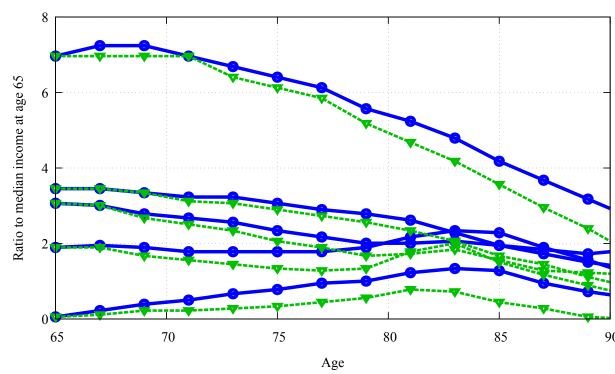
(e) Homeownership Rate



(f) Homeownership Rate for Each Income Bin



(g) Median Financial Assets



(h) Financial Assets for Each Income Quintile

Figure E.8: Model with Housing: Role of Social Insurance (Consumption Floor)

References

De Nardi, M., French, E., Jones, J. B., 2010. Why do the elderly save? The role of medical expenses. Journal of Political Economy 118 (1), 39–75.