Save, Spend or Give? A Model of Housing, Family Insurance, and Savings in Old Age

Daniel Barczyk
McGill University and CIREQ

Sean Fahle
Universität Tübingen

Matthias Kredler
Universidad Carlos III de Madrid

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Contact information: Daniel Barczyk (daniel.barczyk@mcgill.ca). McGill University, Department of Economics, Leacock Building, Room 321b, 855 Sherbrooke Street West, Montreal, QC, H3A 2T7. Sean Fahle (sean.fahle@uni-tuebingen.de). Universität Tübingen, Department of Economics, Melanchthonstraße 30, 72074 Tübingen. Matthias Kredler (matthias.kredler@uc3m.es). Universidad Carlos III de Madrid, Departamento de Economía, C. Madrid, 126, 28903 Getafe.

Abstract

How do housing and family shape the savings, spending, and inter-generational transfer behavior of the elderly? Using the Health and Retirement Study, we document that inter-generational transfers to children are substantially backloaded, that homeowners dis-save much more slowly than renters but often sell their houses when entering a nursing home, and that care by children slows down nursing home entry and is linked to larger bequests, particularly of housing. To rationalize these facts, we develop a dynamic, non-cooperative model of the family with an indivisible housing asset and joint bargaining between elderly parents and their children over the housing and care arrangements of the parents. The model generates realistic savings and care choices and matches the timing of transfers and home liquidations. A key novelty is the *housing-as-commitment channel*: In the absence of long-run family contracts, housing provides a commitment device for more efficient savings. We find that this channel increases homeownership in old age by one-third and families' willingness to pay for houses by 5-10%. This mechanism also facilitates informal care, slows down spending, and leads to larger bequests, implications that we support empirically.

Keywords: consumption/saving/wealth of the elderly, family insurance, inter-generational transfers, dynamic game

1 Introduction

Housing and family are important in shaping economic behavior in old age. We know, for example, that many of the elderly in the U.S. own homes and that elderly homeowners are reluctant to sell or downsize (Venti & Wise, 2004) or to draw upon home equity to support non-housing consumption (Nakajima & Telyukova, 2017). These patterns are clearly linked to the relatively slow rates of dis-saving and the sizable bequests left by the elderly (De Nardi et al., 2016). Also related is the presence of family members that the elderly care about, which lowers the opportunity cost of savings as any unspent wealth is left as a bequest (Lockwood, 2018). Although households with and without children display similar savings and bequest behavior (Hurd, 1989, Dynan et al., 2004), which has been interpreted as evidence against a bequest motive, we also know that family is a substantial provider of in-home long-term care (LTC), which both mitigates nursing home entry risk and shortens nursing home stays (Barczyk & Kredler, 2018).[1]

In this article, we argue that housing and family *together* are crucial for making sense of the elderly's economic behavior. For example, elderly homeowners may be able to resist drawing down their home equity precisely because care from their children allows them to remain at home. Absent this care, the home would need to be liquidated to finance formal care, drawing down savings and making future bequests less likely. Yet, despite these intuitive connections, the existing literature has largely kept housing, family, and LTC separate. We bring these elements together and demonstate that the interactions between them matter.

Using the Health and Retirement Study (HRS), we first assemble a set of empirical facts that describe savings behavior in old age and its connection to housing, old-age risks, and family. We provide new evidence of substantial backloading of transfers to children. As a summary measure, we calculate that the ratio of inter-vivos transfers to bequests for households above age 65 is 0.3.[2] We document key relationships between homeownership, nursing home use, and the presence of children. We find a high hazard of home liquidation coincident with nursing home entry (43% bi-yearly) and in the years following this event. However, we also find that children are effective in preventing nursing home entry and thereby home liquidations. All else equal, disabled, single parents are 3.1 percentage points less likely to reside in a nursing home (-22% relative to the mean) than singles without children. In addition, we find that owners dis-save at a significantly slower rate than renters and receive more informal care and for longer durations. Finally, parents who receive informal care leave larger bequests, especially housing assets.

To rationalize our empirical findings, we put forward a theory to explore how and why the joint

[1] Relatedly, Ko (2018) and Mommaerts (2016) argue that reliance on family care substantially lowers demand for LTC insurance, mirroring earlier theoretical work by Pauly (1990).

[2] Our figure is close to the widely-cited ratio of one-third from Gale and Scholz (1994), which is based on the 1983-1986 Survey of Consumer Finances.

presence of housing and family matters for the saving, spending, and inter-generational transfer behavior of the elderly. We believe that our model is the first to combine housing and family. A family in the model consists of a parent and a child household who make separate consumption-savings decisions with strategic considerations and jointly bargain over the housing and care arrangements of the parent.[3] Importantly, both parent and child lack the ability to commit to future actions. A house is an indivisible asset that delivers a flow of housing services valued above those delivered by the rental market. Children face earnings risk while parents face medical-expenditure, disability (LTC), and longevity risks in retirement. When disabled, LTC needs can be covered by one of the following options: (i) informal care from the child, who faces an opportunity cost in the labor market; (ii) formal care at home; (iii) privately-paid nursing home care; or (iv) Medicaid-sponsored nursing home care, which is modeled as a means-tested, government-provided consumption floor. To the best of our knowledge, our model is the first to include all of these care choices. The model features a variety of within-family transfers: informal care, exchange- and altruistically-motivated inter-vivos transfers, and bequests.

The key novel mechanism in our theory is that a house can serve as a commitment device that enables the family to achieve more efficient savings. We term this mechanism the *housing-as-commitment channel* (HACC), and we construct an illustrative model to explain exactly how it works. HACC consists of two central ingredients. i) First, parent wealth resembles a *common-pool resource* in that both agents derive benefits from it—the parent while alive and the child as the residual claimant after the parent's death. As such, parental wealth is subject to overuse: The parent does not fully internalize the benefit of savings to the child, which depresses parent savings below the social optimum. ii) The second ingredient is that the housing asset acts as a (revocable) *trust*, enabling the parent to commit (over short horizons) to minimal savings and thus a minimal bequest in the event of death. The essential properties that make the house a trust in our model are a) *contractability*—the parent can credibly commit not to sell the house over a short horizon dt, and b) *indivisibility*—the parent cannot consume out of housing wealth.[4]

In the HACC equilibrium of the illustrative model, the parent maintains homeownership in

[3] The addition of the housing asset presents non-trivial challenges in our non-cooperative setup since it adds a real option (selling the house) to a two-player game. A parent's decision on whether to sell or keep the home can conflict with the child's interest, giving rise to discontinuities in value functions. Bargaining, aside from yielding plausible predictions, elegantly solves these discontinuity issues; the option to sell is only executed in equilibrium if it is mutually beneficial.

[4] We deem it reasonable to assume that housing wealth has properties i) and ii), but that financial wealth, while satisfying i), fulfills neither ii,a) nor ii,b). We defer a detailed discussion, which also touches on reverse mortgages, to Section 3. We note that i) and ii) are of interest for other literatures, even when viewed separately. i) is relevant in any overlapping-generations model in which parent wealth passes to the next generation at death, thus generating an externality. As for ii), blunt (i.e., second-best) short-run commitments may help to solve efficiency problems in common-pool problems. For example, fishermen may commit to use old boats or inefficient nets to reduce extraction from common fishing grounds. Such coordination may be easier to enforce than the first best (coordination on the amount fished) since boats and nets are visible to other fishermen while the amount fished is harder to verify.

return for a transfer (care or money) from the child, resembling an annuity contract between the two. We show that this allocation mimics the ex-ante efficient allocation that parent and child can achieve under perfect contracts. HACC thereby solves a double commitment problem: On the one side, the "housing trust" keeps in check the parent's temptation to under-save. On the other side, the house acts as a bargaining chip for the parent that keeps the child motivated to provide for the parent until death.[5]

Next, we insert the illustrative model into a rich overlapping-generations structure and calibrate it to the U.S. economy. To validate the model, we show that it produces a good fit along several dimensions, including savings, housing liquidations, care arrangements, and the timing of transfers. In addition, we assess the empirical implications of HACC, which are that homeowners dis-save more slowly than renters, are more likely to receive informal care and for longer durations than renters, and that parents who receive informal care should leave larger bequests, often in the form of housing. We find robust support for each of these predictions in our data, even after controlling for a large number of observables.

We then use our quantitative model to explore and quantify the channels through which housing, old-age risks, and family affect the economic behavior of the elderly. We first use the model to isolate and quantify the *causal* effects of homeownership. In the model, when comparing homeowners at age 65 to otherwise identical agents whom we force to rent, homeowners have almost 50% higher expected net worth upon LTC entry and death, about half (one-fourth) the probability of ever entering a nursing home (becoming reliant on Medicaid), and spend about twice as much time receiving informal care. Second, we quantify the importance of HACC on homeownership. At the extensive margin, we calculate that HACC accounts for about *one-third* of the homeownership rate after retirement, a result that holds even when we shut down the utility benefit of owning. At the intensive margin, we find that HACC increases families' willingness to pay for their house by 5 to 10% of the home value at age 65, even though the prospect of LTC is still relatively distant at that point in the lifecycle.[6] Third, we use the model to shed light on the bequest motive. We find that parental altruism, in isolation, makes a sizable contribution to bequests in the top part of the distribution. Thus, altruistic preferences endogenously generate bequests as luxury goods. This result is consistent with flexible specifications of warm-glow bequest motives in the literature but uses fewer free parameters. Crucially, our model permits us to unpack the motives behind such specifications.[7] Our results also suggest that the quest for *the* bequest motive may be futile. Multi-

[5]Were the parent to run down her wealth prematurely, the child would be tempted to walk away from a promise to give care to the parent.

[6]We do so by computing the wealth equivalent variation at age 65 required to compensate families for the loss of owner-occupied housing. A contribution that we make here is to propose a sensible way to aggregate willingness to pay within a family, which we term *dynasty wealth equivalent variation*.

[7]See the literature discussion below for a review of these motives.

ple motives—altruism, exchange (HACC), and accidentalness—are at play, and they interact, with their effects being mediated by LTC risk and owner-occupied housing. Finally, our model rationalizes why most, but not all, transfers to children are delayed and given as bequests: No-commitment makes a parent want to maintain control over resources for as long as possible, a tendency that is enhanced by HACC. Quantitatively, the model yields a timing of transfers that is very much in line with our data.

Our paper contributes to several literatures on old age and housing. A large literature has focused on the savings behavior of the elderly,[8] with the most recent papers attributing central importance to health-expenditure risks. Our model includes this feature, in the form of medical and LTC expenditures, but also adds family insurance (in the form of time and money, following Barczyk & Kredler, 2018) and formal home care. Another strand of the literature argues for the importance of the *egoistic* bequest motive (also referred to as *warm glow* or *joy of giving*). Here, a bequest is conceptualized as a consumption good that yields utility as a function only of the size of the bequest. Additional free parameters (strength, curvature, etc.) help in achieving a good fit of old-age savings patterns. Recent estimates from Lockwood (2018) suggest that bequests in such a specification are luxury goods. However, this theory assumes away inter-vivos transfers, although they do occur in the data.[9] In contrast, in our theory, a single altruism parameter yields tight—and reasonable—predictions on inter-generational transfers and their timing.

A largely separate literature examines the extent to which retirees are willing to access their housing equity to finance non-housing consumption; see, e.g., Hurd (2002), Venti & Wise (2004), Yang (2009), Davidoff (2010), Blundell et al. (2016), and Nakajima and Telyukova (2017, 2018). Overall, this literature finds that elderly homeowners are reluctant to draw down home equity except when faced with widowhood or nursing home entry, in which case the house tends be liquidated altogether. Our HACC channel provides a new rationale as to why the elderly are reluctant to consume out of home equity, while still remaining consistent with the fact that home liquidations do occur, especially upon nursing home entry. Nakajima and Telyukova (2017, 2018) incorporate housing into an old-age-savings model in a way similar to ours. They find that the interplay be-

[8] See the excellent survey by De Nardi et al. (2016). There are three themes. (1) Lifetime uncertainty—e.g., Yaari (1965), De Nardi et al. (2009). (2) Bequest motives, which can be grouped into: (i) the *egoistic* motive, that households leave a bequest to increase their own utility—De Nardi (2004), Lockwood (2018); (ii) the *altruistic* motive, that the utility of the recipient plays a role in determining the bequest—Becker & Tomes (1986), Laitner (2002), Barczyk (2016); and (iii) the *strategic* motive, where individuals use bequests to influence the quantity of services provided to them by their children—Bernheim et al. (1985), Perozek (1998), Groneck (2016), Barczyk & Kredler (2018). (3) Uncertain medical expenditures—Palumbo (1999), Dynan et al. (2004), DeNardi et al. (2010), Kopecky & Koreshkova (2014), Dobrescu (2015). De Nardi et al. (2016) argue that future work should study in more detail the interplay between old-age risks and (the) bequest motive(s), which we do in this paper.

[9] Including inter-vivos and time transfers would require stipulating a utility function for each type of transfer, resulting in further free parameters. Another shortcoming of warm-glow specifications lies in their interpretation: whereas warm glow is often interpreted in the literature as a short-cut to altruism towards children, Kopczuk & Lupton (2007) argue that it also encodes concerns that are unrelated to one's children.

tween home equity and the egoistic bequest motive plays a key role in understanding the savings behavior of retirees and the unpopularity of reverse-mortgage products among this demographic. The key difference is that our model also includes a family dimension, which we find strengthens their result.

Finally, a recent literature on households' consumption-savings decisions highlights the special properties of the housing asset. Davidoff (2010) argues that homeownership is a substitute for LTC insurance as housing can be liquidated to finance increased expenditures when disabled, a channel that is also present in our model. Kaplan & Violante (2014) find that many households—despite being wealthy—consume hand-to-mouth, as most of their assets are locked into a high-return illiquid asset. In our framework, many of these wealthy hand-to-mouth consumers are HACC households. Additionally, housing in our model credibly constrains consumption and provides a commitment mechanism for saving in the absence of formal contracts. This resembles what Chetty & Szeidl (2007) describe as *ex-ante* consumption commitments that are only changed in response to large shocks. The idea of committing oneself to a certain good with desirable outcomes is also present in the self-control and temptation literature (e.g., Gul & Pesendorfer, 2004), where we can think of purchasing a house as a way for households to limit their consumption (the temptation good).

The paper is structured as follows. Section 2 lays out the empirical facts that motivate the analysis. We introduce the illustrative model and offer a detailed articulation of the HACC mechanism in Section 3. In Section 4, we present the quantitative model. Section 5 briefly discusses the calibration of the model. Section 6 analyzes the model fit and presents additional empirical support for the HACC mechanism. Section 7 contains our quantitative experiments. Section 8 concludes.

2 Empirical facts

We first assemble a set of empirical facts that describe savings behavior in old age and its connection to three key factors: housing, old-age risks, and family. Our objectives here are twofold: to update existing knowledge on savings using recent data from a single, high-quality data source and also to highlight how the seemingly disparate savings facts are intertwined. Later, following the exposition of our theory, we present a second set of empirical analyses that validate the predictions of the housing-as-commitment channel (see Section 6.4).

Our data for these analyses are drawn from the Health and Retirement Study (HRS), a biannual, longitudinal survey that is representative of U.S. households with a member over the age of 50.[10] We draw a representative sample of households in which at least one member is age

[10]The HRS is sponsored by the National Institute on Aging (grant number NIA U01AG009740) and is conducted by the University of Michigan. Based on a comparison of the HRS with the Survey of Consumer Finances, Bosworth & Smart (2009) find the HRS to be representative of the bottom 95% of the wealth distribution for older households. Although it does not capture the top of the wealth distribution, the length of the HRS panel and the fact that it surveys

65 or older from the pooled 1998-2010 core interviews, and we combine these data with exit interviews from the 2004-2012 survey waves for individuals who were single at the time of their deaths. We focus on single decedents in order to capture the behavior of households at the ends of their lifecycles, in the years leading up to the death of the last household member. The end-of-life period is of special interest because a significant portion of asset dis-accumulation and inter-generational transfers—bequests from parents to children and informal long-term care from children to parents—occurs in this phase. Because the exit interviews contain data on realized bequests, our data allow us to construct a complete picture of retiree saving and transfer behavior at the end of life. Appendix A discusses sample selection and provides descriptive statistics. Appendix G describes the construction of key variables.

2.1 Savings and housing

We begin our analysis at the start of the retirement period. Table 1 reports the distributions of net worth among all households whose eldest member is ages 65-69 and among the subsets of this population that are homeowners and renters (non-owners). The most immediate feature of these data is the highly-skewed wealth distribution in the overall population. While many households enter retirement with substantial net worth, a significant number begin this phase with little or no wealth. These disparities between households become especially stark once we condition net worth on homeownership status. We see that homeowners enter retirement dramatically wealthier than their renting counterparts, with the median owner, for example, holding wealth comparable to a renter at the ninety-fifth percentile.

Table 1: Net worth distributions in early retirement by homeownership

	N	Mean	p10	p25	p50	p75	p90	p95
Renters	3,031	92	-1	0	3	25	156	314
Owners	11,678	663	47	113	291	684	1,394	2,183
All	14,709	551	2	52	204	560	1,206	1,915

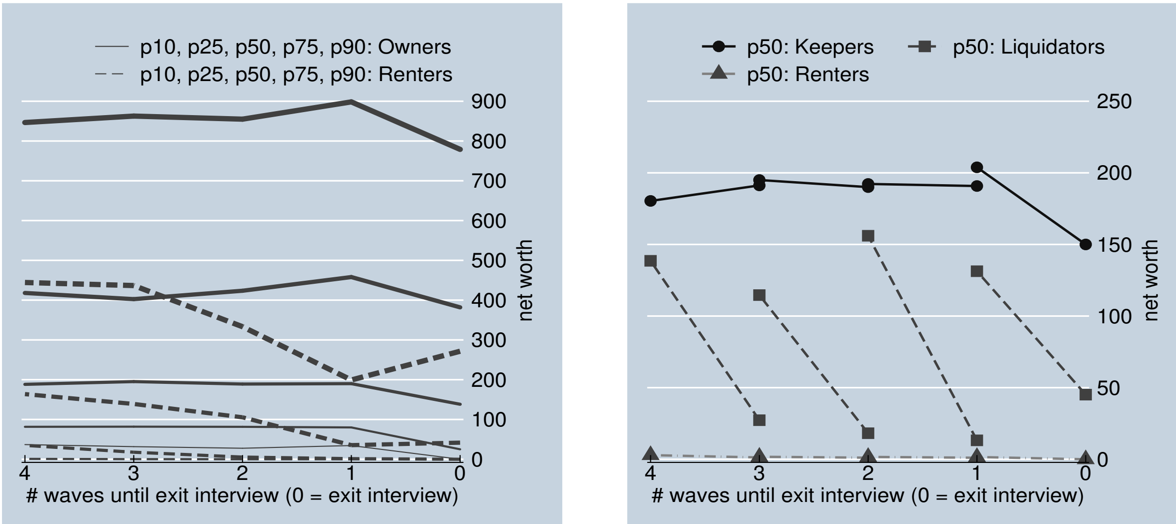
HRS core interviews 1998-2010. Households whose eldest member is aged 65-69. Statistics are computed with respondent-level sample weights. For couples, one observation is selected per household per interview. Amounts are 1000s of year-2010 dollars.

Shifting from the beginning of the retirement period to its conclusion, Figure 1 presents wealth trajectories for a balanced panel of households in the roughly 7.5-year period leading up to the death of their last surviving member.[11] More specifically, the lines in the figure (and those that follow) are percentiles of the panel members' net worth distributions, and their trajectories capture

nursing home residents make the HRS more suitable for our purposes than alternative surveys.

[11]The span of time covered by our wealth trajectory figures varies across individuals because of variations in the timing of interviews and the fact that some individuals return to the sample after missing one or more interviews.

Figure 1: Wealth trajectories and housing



(a) Own or rent in last wave prior exit

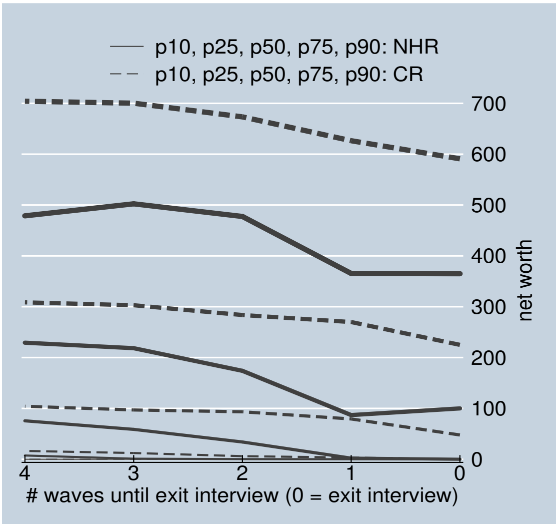
(b) Keepers vs. liquidators vs. renters

HRS core interviews 1998-2010 and exit interviews 2004-2012. Percentiles of wealth (e.g., p50 is the 50th percentile) are reported at 4, 3, 2, and 1 interview-waves prior to the exit interview and at the exit interview (= 0). The sample is a balanced panel of single decedents with four or more core interviews. Panel (a) conditions the wealth trajectories on owning or renting at the last core interview prior to death. Panel (b) divides the sample for each pair of interviews into home keepers, who owned at both interviews; home liquidators, who owned at the first but not the second; and renters, who owned at neither interview. In both panels, amounts are 1000s of year-2010 dollars. Statistics are computed with respondent-level sample weights. Confidence intervals for the wealth trajectories are provided in Figure K.1 in the appendix.

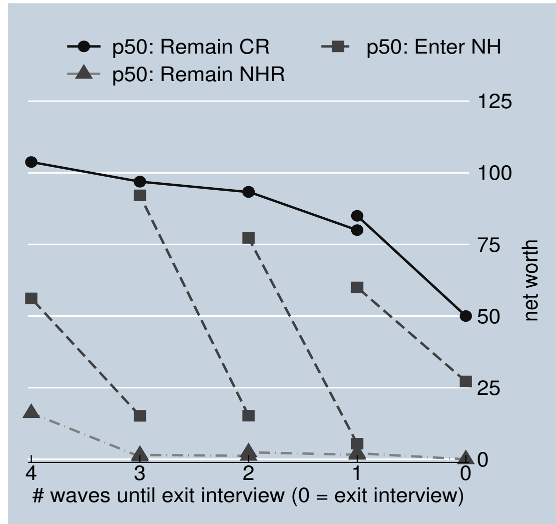
the evolution of these distributions as the households advance toward the end of life. Panel (a) plots these trajectories separately for households that were homeowners and renters at the time of their final core interview, which occurs, on average, 1.5 years prior to death. Two key patterns emerge: first, consistent with the results in Table 1, homeowners are considerably wealthier than renters, and second, we find that owners also dis-save much more slowly.

Delving more deeply into the second pattern, Panel (b) shows the trajectory of median net worth after dividing the sample at each pair of interviews into owners who kept their homes (*keepers*), owners who became renters (*liquidators*), and individuals who owned in neither interview (*renters*). Among those who retain ownership over their homes, we observe virtually no asset dis-accumulation until immediately prior to death. Indeed, dis-saving for owners appears to occur only with the liquidation of housing wealth, at which time wealth declines dramatically. As we document in Appendix H, we find that a significant portion of the declines in liquidators' median net worth can be accounted for by observable factors, such as out-of-pocket medical spending, and by the effect of transitioning from homeownership to non-ownership—which, according to our theory, should accelerate dis-saving among liquidators relative to owners. Measurement error appears to account for a relatively small part of the changes.

Figure 2: Wealth trajectories and nursing home residency



(a) Community or NH resident in last wave prior exit



(b) Remain CR vs. remain NHR vs. enter NH

HRS core interviews 1998-2010 and exit interviews 2004-2012. Percentiles of wealth (e.g., p50 is the 50th percentile) are reported at 4, 3, 2, and 1 interview-waves prior to the exit interview and at the exit interview (= 0). The sample is a balanced panel of single decedents with four or more core interviews. Panel (a) conditions the wealth trajectories on living in the community (CR) or a nursing home (NHR) at the last core interview prior to death. Panel (b) divides the sample for each pair of interviews into those who remain CRs at both interviews; those who remain NHRs at both interviews; and those who switch from CR to NHR between interviews. In both panels, amounts are 1000s of year-2010 dollars. Statistics are computed with respondent-level sample weights. Confidence intervals for the wealth trajectories are provided in Figure K.1 in the appendix.

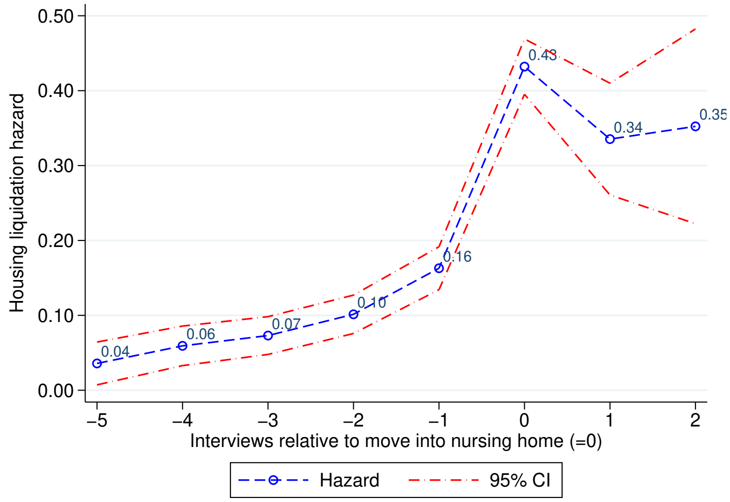
2.2 Savings and long-term care

The second factor that we examine is long-term care. Perhaps the most significant source of spending risk in old age, the risk of needing costly long-term care is now generally understood to be one of the most important drivers of savings behavior in retirement. Consistent with this view, our data reveal a strong correlation between savings dis-accumulation and nursing home utilization.

Nursing home use and savings patterns. Panel (a) of Figure 2 plots end-of-life wealth trajectories separately for individuals who were community residents (CR) and nursing home residents (NHR) at the time of their final core interview. Two major differences are evident: nursing home residents tend to be poorer than community residents and to dis-save more rapidly, particularly in the period leading up to the final core interview. Panel (b) investigates the latter pattern further by examining the trajectories of median net worth on the basis of whether each individual remained a community resident, remained a nursing home resident, or entered a nursing home between each pair of interviews. The resulting graph reveals dramatic decreases in net worth coinciding with moves into a nursing home, a pattern consistent with a rapid spend-down of assets by nursing home residents prior to Medicaid eligibility.

The interaction of long-term care and housing. The reader will note a very strong resem-

Figure 3: Home liquidations and nursing home entry



HRS core interviews 1998-2010. This figure plots the hazard of home liquidation (the probability of not owning at the current interview conditional on ownership at the prior interview) and its 95 percent confidence interval relative to the timing of each move into a nursing home that we observe in our data. All moves into nursing homes by individuals 65 and older are included. The x-axis indexes interviews relative to the move ($x = 0$). We drop cells with fewer than 25 observations.

blance between the (b) panels of Figures 1 and 2. In particular, we observe similarly rapid asset dis-accumulation by those entering nursing homes and those liquidating housing assets. In fact, these patterns are intimately connected: There is a clear relationship in the data between transitions out of homeownership and moves into nursing homes.

This connection can be seen in Figure 3, which plots the hazard of home liquidation relative to the timing of each move into a nursing home that we observe in our data.[12] Two aspects of the figure are noteworthy. First, there is a very high hazard of home liquidation coincident with nursing home entry (43%) and in the years following. For comparison, among households with a member ages 65+, the average liquidation rate between interviews is 5.85%. The spike in the hazard is quantitatively important for the level of homeownership: Not reported in the figure, we calculate that at least 14% of all home liquidations among elderly households in the core HRS data coincide exactly with a move into a nursing home. Second, the figure also reveals that the hazard begins to creep upwards prior to nursing home entry. This increase is suggestive of forward-looking behavior, indicating that anticipated future nursing home utilization may impact decisions prior to a move into a nursing home.

2.3 Savings and the family

Savings patterns and the presence of children. The third and final factor that we examine is the family. More specifically, we examine how savings behavior in retirement is influenced by the

[12] See also Davidoff (2010).

presence of children. Table 2 reports the distributions of net worth for households with and without children at the beginning and end of the retiree household lifecycle. The numbers reveal striking similarities between these two groups. We see from Panel (a) that parent and childless households hold very similar levels of wealth at ages 65-69, near the start of retirement, and Panel (b) confirms that the same is true of the distribution of estates among single decedents.[13]

Table 2: Estate and net worth distributions and the presence of children

(a) Net worth	N	Mean	p10	p25	p50	p75	p90	p95
Children	13,568	558	2	54	206	553	1,229	1,966
No Children	1,008	501	0	34	206	651	1,102	1,685
All	14,576	553	2	53	206	560	1,212	1,919

(b) Estates	N	Mean	p10	p25	p50	p75	p90	p95
Children	2,803	230	0	0	22	198	521	806
No Children	355	205	0	0	13	198	639	1,043
All	3,158	226	0	0	20	198	521	834

Panel (a): HRS core interviews 1998-2010. Percentiles of the household net worth distribution of households whose eldest member is ages 65-69. Statistics are computed with respondent-level sample weights. For couples, one observation is selected per household per interview. Panel (b): HRS exit interviews 2004-2012. Percentiles of the estate distribution of decedents who at time of death were neither married nor partnered. Respondent-level weights from the last available core interview are used. In both panels, amounts are 1000s of year-2010 dollars.

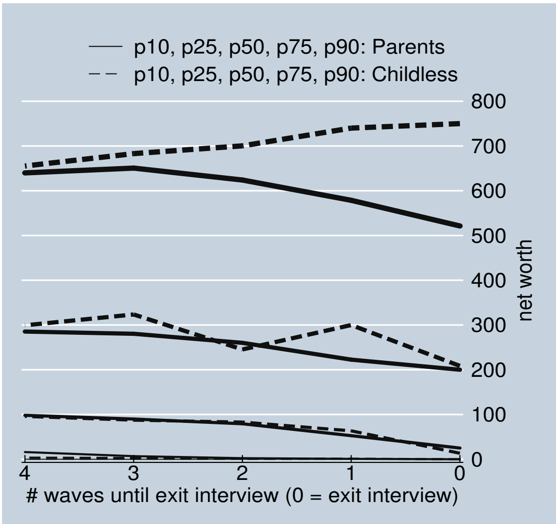
A similar pattern obtains when we turn our focus from the level of wealth to the rate at which wealth is spent down. This can be seen in Panel (a) of Figure 4, where we report end-of-life net worth trajectories for households with and without children. Consistent with the evidence on wealth and estates presented in Table 2, the trajectories are remarkably similar, both in terms of the levels of wealth and the rate of spend-down.[14]

In Panel (b), we combine the groups and look briefly at the overall wealth trajectories for all single decedents. While the figure shows relatively slow rates of dis-saving at the upper reaches of the wealth distribution—illustrating the well-known *retirement savings puzzle*—the figure also reveals considerable asset dis-accumulation near the end of life for those with less wealth. The median individual in our sample holds just under $100,000 at the fourth core interview prior to

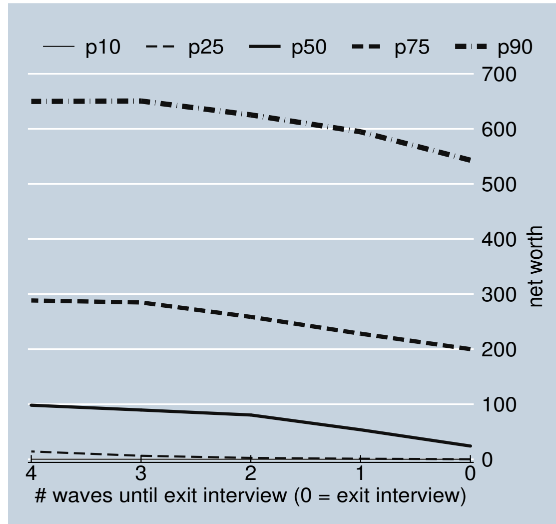
[13] We also see from Table 2 that the distribution of estates, like that of net worth, is highly skewed. In Appendix I, we show that the right tail of the estate distribution appears to follow a Pareto (power-law) distribution for estates above approximately $450,000. Our estimate for the power-law coefficient implies that while the mean exists, higher moments do not. This implies that the Central Limit Theorem does not apply, which makes any estimates relying on central moments (such as means and regression coefficients) extremely sensitive to outliers. We account for this feature of the data in our analysis by focusing on quantiles or log transformations or by excluding the top percentiles.

[14] Although there appears to be a divergence in the wealth trajectories at the 90th percentile, the confidence intervals for the 90th percentile of wealth among the childless are, in fact, too broad to reach any conclusions. See Figure K.1 in the appendix.

Figure 4: Wealth trajectories and children



(a) With and without children



(b) All

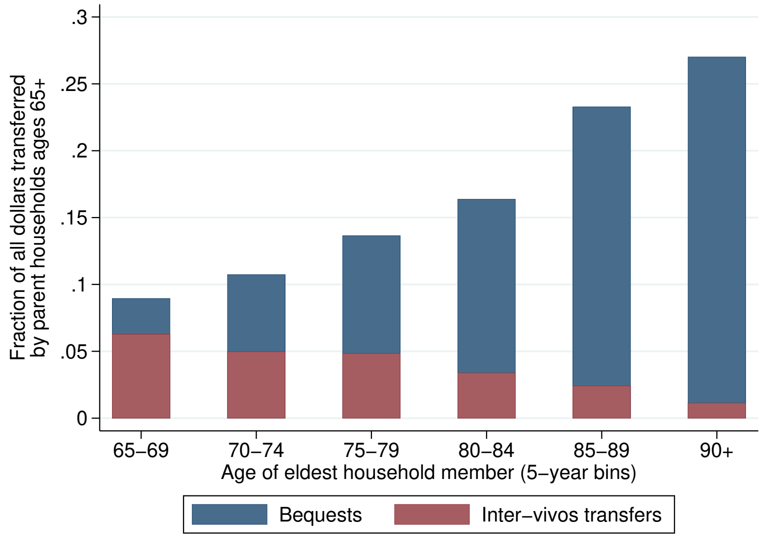
HRS core interviews 1998-2010 and exit interviews 2004-2012. Percentiles of wealth (e.g., p50 is the 50th percentile) are reported at 4, 3, 2, and 1 interview-waves prior to the exit interview and at the exit interview (= 0). The sample is a balanced panel of single decedents with four or more core interviews. Panel (a) differentiates between single decedents with and without children based on the number of living children listed in the exit interview. Panel (b) combines these two groups. In both panels, amounts are 1000s of year-2010 dollars. Statistics are computed with respondent-level sample weights. Confidence intervals for the wealth trajectories are provided in Figure K.1 in the appendix.

death but leaves an estate valued at only $20,000, an 80% decline in wealth in less than eight years. By focusing on the period immediately leading up to death, the figure provides sharper evidence of wealth dis-accumulation at the end of life than is commonly reported.

Returning to the link between children and savings, it should be noted that the absence of a clear association between the two, while remarkable, does not preclude the presence of children from influencing savings behavior. Indeed, strong evidence to the contrary can be found in the considerable transfers of resources, both in money and time, that flow in both directions between elderly parents and their children. We conclude the first part of our empirical analysis by examining these exchanges and their connection to the savings behavior of parents.

Transfers of wealth to children. Figure 5 shows how flows of inter-vivos transfers from parents to children compare to the bequests reported in Table 2, providing a nearly complete picture of the magnitude and timing of financial transfers from elderly parents to their children. The height of each bar in the figure reports the dollars transferred by parent households in a given five-year age bin as a fraction of all dollars transferred by parent households ages 65 and older. The segments of each bar decompose these transfers into their constituent parts: inter-vivos transfers and bequests. To reduce the influence of outliers, we exclude households whose wealth is above the

Figure 5: Timing of inter-generational transfers



HRS core interviews 1998-2010 and exit interviews 2004-2012. Households with a member age 65 or older. Excludes households whose wealth (core interviews) or estate value (exit interviews) exceeds the 95th percentile of wealth in the core interview data. Core interviews: inter-vivos transfers from parents to children. Exit interviews: bequests left by single decedents with children. Statistics are computed with respondent-level sample weights. Because the sample includes more core interview waves than exit interview waves (seven versus five), we scale up the exit interview weights to compensate. (See the discussion in Appendix G.) In households with multiple members, a single member is selected. The height of each bar is the fraction all dollars transferred by households ages 65+ that are given by households in the age category represented by the bar. The segments of each bar break these fractions into their two constituent parts: bequests and inter-vivos transfers.

95^{th} percentile.[15]

The figure reveals a substantial backloading of transfers. We observe that transfers increase with age as does the share of transfers accounted for by bequests. From the HRS data, we calculate that the ratio of inter-vivos transfers to bequests for elderly households is 0.3 (not shown in the figure), which is very close to the widely-cited ratio (one-third) from Gale and Scholz (1994). Our estimate means that, for every $4\,^1\!/_3$ dollars transferred by elderly parents, roughly one is given as an inter-vivos transfer while the others are given as a bequest.

Children and long-term care. The dominant form of support from children to elderly parents is informal care, a crucial channel that mediates the long-term care risk experienced by elderly parents. In Table K.1 of the appendix, we document robust negative correlations between the nursing home use of disabled, single individuals and whether these individuals have children. We find that, even after conditioning on numerous observables, parents are 3.1 percentage points less likely to reside in a nursing home (-22% relative to the mean), are 2.7 percentage points less likely to use a nursing home in the previous two years (-13% relative to the mean), and have nursing home stays about 19% shorter on average ($= \exp(-0.21) - 1$). We also find (even-numbered columns) that these associations are driven to zero by the inclusion in the regression models of

[15]When all households are included, the results are similar, and the backloading that we describe below is even more pronounced.

a measure of informal care from children to parents, itself strongly negatively related to nursing home use.[16] The evidence thus points to an interpretation in which, by providing access to informal care, the presence of children reduces a parent's risk of formal long-term care utilization. This mediation of long-term care risk provides a critical channel through which children can impact parental savings, underscoring again the important interactions between the different determinants of savings behavior.

3 An illustrative model: Housing as a commitment device

Before we lay out our main framework to rationalize the above set of interconnected facts, we first put forward a stylized model that allows us to focus on the *housing-as-commitment channel* (HACC). In this environment, a single player (e.g., a unitary household) would always prefer renting over owning, yet we show that demand for owner-occupied housing can arise when two players interact. When reading what follows, the reader should bear in mind the two central ingredients of HACC laid out in the introduction: i) parent savings are a *common-pool resource*, and ii) the housing asset acts as a *trust*, being both a) *contractible* and b) *indivisible*. We defer the details of our analysis to Appendix B.

Setup of the game. We consider a continuous-time[17] model with two agents, a parent and a child. Agents receive constant flow income y^k and y^p in each instant, where k indexes the child and p the parent. The child is infinitely-lived whereas the parent faces a constant probability of death δdt over each short time interval dt. Upon the death of the parent, the child receives the parent's remaining wealth as a bequest. For tractability, we assume that (i) the child cannot save and (ii) the parent can have only two discrete levels of wealth, either $a_t^p = 1$ or $a_t^p = 0$. The price of a house is also assumed to be 1. When $a_t^p = 1$, the parent can hold wealth either as financial wealth or in the form of a house. Owning implies that the parent's consumption is restricted to her flow income (plus potential transfers from the child, described below), which is the **indivisibility** property of housing. In each instant, the parent can turn housing into financial wealth and vice versa without incurring transaction costs.[18] When holding financial wealth, the parent (i) must obtain one unit

[16] In these specifications, informal care from children is measured using an indicator for whether any child helps with the individual's I/ADL limitations. In Table K.3 of the appendix, we show that the same pattern emerges when we substitute the indicator for a child LTC helper with either an indicator for having any child living within 10 miles or an indicator for having any daughters, two factors highly correlated with care receipt from children but more plausibly exogenous. We reach the same conclusion when we use these two variables as instruments for the child LTC helper variable. These findings are consistent with the literature that examines substitution between formal and informal long-term care (e.g., Van Houtven & Norton, 2004, Charles & Sevak, 2005).

[17] Continuous time simplifies the analysis by eliminating the higher-order terms in the continuation values of the savings game.

[18] In the quantitative model, we will assume that house liquidations are irreversible, but this is inessential for the

of housing services on a frictionless housing market by paying a flow rdt, where $r \in (0, y^p)$ is the exogenous real interest rate, and (ii) obtains an interest flow rdt on financial wealth.[19] When owning, the parent forgoes this interest income but obtains one unit of housing services from the house. Thus, owning is an inferior technology since it has the same cost as renting but restricts parent consumption.

We now describe agents' consumption and transfer choices and their **timing**. Denote by c_t^p and c_t^k the parent's and child's consumption rates at t. In line with the quantitative model, we denote by Q_t a net transfer from parent to child, so $Q_t < 0$ means that the child provides a transfer to the parent at t. When the parent has low wealth ($a_t^p = 0$), we assume for simplicity that no savings are possible. The following game unfolds over each instant $[t, t + dt)$:

1. Bargaining stage: If the parent has high wealth ($a_t^p = 1$), the child proposes a take-it-or-leave-it offer of a transfer flow $Q_t \leq 0$ in return for the parent holding her wealth in housing over $[t, t+dt)$. This is the *inside option*. The parent accepts or rejects the offer. No bargaining takes place if the parent has low wealth ($a_t^p = 0$).

2. Housing stage: If the parent has low wealth, she has to rent. If the parent has high wealth and has accepted the bargain in Stage 1, she is bound to own over $[t, t + dt)$, which is the **contractability** property of housing. Otherwise, when a high-wealth parent rejects the bargain, the parent unilaterally decides whether to hold wealth in housing or financial form over $[t, t + dt)$.

3. Gift stage: If the parent has low wealth or rejects the bargaining offer, the child decides unilaterally on a transfer $Q_t dt \leq 0$.[20]

4. Consumption stage: If the parent holds wealth in financial form, she can choose any consumption rate $c_t^p \geq 0$. Otherwise, if the parent holds her wealth in housing or if she has low wealth, the parent's consumption rate over $[t, t + dt)$ is $c_t^p = y^p - Q_t$. The child cannot save, thus their consumption is $c_t^k = y^k + Q_t$.

5. Law of motion for wealth: A low-wealth parent cannot save, so $a_{t+dt}^p = 0$. For a high-wealth parent, we want to capture that higher rates of consumption imply higher rates of wealth decumulation. We do so by assuming that the savings rate implies a lottery over ending up in the high- or low-wealth state at $t + dt$. We pin down the probabilities for this lottery by requiring the

mechanism. We thus assume a reversible decision here for better tractability and greater generality.

[19] When $a_t^p = 0$, the parent is forced to rent. We impose $r < y^p$ so that renting is feasible for the low-wealth parent.

[20] Since the child is not altruistic here, they will never provide a transfer, $Q_t < 0$, in this stage. We allow for this possibility so as not to advantage the housing over the financial technology—that is, we want transfers between agents to also be feasible in the renting subgame.

(expected) drift of wealth to be as in a conventional model with a continuous wealth variable:

$$\underbrace{(y^p - Q_t - c_t^p)}_{=\dot{a}_t^p dt} dt \overset{!}{=} \mathbb{P}(a_{t+dt}^p = 0 | a_t^p = 1, c_t^p, Q_t)(-1) + 0,$$

where -1 is the change in wealth that occurs when losing the lottery and 0 is the change when winning. The previous equation implies

$$\mathbb{P}(a_{t+dt}^p = 0 | a_t^p = 1, c_t^p, Q_t) = -\dot{a}_t^p dt = (c_t^p + Q - y^p) dt. \tag{1}$$

In the limit as $dt \to 0$, Eq. (1) thus implies that parent wealth follows a Poisson process with endogenous intensity $c_t^p + Q_t - y^p$. This intensity is increasing in c_t^p, as is intuitive.[21] Finally, the parent's spending restriction when owning housing implies $a_{t+dt}^p = 1$ with probability 1.

As for **preferences**, we assume that each agent $i \in \{k, p\}$ receives flow utility $u(c_t^i)$ in each instant, where $u(\cdot)$ is a utility functional with the usual properties: $u' > 0$, $u'' < 0$, and $\lim_{c \to 0} u'(c) = \infty$. Both parent and child discount at the rate $\rho = r > 0$. The game ends when the parent dies at the random time T. For the child, we normalize the value of inheriting $a_T^p = 0$ to zero and set the value of inheriting $a_T^p = 1$ to $B > 0$.[22] As there is no altruism, the parent's continuation value after death is zero in all contingencies.

Efficient allocations. We briefly discuss the ex-ante efficient allocations. This serves to clarify the child's commitment problem and to draw a useful analogy to annuities. Appendix B.1 solves explicitly the problem of a family planner, and Figure B.1 shows the efficient allocations. In the discussion here, we restrict attention to what we call *commitment allocations*: These are the subset of efficient allocations that both family members would prefer ex ante over the outcome of a non-cooperative game in which no housing asset is available (*no-housing equilibrium*). The comparison to the no-housing equilibrium serves to highlight the efficiency gains that the family can realize by coordinating on savings; we will see later how the housing trust can facilitate this coordination, at least imperfectly. Consider now the family planner's problem. Since there is no market for annuities, the planner is subject to uninsurable longevity risk. The planner's best option is thus to share the parent's longevity risk efficiently between agents. In the commitment allocations, this occurs as follows: The planner increases family savings with respect to the no-housing equilibrium, mainly by reducing the parent's consumption in the high-wealth state, but

[21] To rule out negative probabilities, we impose that, for consumption rates implying a positive drift ($\dot{a}_t^p > 0$), the probability $\mathbb{P}(a_{t+dt}^p = 0 | a_t^p = 1, c_t^p, Q_t)$ is bounded below at zero. Thus, the parent will never choose such consumption rates in equilibrium.

[22] In our numerical example below, we set $B = [u(y^k + \rho) - u(y^k)]/\rho$. This value arises endogenously when assuming that the child lives forever after T: Since $r = \rho$, the child would choose a constant consumption stream $y^k + r$ after the parent's death.

starts to transfer resources from child to parent once wealth is zero. The commitment allocations are attractive for the parent since the child essentially provides an **annuity**; they are attractive for the child since the probability of a bequest is higher than in the no-housing equilibrium.

It is now essential to understand that the commitment allocations are not equilibria of the non-cooperative game. The most salient reason for this is a time consistency issue for the child[23]: Ex ante, the child is happy to promise to transfer to the parent in the low-wealth state. Ex post, however, the child would renege on this promise: A parent with depleted wealth no longer has a bequest to offer to the child.[24] A natural way to circumvent this **commitment problem on the child's side** is, of course, for the parent to hold on to her wealth until death. We will now see how exactly this occurs in the decentralized equilibrium.

Solving the game. We now solve for Markov-perfect equilibria of the non-cooperative game. Denote by V_1^i player i's value in the bargaining stage when $a^p = 1$ and by V_0^i the value when $a^p = 0$. Once $a^p = 0$, the parent must rent, and the child chooses a zero transfer. Both players' continuation values upon the parent's death are zero, and thus the Hamilton-Jacobi-Bellman (HJB) equations are

$$(\rho + \delta)V_0^k = u(y^k) \quad \text{and} \quad (\rho + \delta)V_0^p = u(y^p - r). \tag{2}$$

The interesting case is when $a_t^p = 1$. To fix ideas, we will first analyze the parent's and child's payoffs over a short time horizon dt. Taking the equilibrium values V_1^p and V_0^p as given, the parent's value $\tilde{V}_1^p$ from an arbitrary allocation (c^p, Q) played over $[t, t + dt)$ is approximated to a first order by

$$\tilde{V}_1^p \simeq u(c^p)dt + (1 - \rho dt)V_1^p - (c^p + Q - y^p)dt(V_1^p - V_0^p). \tag{3}$$

We note here that $\tilde{V}_1^p$ is independent of the form in which the parent holds wealth. Taking the limit of Eq. (3) as $dt \to 0$, only terms of order dt matter, and the agents' valuations of a dt-allocation (c^p, Q) are given by the **Hamiltonians**[25]

$$H^p(Q, c^p) = u(c^p) - (c^p + Q - y^p)\Delta V^p, \tag{4}$$

$$H^k(Q, c^p) = u(y^k + Q) - (c^p + Q - y^p)\Delta V^k. \tag{5}$$

[23] There is also a commitment problem on the parent's side. Even if the child acted according to the commitment plan, the parent would deviate from the commitment allocation and choose lower savings in the high-wealth state. Because the parent's commitment problem is better understood from the vantage point of the non-cooperative environment, we defer this discussion until we present the solution to the non-cooperative game.

[24] We note that this commitment problem would also surface in many other deals that parent and child may devise to share risk. One such deal could be that the parent signs over ownership of her assets to the child, who in turn promises to pay the parent a constant annuity or to provide care to her. Again, once the child has received the parent's wealth, she would be tempted to walk away from the arrangement.

[25] Follow the same steps for the child to obtain the second equation.

Here, we define the value differentials $\Delta V^p = V_1^p - V_0^p$ and $\Delta V^k = V_1^k - V_0^k$, which we expect to be positive in equilibrium. The indifference curves in Figure 6 visualize the level lines of the Hamiltonians in equilibrium. The child always prefers higher Q (giving less to the parent) and lower c^p (since this means higher expected bequests). The parent always prefers lower Q (more help from the child) and has the typical concave payoff from c^p, familiar from consumption-savings models.

We now proceed by backward induction over the game's stages, always for the case of high parent wealth. Consider first the case in which the parent has declined the bargain in Stage 1 and thus rents. In the consumption stage, the parent maximizes the Hamiltonian in Eq. (4), yielding the standard first-order condition $u'(c^p_{rent}) = \Delta V^p$.[26] This choice is independent of the child's transfer Q_t, thus the parent's best response when renting is a horizontal line in Fig. 6. For the child, the optimal gift in the gift-giving stage is obviously the corner solution $Q = 0$. The intersection of the best responses yields the renting subgame outcome in the upper-right corner, which features a negative drift in wealth ($\dot{a}^p_t < 0$).[27]

It is now important to note that the two indifference curves that emanate from the renting outcome form a Pareto lens that is familiar from standard Edgeworth boxes. Under these Pareto improvements, the parent consumes less, and in exchange, the child provides a transfer, or what we may call a "contribution" to the parent's savings. Why are the points in the Pareto lens not equilibria of the renting subgame? The reason is a coordination failure as in the classic Prisoner's Dilemma: If parent and child struck an informal deal on such an allocation, the parent would revert back to her best response in the consumption stage and so would the child in the gift-giving stage. This highlights the **parent's commitment problem**: In absence of a trust asset, the parent under-saves.

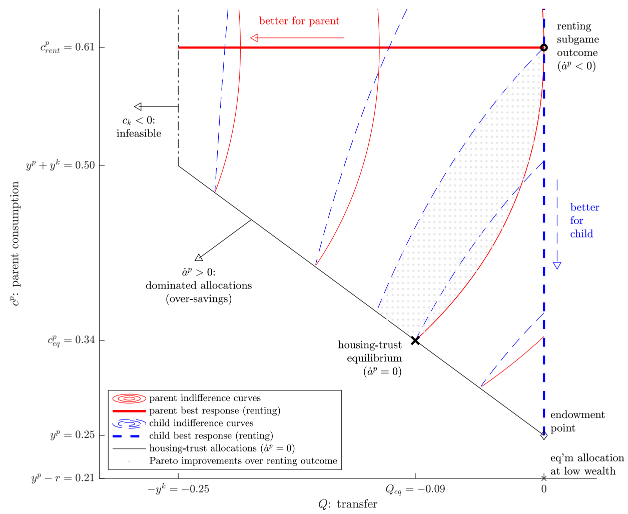
What is the economic force that makes the renting outcome inefficient? The inefficiency is due to the **common-pool** property of parent savings, which is captured in the parent's saving rate entering *both* the parent's and the child's Hamiltonians. In particular, Eq. (5) shows that c^p imposes a negative externality on the child by increasing the hazard rate, $c^p + Q - y^p$, of a zero bequest. This is not internalized by the parent, who only takes into account her own marginal cost of consumption, ΔV^p. The child-to-parent transfer, $Q \leq 0$, is distorted in a similar way, entering H^p as a positive externality. Thus, from an efficiency perspective, the parent consumes too much and the child contributes too little in the renting outcome.

We now show how bargaining over the **trust** (housing) asset can solve the twin commitment problems of the parent and child and deliver an allocation with higher parent savings and a higher child-to-parent transfer. In this allocation, the housing-trust equilibrium in Fig. 6, the child offers

[26] This is the same first-order condition as in continuous-wealth models when replacing ΔV^p by a partial derivative.

[27] Note that the continuous-time limit makes best responses very tractable—a pervasive feature of savings games.

Figure 6: Payoffs (=Hamiltonians) from dt-allocations at $a_t^p = 1$ in basic illustrative model



Indifference curves: level lines of $H^p(Q, c^p)$, $H^k(Q, c^p)$. Parameters: $u(c) = \ln(c)$, $\rho = r = 0.04$, $y^k = y^p = 0.25$, $\delta = 0.2$.

the transfer Q_{eq} that makes the parent just indifferent to the renting outcome, and the parent accepts the bargain and owns housing. With her wealth in housing, the parent's commitment problem is solved for the dt-period: the trust features of housing commit her to zero savings, removing the option to renege in the consumption stage. The child's commitment problem is also solved because the trust allocation is replayed in every dt-period while the parent is alive, meaning that the parent never dis-saves, and the low-wealth state is avoided entirely.

Formally, the HJB characterizing the child's equilibrium offer Q_{eq} is

$$(\rho + \delta)V_1^k = \delta B + \max\left\{H_{out}^k, \max_{Q \le 0} H_{in}^k(Q)\right\} \tag{6}$$

$$\text{s.t.} \quad H_{in}^p(Q) \ge H_{out}^p, \tag{7}$$

$$\text{where} \quad H_{out}^i = H^i(0, c_{rent}^p) \qquad \text{for } i = k, p, \tag{8}$$

$$H_{in}^i(Q) = H^i(Q, y^p - Q) \qquad \text{for } i = k, p. \tag{9}$$

Here, we have defined H_{out}^i and H_{in}^i as player i's Hamiltonian under the outside (renting) and inside (housing) options, respectively. Under the inside option, the child can propose one of the housing-trust allocations, which are on the line defined by zero savings, i.e., $c^p = y^p - Q$. The parent's participation constraint, Eq. (7), then constrains the child to offer points that the parent weakly prefers to the renting outcome. If the child also prefers at least one of these allocations to the renting outcome—i.e., if a subsegment of the housing-trust line falls into the Pareto lens, as is the case for the parameterization in Fig. 6—then a housing-trust equilibrium obtains: the child prefers the inside option over H^k_{out}, picking the most advantageous transfer in the inner max-operator in Eq. (6).[28] Although the housing equilibria represent Pareto improvements vis-à-vis the renting outcome, the graph also reveals that they are (generically) not Pareto-optimal themselves. Housing is therefore an effective, albeit blunt, tool to commit the family to more efficient savings.

Adding LTC. So far, we have deliberately left out LTC to highlight the workings behind HACC in the starkest possible way. In Appendix B.2, we study an extension with a care choice. HACC can be operative in two ways. The first is that the child provides informal care to a parent, who in exchange, holds on to the house; this is the empirically more relevant scenario and obtains for low-opportunity-cost children. Second, the child may give financial support to the parent, enabling the parent to stay in her home and to contract formal home care. As is intuitive, this arrangement is predicted for high-opportunity-cost children; it is empirically less prevalent. The extended model serves to make two points: First, the informal-care arrangement brings the model more in line with the data, where time transfers by children are much more common than monetary transfers. Second, it shows how a house can ensure prolonged care at home and help the parent avoid becoming impoverished and dependent on (less-preferred) Medicaid care. Again, we show that the housing trust allows the family to approximate the arrangement under the (ex-ante efficient) commitment allocations.

HACC: necessary assumptions and robustness. We now ask, more generally, which assumptions make HACC work and how robust these are in realistic settings. To sum up, our illustrative model shows that HACC occurs if i) Pareto improvements exist over the outside option (the renting outcome), ii) there exists a "trust" asset that allows the parent to commit to a minimal amount of savings, at least over short horizons, and iii) one of the trust allocations from ii) falls into the set of Pareto improvements from i). Conditions i) and ii) imply *necessary* conditions for HACC that are *qualitative* in nature. Condition iii) decides whether the house/trust is indeed used in equilibrium, which is determined by various *contributing factors* that are *quantitative* in nature.

i) Pareto improvements exist. Under which conditions are Pareto improvements over the renting outcome possible? The answer is: under very general conditions. Prop. 1 in the appendix shows that a sufficient condition for a Pareto lens to open to the southwest of the renting outcome is that $\Delta V^p > 0$ and $\Delta V^k > 0$. This means that parent savings should be beneficial to both parties in the future, which is exactly the **common-pool** property of parent savings. This property is very robust. For example, $\Delta V^p > 0$ typically holds in all but the terminal period of a finite-horizon setting, which implies that HACC does not rely on the infinite-horizon assumption. A second way for $\Delta V^p > 0$ to fail is if the parent perfectly annuitizes all wealth; this is unlikely to be the case in

[28] If none of the line falls into the lens, then the bargain is not an equilibrium, and the equilibrium features renting. Appendix B.1 gives more formal detail.

reality, where rates of voluntary annuitization by the elderly are very low.[29] For $\Delta V^k > 0$ to fail, a child would have to be *completely* excluded from a parent's will, which is a rare occurrence.

ii) Existence of trust asset. The existence of a trust in our model is implied by the assumptions we make on the housing asset, namely, *contractibility* and *indivisibility*. We note here that in general the trust asset need not be a house; any other asset could assume this role if it can commit the parent to a minimal amount of savings.[30]

a) Contractability. Contractability is met if the parent can credibly commit not to sell the trust asset, at least over a short horizon dt (i.e., the trust can be revocable *after* dt, as it is here). It is reasonable to assume that houses, since they are tangible and require some time to sell, have this property, while financial assets do not. Second, it is necessary that parent and child cannot *directly* contract on consumption decisions, which is again reasonable: Whereas general consumption expenditures, especially on food and services, are not readily verifiable, putting a house for sale is. We note that contractability is even more appealing an assumption when a child provides informal care, thus spending large amounts of time in the parent's home or even co-residing. The latter is a common occurrence: 34% (47%) of single, elderly community residents with 2+ (5) ADL limitations co-reside with an adult child.

b) Indivisibility: accessing home equity. Indivisibility is met in reality if either (1) parents cannot borrow against the house or (2) borrowing is possible via reverse mortgages or home equity lines of credit, but the parent can credibly commit to not using them. We deem both reasonable. First, the literature on homeownership among the elderly finds that few of the elderly appear willing or able to use financial products to access their home equity (Nakajima & Telyukova, 2017, Cocco & Lopes, 2019). These articles point out that few elderly homeowners qualify for conventional mortgages, home equity loans, or home equity lines of credit due to the income requirements of these products, and even fewer make use of reverse mortgage loans.[31] Releasing home equity by selling and moving into a smaller home is also rare (Venti & Wise, 2004, Nakajima & Telyukova, 2017). Second, even if the parent has the chance to obtain a reverse mortgage, this action is likely verifiable by the child and hence contractible. Thus, our mechanism incidentally provides a

[29] Factors such as bequest motives, old-age health risks, and the actuarial unfairness of available products have been shown to greatly reduce demand for annuities. See, for example, Peijnenburg et al. (2017) and the references therein.

[30] In fact, we are able to obtain housing equilibria even after setting $r = 0$, which removes housing services from the model and turns the house into a pure trust.

[31] For example, using data from the American Housing Survey, Nakajima & Telyukova (2017) report that, between 1997 and 2013, the proportion of homeowners ages 65 and above with reverse mortgage loans was only 0.84%. The literature offers a variety of explanations for this apparent puzzle. Nakajima & Telyukova (2017) identify bequest motives and transactions costs as important factors while Cocco & Lopes (2019) point to tastes for remaining in one's own home and the home maintenance requirement of reverse mortgage contracts as the greatest deterrents. In another study, Davidoff et al. (2017) show that a lack of knowledge about these products among the elderly also contributes to low demand.

possible new rationale for why the demand for reverse mortgages is low in the data, especially for the elderly with children.

iii) Contributing factors. Which factors determine whether the housing allocation falls into the Pareto lens in Fig. 6? This will depend on the shape of both players' indifference curves.[32] A first contributing factor is the child's curvature in utility: higher values of y^k decrease the curvature of the child's indifference curves, making a housing equilibrium more likely to exist. Economically speaking, a child with a high intertemporal elasticity of consumption/low risk aversion is more willing to accept a non-smooth consumption path and to provide an annuity to the parent in exchange for a future bequest. Since children are in their prime savings years when parents die, and since they can often count on multiple sources of income (e.g., spouses), we expect this to be a force that strengthens HACC quantitatively. A second set of factors are those that increase the child's willingness to pay for future bequests, such as a high yield, r, on the housing asset; a high death hazard, δ; and a low rate of time preference, ρ. All of these induce a large bequest payoff, δB, and thus a high value of parent wealth to the child, ΔV^k. A high death hazard, δ, is especially relevant at advanced ages and for LTC-dependent elderly; we thus expect HACC to be particularly strong in this group. A third class of factors that can quantitatively strengthen HACC are those that increase either the cost of the renting option (e.g., a renting premium, premia on reverse mortgages) or the benefit of the owning option (e.g., a preference by parents for owner-occupied housing or for receiving care at home). The literature has found support for all of these, again supporting HACC. Finally, a fourth factor is high risk aversion by the parent (low y^p), which increases the parent's demand for an annuity.

4 Quantitative Model

We now insert the stylized setting from the previous section into a rich overlapping-generations structure with incomplete markets. For the sake of quantitative realism, we now allow both parent and child to save, and we introduce imperfect altruism so that the model generates both altruistically-motivated and exchange-motivated transfers. Finally, we introduce a utility premium from homeownership as is commonly used in the macroeconomic housing literature to generate the observed levels of ownership in the data.

4.1 Setup

Overview. Time is continuous. The economy is populated by overlapping generations of individuals. There is no population growth. An individual's age is denoted by j. Individuals work

[32] See the proof of Prop. 1 in the appendix for their slopes.

when $j \in [0, j_{ret})$, where j_{ret} is the retirement age. They are retired when $j \in [j_{ret}, j_{dth})$, where $j_{dth} = 2j_{ret}$ is the maximum life span. Markets to insure against risk are absent. There is a savings technology with exogenous return r and agents face a no-borrowing constraint.

Family structure. A *family* is made up of two *households* (or *agents*): a *child household* (or just *child*, indexed by k, standing for the more colloquial "kid") of age $j^k \in [0, j_{ret})$ and a *parent household* (or just *parent*, indexed by p) of age $j^p = j^k + j_{ret}$. There is a measure one of families for each child age $j^k \in [0, j_{ret})$ in the economy.

State variables. We first establish some notation to facilitate the exposition. A family's state is given by the vector $z \equiv (a^k, a^p, s, \epsilon^k, \epsilon^p, h, j^p)$. $a^k \geq 0$ denotes the child's wealth, and $a^p \geq 0$ the parent's. ϵ^k and ϵ^p are productivity states from a set $E \equiv \{\epsilon_1, \ldots, \epsilon_{N_\epsilon}\}$. $s \in S \equiv \{0, 1, 2, 3\}$ is the health state of the parent. $s = 0$ stands for *healthy*. The states $s = 1, 2$ are *disability* states that are meant to capture states of the world in which the last surviving member of the household is in need of care.[33] In state 1 (*basic care*), the parent can receive care from all sources, including informal care from the child. In state 2 (*skilled care*), however, care must come from a formal source, i.e., informal care is not a choice. State 2 captures situations in which either i) disability is so severe that it necessitates professional care or ii) the family situation is such that it makes informal care impossible (e.g., all children live far away from the parent, strong feelings of aversion or shame toward informal care, etc.).[34] $s = 3$ means that the parent household is dead. Finally, $h \in \{0, [h_{min}, \infty)\}$ is the parent's housing state. $h = 0$ refers to renting whereas $h \geq h_{min}$ indicates that the parent owns a house of value h. $h_{min} > 0$ is a parameter that specifies the minimum house size in the economy. Children always rent.[35]

Sources of uncertainty. We assume that children face uncertainty about their labor productivity but that parents do not. Specifically, ϵ^k follows a Poisson process with age-independent hazard matrix $\delta_\epsilon = [\delta_\epsilon[\epsilon^i, \epsilon^j]]$, where entry $\delta_\epsilon[\epsilon^i, \epsilon^j]$ gives the hazard rate of switching from state i to

[33] The majority of disabled spouses receive care from their partners. (See, for example, Barczyk & Kredler, 2019.) We do not model this situation since it is not of first-order importance for inter-generational interactions.

[34] In reality, there is likely a continuum of preferences towards informal caregiving. Some children may see it as a moral or religious imperative to provide care for they elderly parents; others may have a pragmatic attitude towards informal care and only choose this arrangement if economically beneficial. Similarly, parents may feel positively about being cared for by family, or it may be a source of shame or guilt. The two states assumed here are a parsimonious way of capturing such heterogeneity and allow the model to better match the prevalence of informal care in the data.

[35] We make this assumption to keep the size of the state space manageable. It is key that children in our model face realistic incentives when it comes to savings, care, and work decisions. For example, the marginal valuation of wealth should be realistic so that the child attaches a credible value to bequests; similarly important is that opportunity cost of caregiving is reasonable. Since children are in their prime savings years when their main interactions with parents occur (caregiving, bequests), they are likely to hold liquid wealth at the margin. Thus, the assumption of liquid wealth seems defensible.

state j.[36] Once a household reaches age 65, it stays with the productivity state it has at that point in time and receives a pension flow that is a function of this state. This pension is given by the function $y_{ss}(\epsilon^p)$, where ss stands for Social Security. Before age j_{ret}, income is a function of productivity and age: $y(j^k, \epsilon^k)$. When a child enters retirement, it becomes a parent and is matched to a child household that is assumed to start life with the same productivity state that the parent has.

All agents are healthy ($s = 0$) before retirement age. From age 65 on, the parent faces a Poisson process for the health state s with an age-dependent hazard matrix $\delta_s(j^p, \epsilon^p)$. We allow hazards to depend on ϵ^j to capture the substantial variation in disability and mortality hazards across socioeconomic strata. Once the parent dies, the parent's net worth, $a^p + h$, including both financial and housing assets, is transferred to the child. There is no estate tax.[37] Out-of-pocket medical expenditures are known to be a severe financial risk that drives the savings decisions of the elderly in the U.S. We thus include this feature in our model. In retirement, the parent can suffer a *medical event* with hazard $\delta_m(j^p, \epsilon^p, s)$. Upon such an event, the parent draws a lump-sum cost M from a cdf $F_M(M)$.

Consumption, savings, and gift-giving. Households face a standard consumption-savings trade-off at each point in time, with the additional possibility of gifts. In each instant, both agents choose a non-negative gift flow, $\{g^i\}_{i\in\{k,p\}}$, to the other agent. They also decide on a consumption flow, $\{c^i\}_{i\in\{k,p\}} \geq 0$. Savings are then residually determined from the budget constraint; see also the paragraph *Timing protocol* below.

Housing. Children are always renters. Once the child enters retirement and becomes a parent, it can buy a house. As the child is subject to a no-borrowing constraint, the feasible set of houses for a child with assets a^k is $\{h : h \leq a^k \text{ and } h \geq h_{min}\}$. At each moment in time, i.e., for all $j \geq j_{ret}$, the parent can then decide to sell the house at the price h. We denote this decision by $x \in \{0, 1\}$, where $x = 1$ stands for selling. Houses cannot be bought after age j_{ret}, only sold. Renters can freely choose the size of their apartment at each point in time. As is common in the macroeconomic literature on housing, we assume that homeowners derive an extra utility benefit from owning.[38] Formally, we assume that housing services, $\tilde{h} \in \tilde{H}(h)$, consumed by a household

[36] We define the diagonal elements of all hazard matrices δ as $\delta_{ii} = -\sum_{j\neq i} \delta_{ij}$ so that all rows of δ sum up to zero.

[37] This is realistic for our purposes since only the richest 0.2% of households pay estate taxes under current U.S. rules. See, Joint Committee on Taxation (2015).

[38] For clarity, we will usually refer to this model feature as a utility benefit. In reality, such a benefit might exist for other reasons, e.g., because owners can implement specific features when building a house or because they can make changes to their dwelling that renters are not allowed to make. Another interpretation in the literature is that the owning benefit is a stand-in for a premium that renters have to pay to compensate landlords for moral hazard that arises because renters may not maintain their dwellings as well as owners do.

with housing state h are chosen from the set

$$\tilde{H}(h) = \begin{cases} [0, \infty) & \text{if } h = 0 \text{ (renter)}, \\ \{\omega h\} & \text{if } h > 0 \text{ (owner)}, \end{cases}$$

where $\omega \geq 1$ is a parameter that governs the utility premium on owning. Flow expenditures for housing are given by the function

$$E_h(h, \tilde{h}) = \begin{cases} (r + \delta)\tilde{h} & \text{if } h = 0 \text{ (renter)}, \\ \delta h & \text{otherwise (owner)}, \end{cases}$$

where $\delta > 0$ is the depreciation rate of housing and r is the interest rate. Renters have to pay the rental rate that would obtain in a perfectly competitive rental market, $r + \delta$, for the housing services $\tilde{h}$ they buy on the rental market. Owners only have to pay for repairs to their house that keep depreciation at bay.

Long-term care. In health states $s = 1, 2$, the parent has a need for care that must be covered. There is no (utility) preference for different care forms; thus, only monetary costs and benefits matter for the family's care decision. The following care arrangements are available:

1. *Informal care* (IC): The child cares for the parent. We assume that the child incurs a loss of a fraction $\beta \in (0, 1]$ of her flow income, y^k, capturing the opportunity cost of care. This care form is available in health state $s = 1$ (basic care) but not in $s = 2$ (skilled care).

2. *Formal care* (FC): All of the following formal-care options are available in both states $s \in \{1, 2\}$:

   (a) Means-tested *Medicaid* (MA): This option is available to the parent with zero wealth ($a_t^p = 0$) and insufficient income to cover the cost of formal care; the house is excluded from the MA means test.[39] If the parent chooses MA, the government obtains the parent's endowment and provides care and a consumption floor C_{ma}.

   (b) Privately-paid care (PP): Depending on whether the parent owns or rents, privately-paid formal care takes one of the following forms:

      i. *nursing home care* (NH): Renting parents are assumed to receive nursing home care. The parent has to pay the price of basic care services, p_{bc}. In addition, the

[39] As is the case in the U.S., individuals can remain owners of their home when in MA care. While U.S. states are required to recover the cost of Medicaid benefits from the estates of Medicaid beneficiaries, this consideration does not arise in our setting since in the equilibrium practically all agents take up Medicaid only *after* having sold their home and spent down all of their resources.

parent decides on other consumption expenditures, c^p, and housing services, $\tilde{h}$, which capture room and board and the amenities of the facility.

ii. *formal home care* (FHC): Owning parents receive formal home care. The parent has to pay p_{fhc} for formal home care services, which provides the equivalent basic care services as NH.[40]

Preferences and household size. *Flow felicity* of household $i \in \{k, p\}$ with consumption c^i and housing services $\tilde{h}^i$ is given by:

$$u(c^i, \tilde{h}^i; n^i) = \frac{n^i}{1-\gamma}\Big(\tfrac{1}{\phi(n^i)} \underbrace{(c^i)^{\xi}(\tilde{h}^i)^{1-\xi}}_{c\text{-}h\text{-aggregate}}\Big)^{1-\gamma}. \tag{1}$$

Here, $\xi \in (0,1)$ is the consumption share in the Cobb-Douglas aggregator over housing and other consumption. $\gamma > 0$ is a parameter that governs how strongly households want to smooth the consumption aggregate over time and across states of the world. n^i is the number of household members, and $\phi(n)$ is a household equivalent scale that satisfies $\phi(1) = 1$ and $\phi'(n) \in [0,1]$ for all $n \geq 1$.

Flow utility of household $i \in \{k, p\}$ in an instant is given by $U^i = u^i + \alpha^i u^{-i}$, where $-i$ denotes the other household in the family and where $\alpha^i > 0$ is agent i's altruism parameter. Both households discount expected utility at the rate $\rho > 0$. Once dead, the parent values the child's felicity at α^p, the grandchild's felicity at $(\alpha^p)^2$, and so forth; this gives rise to a recursive representation for value functions as is standard in the altruism literature.

Bargaining options. In each instant, the parent and child bargain over two choices jointly: informal-care-provision and house-selling decisions. Formally, we assume that a state z is associated with the following set of bargaining options (which we will also refer to as *inside options*)

[40] In reality, hiring an FHC aide is also possible for renters (FHC+rent). In fact, we find that FHC cases in our data are about half renters and half owners. The reason we restrict FHC to owners only is that the calibrated cost of FHC is higher than the cost of care in NH ($p_{fhc} > p_{nh}$), so individuals in our model would always choose NH over FHC+rent. In order to have a meaningful distinction between FHC+rent and NH in our model, we would need to introduce a utility benefit of staying at home in addition to the existing utility benefit of owning. Moreover, we would need heterogeneity in these costs and benefits of FHC+rent in order to generate NH and FHC+rent outcomes consistent with the data. Given these additional complications, we deem it defensible that we interpret FC+rent as NH.

that the two agents can implement instead of the outside option:

$$\mathcal{I}(z) = \begin{cases} \{\} & \text{if } s \in \{0,2\} \text{ and } h = 0, \\ \{\text{keep}\} & \text{if } s \in \{0,2\} \text{ and } h > 0, \\ \{\text{IC}\} & \text{if } s = 1 \text{ and } h = 0, \\ \{\text{keep+IC}, \text{sell+IC}, \text{keep+FHC}\} & \text{if } s = 1 \text{ and } h > 0. \end{cases}$$

In words this says that (i) for healthy renters and for renters who need skilled care, there is nothing to bargain on; (ii) healthy homeowners and homeowners in need of skilled care only bargain on the house-selling decision; (iii) disabled renters who require only basic care bargain only on informal care provision; and (iv) disabled homeowners in need of only basic care bargain jointly on informal care and house-selling.

When agreeing on an inside option $i \in \mathcal{I}(z)$, agents can make a side payment, Q, in the form of a monetary flow. We refer to these payments as *exchange-motivated transfers*. Here, Q denotes the net flow from parent to child. There is also the *outside option* (abbreviated as *out*). Under this option, the parent decides unilaterally on the source of formal care (when disabled) and whether or not to sell the house (if an owner); bargaining transfers are zero ($Q = 0$) under the outside option. We denote the set of all options by $\mathcal{B}(z) \equiv \{\mathcal{I}(z), out\}$.

Note that under both the inside and outside options, the state z changes if the house is sold. We define the new state associated with option $b \in \mathcal{B}(z)$ as

$$z'(z, b) = \begin{cases} (a^k, a^p + h, s, \epsilon^k, \epsilon^p, 0) & \text{if house is sold under } b. \\ z & \text{otherwise.} \end{cases}$$

Finally, we assume transfers can only flow one-way in situations in which one party wants to bribe the other into an inside option. Specifically, we impose the following lower and upper bounds for the transfer Q under the inside option $b \in \mathcal{I}(z)$:

$$\bar{Q}_l(z, b) = \begin{cases} 0 & \text{if } b \text{ specifies IC and that the parent rents,} \\ -\infty & \text{otherwise,} \end{cases}$$

$$\bar{Q}_u(z, b) = \begin{cases} 0 & \text{if } b \text{ does not specify IC,} \\ \infty & \text{otherwise.} \end{cases}$$

That is, (i) when IC is given to a renting parent, an exchange-motivated transfer can only flow from parent to child since the child provides a service for the parent; (ii) when the parent does not receive IC, the transfer can only be from child to parent since the parent is doing a favor to the child by refraining from selling; and (iii) when a parent keeps the house and receives IC, we impose no bound on Q since both parties benefit from the arrangement.[41]

Bargaining protocol. To keep the computational burden manageable, we assign bargaining power entirely to one party in each situation. Specifically, the powerful agent makes a take-it-or-leave-it offer to the other agent: the powerful party proposes a combination of an inside option $i \in \mathcal{I}(z)$ and a transfer $Q \in [\bar{Q}_l(z;i), \bar{Q}_u(z;i)]$; the weak party then either accepts or rejects. If the bargain is rejected, (i) disabled parents have to obtain care from formal sources, and (ii) owning parents have the option to sell the house unilaterally after the bargaining stage (see the timing below).

Bargaining power. We assign bargaining power in each situation in the way we feel is most natural. (i) If the parent requires basic care ($s = 1$) and rents, the parent makes a take-it-or-leave-it offer of a transfer that compensates the child for IC. (ii) For the case of home-owning parents that are either healthy or require skilled care, we let the child make a take-it-or-leave-it offer of a transfer to compensate the parent for not selling the house. (iii) Finally, for home-owning parents with basic care needs, we assume that the bargaining power sits with the child if and only if the parent would sell the house under the outside option, which is in line with scenarios (i) and (ii).

While other assignments may be plausible, we find that the particular choice matters little. In Appendix F, we show that the quantitative results are robust to two extreme alternative scenarios: assigning bargaining power (i) always to the child or (ii) always to the parent. Consequently, what matters most for the model's mechanisms and quantitative results is *if* the two parties can find mutually-beneficial arrangements; *how* the surplus from these arrangement is split turns out to be less consequential.

Timing protocol. The sequence of decisions over an infinitesimal amount of time, $[t, t + \mathrm{d}t)$, unfolds over the following five *stages*:

1. *bargaining*: The party with bargaining power makes an offer (i, Q), where $i \in \mathcal{I}(z)$ and $Q \in [\bar{Q}_l(z,i), \bar{Q}_u(z,i)]$.[42] The weak party then either accepts or rejects.

2. *house-selling*: If no bargain was struck (i.e., the weak party rejected in Stage 1), owning parents decide whether to sell their house or not, $x \in \{0, 1\}$.

[41] In our computations, we replace the bounds $-\infty$ and ∞ by multiples of the receiving agents' incomes, $\bar{T}_p(z)$ and $\bar{T}_k(z)$, which can become binding when one agent wants to give large gifts to an agent inside the state space. See Appendix J.1 on optimal gift-giving. When an agent is broke, the agent's flow income automatically imposes an upper bound on transfers.

[42] Note here that by backward induction, the house-selling decision in Stage 2 can be determined independently of the bargaining outcome in Stage 1. Thus, bargaining power can be assigned without problems in families with disabled home-owning parents.

3. *gift-giving*: Parent and child choose gift flows, $g^p, g^k \geq 0$.

4. *Medicaid*: Disabled parents in formal care decide whether to receive MA or not, $m \in \{0, 1\}$. Parents in MA have to hand over all income, financial assets, and any transfers received in Stages 1 or 3 to the government.

5. *consumption*: Parent and child choose consumption flows, $c^p, c^k \geq 0$. Renters choose housing services.

After all decisions are made, utility is collected, interest on savings accrues, and shocks realize.

Production technologies and government. In one of our counterfactuals (*Sweden*), we introduce a government-provided formal-care subsidy, which is financed by an increase to Social Security contributions. To implement this in our model, we specify linear technologies in labor for care services and a government budget constraint; see Appendix C.1.

4.2 Equilibrium definition

We adopt a standard stationary equilibrium definition and restrict attention to Markov-perfect equilibria. Both agents respond optimally to each other in each stage and in each instant of the game. Restricting ourselves to Markovian strategies allows us to use Hamiltonian-Jacobi-Bellman (HJB) equations to characterize the solution to the game. We then use the ergodic measure of families that results from these conditions to calculate aggregate variables.

4.3 Solving for equilibrium

Appendix C derives the HJBs for both players by backward induction over the stages of the instantaneous game. We then derive results that characterize each player's best responses and substantially simplify the solution of the model. This makes solving the model numerically feasible. We solve for the equilibrium value functions by backward iteration on age, j^p, using standard Markov-chain approximation methods.[43] We backward iterate over multiple generations until the value functions of children at j_{ret} converge. Appendix J contains the details.

[43]The Markov-chain approximation method we use is equivalent to a classical finite-difference method of the explicit type. For a friendly user guide, see https://qeconomics.org/ojs/index.php/qe/article/view/163 and click on View (Supplement).

5 Calibration

We calibrate our model to the US economy in the year 2010. Table 3 gives an overview of parameters and calibration targets, which we now briefly discuss. In general, we aim to tie our hands by fixing most parameters either by directly estimating them from the data or by taking them from other studies, leaving the model with few (five) degrees of freedom. We pin these down by matching five moments that are related (close to) one-to-one with the remaining parameters.

Demography. We set the length of a life phase to $j_{ret} = 30$ years. The start of an agent's life corresponds to age 35 in the data, and retirement to age 65. Parents may attain a maximum age of 95. Household size, $n^i = n(j^i, s)$, is a deterministic function of age and the disability state. We assume that each child household is composed of two members. For retired households, we follow Barczyk & Kredler (2018) and let n^i decline smoothly from 2 to 1 while the parent is healthy ($s = 0$). The smooth decline of n^i is chosen to match the observed survival of males in the HRS and helps us obtain realistic consumption profiles over the life cycle. Once the disability shock hits, i.e., once $s \in \{1, 2\}$, we assume that household size is $n^i = 1$ (widowhood).

Housing. The housing grid is non-linear, with smallest house size equal to \$50K and largest house size equal to \$2 million: $h \in \{50, 93, 170, 316, 585, 1{,}080, 2{,}000\}$, expressed in thousands of dollars.[44] Following Nakajima & Telyukova (2018), we set housing depreciation to $\delta = 1.7\%$ and the consumption share in utility to $\xi = 0.81$. We use a standard value, $r = 2\%$, for the interest rate.

Health and mortality shocks. We follow Barczyk & Kredler (2018) in order to estimate LTC and mortality risks and the process for out-of-pocket non-LTC medical expenditures. We update the data to account for the fact that our economy is calibrated to the year 2010 (and not to 2000). A brief description is as follows. Disability and mortality hazards are estimated in logistic regressions using HRS data; we define disability as requiring 90 or more hours of care per month. We pool states $s \in \{1, 2\}$ (basic and skilled care) to one disability state for this estimation. We then assume that individuals, upon entering disability, make a one-time draw from a binary random variable that determines if they are type 1 or 2 and calibrate the probability χ for skilled care to match the prevalence of IC; see below. The out-of-pocket medical-expenditure distribution is assumed to be log-normal; we estimate it using both core and exit interviews from the HRS.

Labor efficiency units. We adopt a 4-state Markov process for labor productivity. Our parameterization follows the spirit of Kindermann and Krueger (2014). In line with the recent literature,

[44] We experimented with various housing grids, including finer ones and grids with larger minimal and maximal housing sizes. We found that the results along a variety of dimensions do not change much. The maximal house is not chosen in equilibrium.

our earnings process features a highest ("star") state with special characteristics: agents in this state earn a very high income, but there is a high probability of exiting this state and returning to a low level of productivity. This induces a large precautionary savings incentive, which in turn generates a more pronounced upper tail of the wealth distribution at the start of retirement. We pin down the hazards in the transition matrix by targeting household disposable income statistics and the Gini coefficient provided by the OECD. Specifically, we aim for a good fit to the bottom and the top quintiles. A deterministic age profile of efficiency units is obtained by estimating a Mincer regression with a quadratic polynomial using U.S. Census data for the year 2010. Section D in the appendix provides the details, including the fit of the household earnings process.

Table 3: Calibration

γ	α^k	ξ	δ	r	ρ^ϵ	β	ψ	p_{fhc}	p_{bc}	MA	A_f
2	0.018	0.81	1.7%	2%	0.97	2/3	54.8%	\$38.4	\$35.3	\$64.4	$(35.3)^{-1}$

Parameters calibrated outside of model. Dollar figures in \$000's of 2010 dollars.

Age-earnings profile	LTC hazard	Mortality hazard	Medical costs
US Census: 2010	HRS: 2000-2010	HRS: 2000-2010	HRS: 2006-2010

Own estimates from HRS and US Census data.

Calibration target	Data	Model
Median household wealth (ages 65-69)	\$206.0	\$206.0
Homeownership rate (ages 65+)	75.2%	75.7%
Informal care	48.7%	48.8%
Medicaid uptake rate	27.5%	27.7%
Mean (annual) gift: (healthy)-parent-to-child	\$3.36K	\$3.36K
Parameter	**Description**	**Value**
ρ	Discount rate	0.0418
ω	Extra utility homeownership	1.535
χ	Skilled care fraction	26.0%
C_{ma}	Medicaid consumption floor	\$5.65
α^p	Parent altruism	0.4585

Model-calibrated parameters. Data source: HRS core interview sample, waves 1998-2010. Sample includes households with children whose eldest member is age 65 or older. Dollar figures in \$000's of 2010 dollars. Homeownership rate is the average homeownership rate among those aged 65 and above. Medicaid uptake rate is fraction among single, disabled elderly ages 65+ who obtain Medicaid-financed care at home or in a nursing home. Mean gift parent-to-child is average annual financial transfer from healthy parent(s) aged 65+ to all children (including zeros).

Care technologies. With respect to the production sector, we follow Barczyk & Kredler (2018). We normalize productivity in the consumption-goods sector to $A_y = 1$ and set $\beta = 2/3$, meaning that a child household loses one-third of its labor income when providing informal care. The Medicaid consumption floor, C_{ma}, is calibrated to match the fraction of disabled individuals that rely on Medicaid financing.

To pin down productivity in the nursing home sector, we estimate that the annual (average) Medicaid reimbursement rate in 2010 was $MA = \$64{,}400$, based on Stewart et al. (2009). Recall that we defined the price of basic care services, p_{bc}, as the cost of care that is absolutely essential, excluding room and board and other amenities. Thus, p_{bc} can plausibly considered to be an expenditure shock as opposed to a consumption choice. Based on several balance sheets of nursing homes across the U.S., we find that $\psi = 54.8\%$ of nursing homes' total costs are care-related.[45] Under the assumption that Medicaid provides for the bare minimum of care services, we back out that $p_{bc} = \psi MA = 35{,}300$, from which we then recover $A_f = [p_{bc}]^{-1}$.

In contrast to Barczyk & Kredler (2018), our model also includes formal home care and a skilled-care state in which informal care is not feasible. In order to obtain an estimate of the annual cost of formal home care, we ask how much it would cost for a single, disabled person to receive exclusively formal home care. In our sample, a single, disabled individual living in the community receives a median of 210 hours of care monthly. To obtain our estimate for p_{fhc} we multiply this number by \$15, the average hourly private-pay rate of a home caregiver in 2010 as reported by the Bureau of Labor Statistics and MetLife (2012), and then multiply by 12 months. To calibrate the fraction of individuals who require skilled care, χ, we target the informal care fraction in the data. Obtaining a direct estimate from the data is challenging since IC is observed across all levels of disability. Reassuringly, we find that the calibrated fraction closely aligns with the fraction of severely disabled individuals whose children live far away.

Preferences. We set the coefficient of relative risk aversion to $\gamma = 2$, a standard value in the macroeconomics literature. In our calibration, it turns out that child altruism is very hard to identify. Our model tells us that most child-to-parent (monetary) transfers are motivated by exchange. These transfers are not responsive to child altruism, α^k, at low values of this parameter. Due to this identification problem, we calibrate child altruism based on another paper (Barczyk & Kredler, 2018).[46] The rate of time preference, ρ, is obtained by matching median household wealth at ages 65-69, thus ensuring that wealth levels at the beginning of retirement is reasonable. We obtain the extra utility from ownership, ω, by matching the average cross-sectional homeownership rate for ages 65 and above. Parent altruism, α^p, is calibrated to match the mean annual transfer from non-disabled parents to children; we restrict to healthy parents here in order to exclude exchange-

[45] We categorize the cost components of nursing home balance sheets into three categories—clearly-care-related, clearly unrelated to care, and unclear—and use the first and second categories to obtain an estimate of the fraction of costs that is care related. We then assume that the unclear category follows the same split.

[46] Since the curvature of utility is different in that paper, we do so by equalizing the altruism measure $a^k \equiv (\alpha^k)^{1/\gamma}$ across the two models. a^k can be interpreted as the ratio of parent to child consumption that the child would choose if in charge of family finances. The use of a^k was advocated in a previous paper (Barczyk & Kredler, 2014) as a means for comparing altruism across different CRRA utility specifications.

motivated transfers.[47]

6 Model validation

We now show that the model is successful in replicating many of the empirical features from Section 2 and that the observable implications of HACC are consistent with the data. Model-based statistics are calculated by drawing a large artificial panel of households in line with the construction of the HRS. We largely defer discussions about mechanisms in the model to Section 7.

6.1 Savings behavior and homeownership

We begin with the wealth distribution of households in early retirement (ages 65-69), shown in Table 4. A good model fit is desirable for these ages as it ensures plausible initial conditions for the elderly, who are our main focus, and validates the adequacy of our assumption that homeownership can only be acquired at age 65. We see that the model closely matches overall net worth as well as its housing and non-housing components. In both data and model, non-housing wealth (which is only financial wealth in the model) is small up to the median and then increases substantially; in contrast, median housing wealth is relatively sizable and the housing-wealth distribution is much less skewed. The good fit in the lower quantiles is possible due to the inclusion of a consumption floor and family insurance whereas the good fit in the upper quantiles is achieved by the extra "star" state in the income process

Table 5 shows separate wealth distributions for renters and owners at the start of retirement. In both data and model, owners are substantially wealthier than renters. The median owner has wealth in excess of one-quarter of a million dollars whereas a median renter's net worth is around zero. In both data and model, renters have practically no net worth up to the 75th percentile, which subsequently increases somewhat. For owners, the model captures the wealth distribution especially well from the median upward but generates somewhat higher levels of wealth than seen in the data for the lower percentiles.

To evaluate savings behavior over time, we construct wealth trajectories for households at the last four core interviews and the exit interview, a period that roughly corresponds to the final 7.5 years of life. Figure 7 depicts how selected percentiles of the net worth distribution evolve in comparison to the data. The model fits the data very well in two key respects. First, and most critically, the model replicates the relatively slow rates of dis-saving found in the data, as can be seen in the modest negative slopes of the lines. Second, in terms of levels, the model

[47] Average transfers include zeros to take into account both the intensive and extensive margins of gift-giving.

Table 4: Net worth distribution at the start of retirement

(a) Data	p10	p25	p50	p75	p90	p95
Housing	0	46	134	261	501	727
Non-housing	-40	0	43	274	808	1,355
Net worth	2	54	206	553	1,229	1,966

(b) Model	p10	p25	p50	p75	p90	p95
Housing	0	89	156	262	416	687
Non-housing	0	0	59	274	676	1,313
Net worth	0	96	206	535	1,094	2,004

(c) % of wealth in housing	p10	p25	p50	p75	p90	p95
Data	21	38	65	99	100	100
Model	37	46	62	100	100	100

Data: Health and Retirement Study. Core interviews 1998-2010. Model: Artificial panel. Panel (a): Parent households whose eldest member is ages 65-69. Panel (c): Home-owning parent households whose eldest member is ages 65-69. The % of wealth in housing is the ratio of housing wealth to net worth; panel shows quantiles of this %. Housing wealth is defined as the combined value of the primary and secondary residences, not net of mortgages. While this ratio can exceed 100% in the data in cases where households have negative non-housing assets, we top-code the ratio at 100% for comparison to the model, where borrowing is not possible. Households with net worth less than or equal to zero (about 1% of owning households) are assigned ratios of 100%. Amounts in Panels (a) and (b) are 1000s of year-2010 dollars.

Table 5: Net worth distributions by homeownership at the start of retirement

(a) Data	p10	p25	p50	p75	p90	p95
Owners	47	113	291	684	1,394	2,183
Renters	-1	0	3	25	156	314

(b) Model	p10	p25	p50	p75	p90	p95
Owners	98	141	308	612	1,392	2,188
Renters	0	0	0	24	49	106

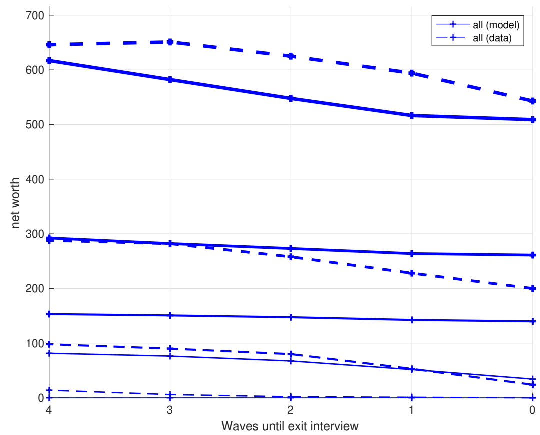
Panel (a): HRS core interviews 1998-2010. Parent households whose eldest member is ages 65-69. Panel (b) Artificial panel generated from the model. Amounts are 1000s of year-2010 dollars.

successfully captures the upper part of the wealth distribution, though, for the lower part of the wealth distribution, wealth levels are too high relative to the data.

Figure 8 shows how selected percentiles of the net worth distribution evolve over time conditional on homeownership at the final core interview (approximately 1.5 years before death). The model is particularly successful in capturing these empirical patterns. In both the data and the model, we see that owners are, again, considerably wealthier and that there are pronounced differences in dis-saving rates between the groups. Owners dis-save slowly and have essentially flat wealth trajectories whereas renters reduce their net worth more substantially.

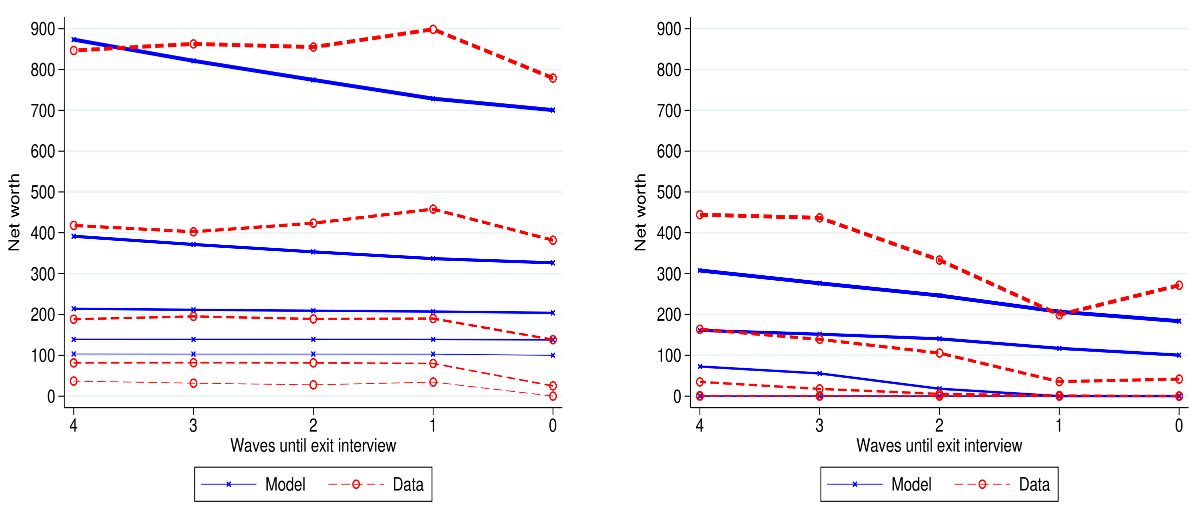
In terms of homeownership rates, presented in the left panel of Figure 9, we see that the model

Figure 7: Net-worth trajectories: All



Lines correspond to the 10th, 25th, 50th, 75th, and 90th percentiles of the net worth distributions in the model (solid lines) and the data (dashed lines). Net worth is measured in 1000s of year-2010 dollars. Model: Artificial panel. Data: HRS core interviews 1998-2010 and exit interviews 2004-2012. Balanced panel of single decedents with four or more core interviews and an exit interview in our sample period. Horizontal axis: Counts interviews from the fourth core interview prior to death ("4") until the exit interview ("0"). Confidence intervals for the wealth trajectories from the data are provided in Figure K.1 of the appendix.

Figure 8: Net-worth trajectories: Own vs. Rent

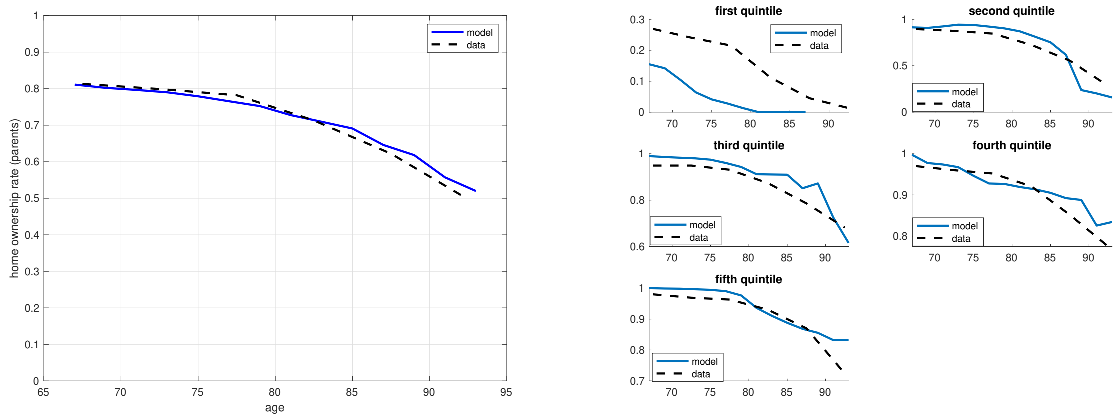


(a) Owners

(b) Renters

Lines correspond to the 10th, 25th, 50th, 75th, and 90th percentiles of net worth recorded at 4, 3, 2, and 1 interview-waves prior to the exit interview and at the exit interview ("0"). Owners (a) and renters (b) are classified based on their homeownership status at their last core interview ("1"). Data: HRS core interviews 1998-2010 and exit interviews 2004-2012. Balanced panel of single decedents with four or more core interviews and an exit interview in our sample period. Model: Artificial panel generated from the model. None of the statistics targeted in calibration. Confidence intervals for the data are provided in Figure K.1 in the appendix.

Figure 9: Homeownership in retirement



Cross-sectional homeownership rate by age. 5-year age bins: $[65-70)$, $[70-75)$, etc. Left panel: overall. Right panel: by wealth quintile. Data: HRS core interviews 1998-2010. Parent households whose eldest member is age 65 or older. "Age" is age of eldest household person. Only the average homeownership rate above 65 is targeted in calibration.

replicates the pattern in the data almost exactly. Furthermore, when we stratify each age group by wealth quintiles (right panel), we find that the model tracks within-quintile ownership rates very well, though it understates ownership rates for the lowest wealth quintile.

6.2 Long-term care

Table 6 shows that the model obtains a very good fit in replicating the fractions of care arrangements in the data. We refer the reader to Barczyk and Kredler (2018) for a more detailed discussion of the model fit in various care-related dimensions. Note, however, that in contrast with that paper, we do not subsume FHC into NH but instead model FHC as a separate care option. The good fit for FHC is obtained here, in part, due to the skilled-care state; in this state, no IC can be provided, and children instead opt to subsidize FHC expenditures to protect the house from being liquidated.

The model also does a very good job of capturing care arrangements by homeownership: Among individuals who require LTC, 67% are renters (data: 64%) and 33% are homeowners (data: 36%). Furthermore, among disabled renters, 38% receive IC (data: 42%), and among owners, 70% receive IC (data: 62%).

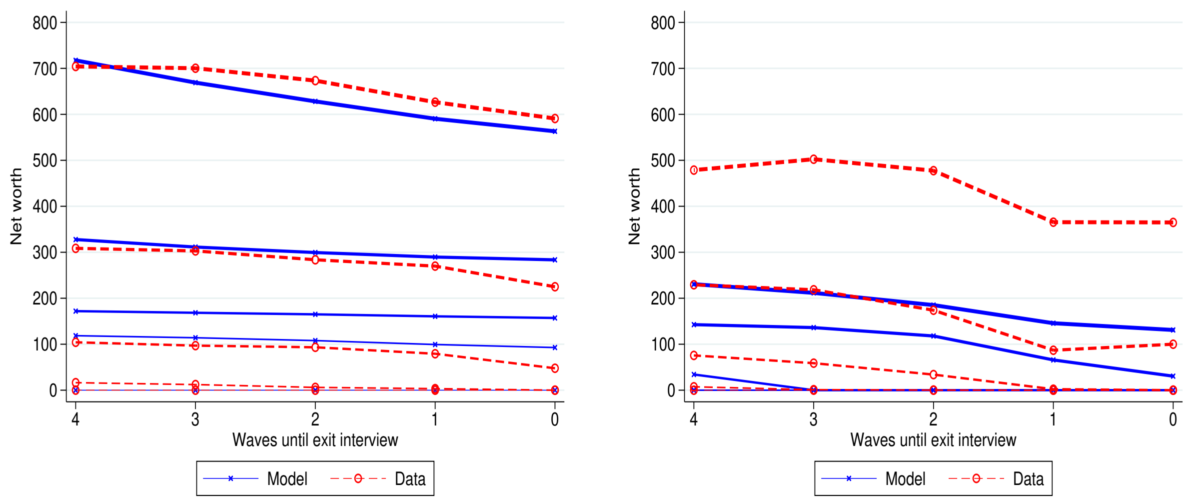
Figure 10 shows wealth trajectories conditional on residing in a nursing home at the time of the final core interview. Consistent with the data, community residents (CR) are substantially wealthier than those who reside in a nursing home (NHR). In the data, the 90th percentile of NHR is wealthier than in the model, presumably because there is more heterogeneity in nursing homes in reality than in the model. The other percentiles of NHR, however, are very much in line with one another.

Table 6: LTC arrangements (in %)

Source	IC	FHC	NH	MA
Data	48.7	8.4	15.5	27.5
Model	48.8	9.6	13.9	27.7

IC: informal care, FHC: formal care at home, NH: privately-paid nursing home, MA: Medicaid-financed formal care. Data: HRS core interviews waves 1998-2010. Disabled, single respondents ages 65+. Disabled is defined as receiving 21+ hours of LTC per week. The IC rate is calculated directly from data. IC is defined as receiving more than 50% of care hours from informal sources and receiving no nursing home care. We obtain the other rates as follows. In our sample, 15.0% obtain mostly formal care at home ($\leq$50% IC and no nursing home care), and 39.9% reside in a nursing home. Barczyk & Kredler (2018) report that 47.9% of disabled FHC individuals are MA-financed. Among nursing home residents, Barczyk & Kredler (2018) report that 56.1% are fully or mostly covered by MA. We thus compute the FHC rate as $0.15 \times (1 - 0.479)$, the NH rate as $0.399 \times (1 - 0.561)$, and the MA rate as $0.15 \times 0.479 + 0.399 \times 0.561$.

Figure 10: Net-worth trajectories: Community vs. nursing home



(a) Community residents

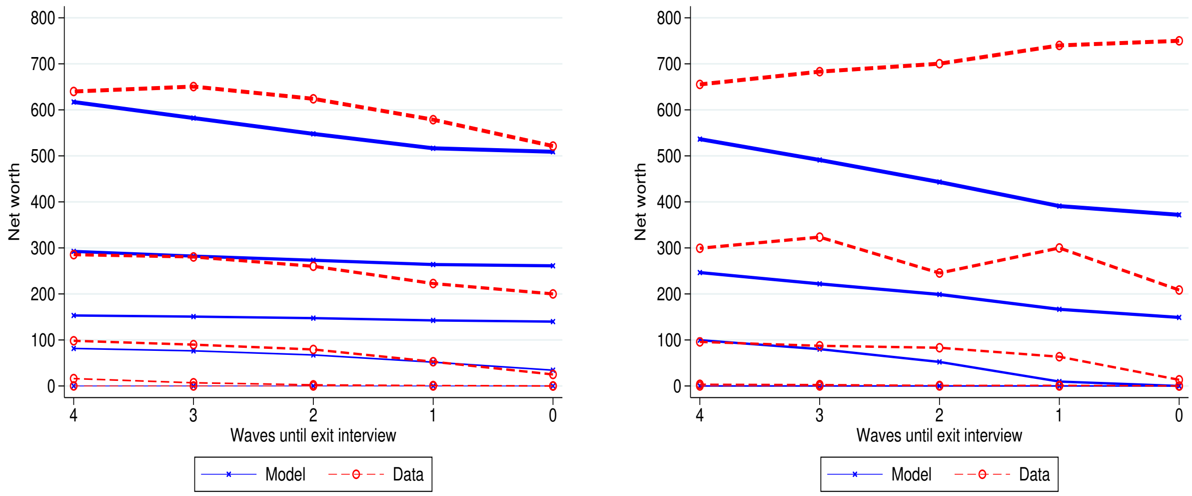
(b) Nursing home residents

Lines correspond to the 10th, 25th, 50th, 75th, and 90th percentiles of net worth recorded at 4, 3, 2, and 1 interview-waves prior to the exit interview and at the exit interview ("0"). Community residents (a) and nursing home residents (b) are classified based on their residence status at their last core interview ("1"). Data: HRS core interviews 1998-2010 and exit interviews 2004-2012. Balanced panel of single decedents with four or more core interviews and an exit interview in our sample period. Model: Artificial panel generated from the model. None of the statistics targeted in calibration. Confidence intervals for the data are provided in Figure K.1 in the appendix.

We saw in Figure 3 of Section 2 a strong relationship between the liquidation of housing assets and moves into nursing homes in the data. This is also the case in the model. In our model, the liquidation probabilities among those who eventually become disabled are 9.8% prior to the onset of LTC, 34.8% at the onset of disability, and 31.7% after the onset of LTC.[48] In contrast, among those who remain healthy throughout, the liquidation probability equals 10.2% (between age 65 and death). In the model, 35.6% of owners at age 65 liquidate at some point. Of all the liquidations,

[48]We calculate the first number as the number of liquidations occurring in spells from retirement up to LTC onset divided by the number of such spells (i.e., the number of owners at 65 who eventually receive LTC). We proceed analogously for the other numbers.

Figure 11: Net-worth trajectories: Parents vs. Childless



(a) Parents

(b) Childless

Lines correspond to the 10th, 25th, 50th, 75th, and 90th percentiles of net worth recorded at 4, 3, 2, and 1 interview-waves prior to the exit interview and at the exit interview ("0"). Data: HRS core interviews 1998-2010 and exit interviews 2004-2012. Balanced panel of single decedents with four or more core interviews and an exit interview in our sample period. Model: Artificial panel generated from the model. None of the statistics targeted in calibration. Confidence intervals for the data are provided in Figure K.1 in the appendix.

only 13.6% are accounted for by those who remain healthy throughout.

6.3 Savings and the family

Figure 11 presents end-of-life wealth trajectories generated by the data and the model conditional on the presence or absence of children.[49] The savings trajectories of the childless economy align well with those in the data for the 75th and the lower percentiles. At the 90th percentile, a discrepancy emerges, the model predicting lower savings and faster dis-saving by the childless than in the data. However, we cannot read much into this feature as the confidence intervals for the 90th percentile of wealth among the childless are exceedingly broad. (See Figure K.1 of the appendix.) Parents in the model are richer than in the data over their final years of life. The main reason for this is that parents in the model hold houses which have a higher valuation than is the case in the data. (See housing bequests in Table 7.) We will discuss the channels behind these results in detail in Section 7.3.

Table 7 contrasts the bequest distribution generated by the model—no feature of which enters the model calibration—with its empirical counterpart. The model does especially well for the

[49]To obtain the trajectories for childless individuals in the model, we solve our model for a cohort of households that has no children but is otherwise as in the baseline economy. Specifically, we assume that childless agents have no access to informal care and are not altruistic towards any other agent in the economy, thus bequests are "wasted."

Table 7: Bequest distribution

Source	non-negligible	p25	p50	p75	p90	p95
Data	51%	0	22	198	521	806
Model	75%	30	139	259	495	817

Percentiles of the bequest distributions. Data: HRS exit interviews 2004-2012 for a sample of single decedents. We use respondent-level weights from the last core interview to compute the statistics. "non=-negligible" means $> 15K$. None of the numbers targeted by calibration.

higher percentiles, but generates bequests that are too large at the lower percentiles.

Table 8: Bequest distribution by asset class

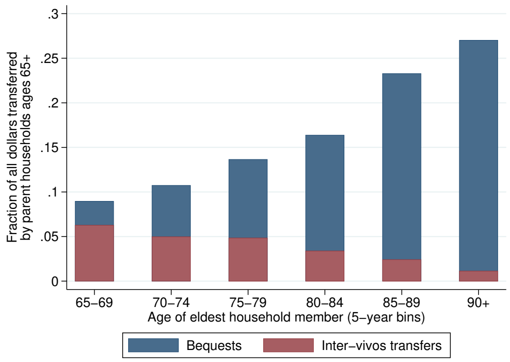
Data	non-negligible	p25	p50	p75	p90	p95
Housing	45%	0	0	104	230	365
Non-Housing	41%	0	5	87	352	643
Of which:						
Liquid non-housing	37%	0	2	58	239	493
Illiquid non-housing	14%	0	0	5	24	141
Illiquid	48%	0	9	136	300	521
Liquid	37%	0	2	58	239	493
Model						
Housing	53%	0	88	222	338	601
Financial	35%	0	0	82	203	352

Percentiles of the bequest distributions. Data: HRS core interviews 1998-2010. Wealth measures are taken from the final core interviews of a sample of single decedents with children. Housing wealth is defined as the combined value of the primary and secondary residences, not net of mortgages. Non-housing wealth is defined as net worth excluding housing wealth. Illiquid wealth consists of housing wealth plus vehicles, businesses, and the net value of other real estate. The remaining components of net worth are considered liquid. "non-negligible" means $> 15K$. None of the numbers targeted by calibration.

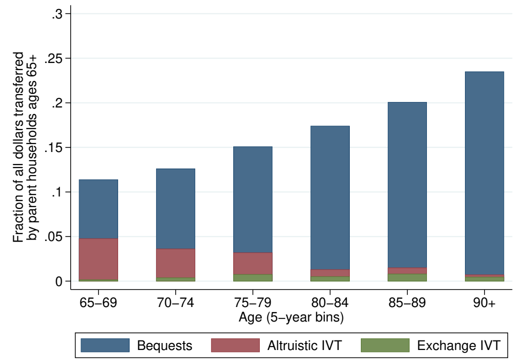
Table 8 separates total bequests into a housing and a non-housing category. We further break the non-housing category into liquid and illiquid (transportation, businesses, and real estate other than own residences) components. Through the lens of the model, these illiquid non-housing assets, which are relevant only in the right tail of the wealth distribution, can plausibly be interpreted as belonging to the housing asset and to contribute to HACC since they are illiquid and easily observable. We thus present a second split of total net worth into "illiquid" and "liquid" that counts such assets as illiquid.

The model does a good job in capturing the extensive margin of leaving a housing bequest, but it overstates the value of these bequests. In terms of non-housing bequests, the model is successful in replicating the low bequest numbers but fails to generate the upper tail. When separating out illiquid assets from non-housing wealth, we see that the model predictions move much closer.

Figure 12: Timing of inter-generational transfers



(a) Data



(b) Model

Data: HRS core interviews 1998-2010 and exit interviews 2004-2012. Households with a member age 65 or older whose wealth (core interviews) or estate value (exit interviews) is below the 95th percentile of wealth in the core interview data. Core interviews: inter-vivos transfers from parents to children. Exit interviews: bequests left by single decedents with children. Statistics are computed with respondent-level sample weights. Because the sample includes more core interview waves than exit interview waves (seven versus five), we scale up the exit interview weights to compensate. (See the discussion in Appendix G.) In households with multiple members, a single member is selected. Model: Artificial panel generated by the model. The height of each bar is the fraction all dollars transferred by households ages 65+ that are given by households in the age category represented by the bar. The segments of each bar break these fractions into their two constituent parts: bequests and inter-vivos transfers.

Finally, we turn to the timing of transfers. Figure 12 shows that the model is very successful in reproducing the fact that most transfers are delayed and given as bequests. The figure also shows a decomposition of transfers into altruistic and exchange-motivated components, which we can perform in the model but not in the data. We see that transfers are almost exclusively of an altruistic nature at first, but as disability becomes more prevalent, exchange-motivated transfers start to dominate from age 80 onward. In addition, we find that the model successfully matches the average age at which a typical transfer dollar is given: For IVTs (bequests), the average parent age is 75.6 (85.4) in the data compared with 75.0 (83.6) in the model.

6.4 Empirical evidence for HACC

We conclude the model validation by assessing three testable predictions of HACC. All else equal, owners should (i) dis-save more slowly and (ii) receive more informal care and for longer durations than renters, and (iii) parents who receive informal care should leave larger bequests, particularly housing assets. Because HACC is likely to be most salient at the end of the household lifecycle when the need for LTC is most acute, we verify these patterns in our sample of single decedents. To match the setting in the model, we restrict our attention to individuals with children and consider only the interviews at which they are single.

(i) Owners dis-save more slowly. We have already seen in Figure 1 visual evidence of slower rates of dis-saving by homeowners in the data. We show in Table K.4 of the appendix that these patterns persist after accounting for many observable differences between owners and renters. The table reports results from median regressions of annualized changes in wealth between interviews on lagged homeownership and a large set of observables. Even after conditioning on prior wealth, many demographic characteristics, multiple metrics of health, and long-term care utilization, we find homeownership to be associated with significantly slower rates of dis-saving.

(ii) Owners receive more informal care from their children and for longer. We reported in Section 6.2 that disabled homeowners are more likely to receive IC than renters in both the model (62% versus 42%) and the data (70% versus 38%). To better assess the role of housing in accounting for these differences, Table 9 re-examines the comparison in the data using linear probability models that are conditioned on an extensive set of controls (not reported), including measures of functional limitations and memory disease, age, sex, race and ethnicity, education, religion, Census division, and interview wave. The dependent variable is an indicator for receiving informal care from children, and the key explanatory variables are measures of net worth and homeownership from the previous interview.[50]

Consistent with HACC, prior homeownership predicts receipt of informal care across the specifications. Moreover, the association is economically significant: In the main specification (second column), the likelihood of informal care is 12 percentage points greater among owners than renters, a 30% increase relative to the mean. This pattern is also evident for a sub-group of individuals newly entering care arrangements (middle two columns) and for individuals previously receiving informal care from their children (rightmost two columns), the latter indicating more prolonged informal care arrangements among homeowners. Although net worth positively predicts informal care when housing is ignored, the results suggest that it is housing wealth rather than overall net worth that matters for receiving informal care from children.

These correlations are robust to conditioning on many observable characteristics that vary systematically with homeownership and could confound this relationship: that homeowners are wealthier, healthier, from different demographic groups, and live in different areas. We are, of course, unable to rule out unobservable confounds—for instance, that in more close-knit families, children provide more informal care, and parents save more for bequests—though we note that any such explanation would need to articulate why this confounding influence operates exclusively through housing wealth rather than overall net worth.[51]

[50] HACC predicts that families with access to the housing savings technology will be more likely to negotiate informal care arrangements. In the quantitative model, access to this technology in each period is determined by ownership in the previous period, as home sales are irreversible. To match this timing, we compare the long-term care arrangements of individuals who owned versus rented at the time of the previous interview. The use of lagged values should also mitigate to some degree the simultaneity between homeownership and the choice of care arrangement.

[51] We show in Table K.6 of the appendix that these correlations are also robust to the inclusion of numerous child characteristics. Thus, we are able to rule out that this relationship between ownership and informal care is driven by owners and renters having different quantities or "qualities" of children, mechanisms not well captured by the model.

Table 9: Informal care arrangements and housing

Conditional on:	Dependent variable: Receiving $>50\%$ care hours from children					
			No care at prev. interview		IC at prev. interview	
	(1)	(2)	(3)	(4)	(5)	(6)
Net worth (prev. interview)	0.0066***	0.0010	0.0077***	0.0032	-0.00045	-0.0034
	(0.0014)	(0.0016)	(0.0022)	(0.0027)	(0.0022)	(0.0026)
Own home (prev. interview)		0.12***		0.094***		0.064**
		(0.018)		(0.029)		(0.030)
Observations	6,148	6,130	2,097	2,088	1,817	1,813
R^2	0.16	0.17	0.12	0.13	0.13	0.13
Mean of dep. var.	0.40	0.40	0.49	0.49	0.65	0.65

Coefficient estimates from linear probability models. Standard errors clustered at the household level in parentheses. Asterisks denote statistical significance at the 1% (***), 5% (**), and 10% (*) levels. The dependent variable in all models is an indicator equal to 1 if the individual receives more than 50% of long-term care (LTC) hours from their children and no nursing home care. The sample includes all core and exit interviews for our sample of single decedent parents who are single and receiving some form of LTC at the current interview. An observation is a person-interview. Columns (3)-(4): restricted to individuals who did not receive any LTC at the prior interview. Columns (5)-(6): restricted to individuals who received more than 50% of LTC from their children and no nursing home care at the previous interview. Homeownership and net worth are both measured at the previous interview. Net worth is transformed using the inverse hyperbolic sine transformation to reduce the influence of outliers while accommodating non-positive values. In all specifications, controls (not reported) include: age, sex, race (White, Black, other), Hispanic ethnicity, education (less than high school, high school / GED, some college, or college graduate), number of children, separate sets of indicators for each level of ADL (0-5) and IADL (0-5) limitations and whether ever had memory-related disease, and indicators for religion, Census division, and interview wave. For the complete set of coefficient estimates, see Table K.5 in the appendix.

(iii) Informal care recipients leave larger bequests, particularly housing. To assess the final prediction of the HACC mechanism, we report in Table K.7 of the appendix partial correlations between bequests and the receipt of informal care from children. All correlations are conditioned on a large set of controls (not reported) similar to those described in the previous sections. Holding constant the total amount of long-term care an individual receives in the last six years of life, we find that an increase in the share of that care provided by one's children is positively associated with the probability of leaving any bequest, the log of the estate value, and the likelihood of bequeathing housing assets, in particular. Although not dispositive evidence, these positive associations are consistent with key ingredients of the HACC mechanism: first, that informal care arrangements can be sustained with the promise of future bequests; and second, that informal care can protect this promise by substituting for more costly formal care.[52] While these patterns are also consistent with unobservable confounds, such as the strength of family ties, additional evidence in Table K.10 of the appendix lends further support to our interpretation. There, we show that, when we divide our sample of decedents into those who were homeowners at some point in the sample period and those who were not, the positive correlations between bequests and informal care disappear in the

[52]Reinforcing the idea that substitution between informal and formal care is an important mechanism behind these correlations, we report in Table K.9 of the appendix that, once we condition on a measure of nursing home utilization during the sample period, there ceases to be a statistically significant correlation between informal care and three out of the four measures of bequests.

latter group. While some associations are weaker for owners as well, the link between informal care and housing bequests remains strong.

Taken together, the empirical evidence suggests a special role for housing. If parents could commit to future transfers to their children in exchange for informal care, we would not expect the relationship between informal care and bequests to hold only for owners and not for renters nor would we expect homeownership to be predictive of informal care receipt after conditioning on overall wealth. The fact that we observe these patterns in the data lends further support to our theory of housing as a commitment channel.[53]

7 Counterfactual experiments

We now use the model to quantify the importance of housing and family for the economic behavior of the elderly. We also estimate HACC's contribution to the homeownership rate and measure how valuable this channel is to families. In the process, we explain the mechanisms through which the model rationalizes the empirical regularities laid out in Sections 2 and 6.

7.1 Causal effects of homeownership

We first use the model to quantify the *causal* effects of homeownership on key outcomes. Homeowners differ from renters both due to *selection* into homeownership—owners tend to be healthier and wealthier and to have more productive children—and because owning a home affects agents' economic behavior, ceteris paribus; the latter are the *causal* effects of owning. To capture the causal effects, we create identical copies of homeowners who must (unexpectedly) sell their homes and rent. Differences that emerge between owners and the *owners' clones-forced-to-rent* agents (or simply, *clones*) may be attributed to the causal effects of homeownership.

The first two columns of Table 10 compare expected future outcomes of 65-year-olds who are homeowners (82.9% of model households) and renters (17.1%). The table reveals substantial disparities between these groups, which are due to both selection and causal effects. The third column shows expected outcomes of the owners' clones-forced-to-rent who must sell and become renters at age 65. The fourth column then shows how much of the differences between owners and renters can be accounted for by stripping owners of their homes ("causal effect"). In general, causal effects of ownership are large: Clones dissave faster before LTC entry and leave lower bequests, and they are much more likely to receive NH or MA than IC.

The crucial mechanism behind the higher expected net worth (upon LTC and death) is that homeownership entails lower expenditures. The first column of Table 11 contrasts homeown-

[53] We thank Karen Kopecky for suggesting several of these analyses.

Table 10: Effects of owning at age 65 on expected future outcomes

At age 65: Variable	renters (17.1%)	owners (82.9%)	owners' clones-forced-to-rent (82.9%)	causal effect
net worth at 65	19.4K	359.7K	359.7K	–
exp. disc. net worth upon LTC	0.6K	141.6K	74.6K	47.5%
exp. disc. bequest	1.0K	124.7K	66.4K	47.1%
exp. disc. exchange IVT	0.1K	6.8K	6.0K	11.2%
exp. disc. altruistic IVT	0.0K	22.8K	5.8K	74.5%
life expectancy	18.84y	19.18y	19.18y	–
exp. time h-to-m	17.21y	10.17y	4.08y	–86.5%
prob. ever LTC	52.0%	52.3%	52.3%	–
prob. ever NH	51.2%	15.4%	36.2%	58.1%
prob. ever MA	51.2%	7.2%	27.6%	46.4%
exp. time in IC	0.02y	1.12y	0.67y	40.9%
prob. ever rent	100.0%	35.6%	100.0%	–

Variables are measured at age 65. *renters* and *owners* are categorized based on ownership at age 65. *owners' clones-forced-to-rent* are identical copies of homeowners who are forced to become renters at age 65. Nominal variables are discounted at interest rate r. *h-to-m* stands for hand-to-mouth: these are households for whom consumption equals current income. *causal effect* is the difference between owners and clones as a percentage of the difference between owners and renters. The second row of table head gives the fraction of households belonging to each category. LTC: long-term care. IVT: inter-vivos transfer. IC: informal care. NH: nursing home. MA: Medicaid.

Table 11: Behavioral effects of home-owning

Group	expenditure	IC	exchange IVT	owners hand-to-mouth
healthy	48.0K	–	-0.6K	58.4%
healthy owners' clones	60.9K	–	0.0K	0.0%
disabled	43.4K	70.2%	-3.8K	73.6%
disabled owners' clones	59.4K	68.8%	6.6K	0.0%
receiving IC	31.4K	100.0%	3.4K	77.0%
IC owners' clones	44.0K	98.0%	9.3K	0.0%

Spending behavior in a cross-section of home-owning agents by health status and informal care (IC) receipt. *owners' clones* abbreviates *contemporaneous* owners' clones-forced-to-rent. These are identical copies of homeowners who are stripped of their homes and whose behavior is recorded in the same instant. One such clone is created for each homeowner in the artificial panel at each instant in which they are alive and own a home. *Owners hand-to-mouth*: consumption equals current income. *Expenditure*: spending on consumption + housing (rent for renters, depreciation plus foregone interest for owners) + spending on formal care (NH and FHC). *Exchange IVT*: net transfer Q between parents and children resulting from joint bargaining over home-selling and informal care.

ers' expenditures on housing, consumption, and care with what they would have spent were they stripped of their houses in the same instant ("contemporaneous clones"). Clones' expenditures are substantially higher, especially among disabled owners (by almost one-third). Much of this difference is due to the fact that owners expect to be hand-to-mouth for much longer durations than clones (see the last column of Table 11), a result in line with HACC.[54]

The slower dis-savings rate of owners increases bequests mechanically. This, in turn, incentivizes children to provide IC for longer and for smaller contemporaneous transfers (see the columns "IC" and "exchange IVT"), which further props up bequests since expensive nursing home stays are avoided. Finally, Table 11 shows that the effects of housing on care choices are primarily *dynamic* and not contemporaneous: The last two rows show that almost all owners who receive IC would still receive IC the next day if they were forced to sell the house. However, absent the house, they would spend down their wealth faster (both on higher expenditures and higher IVTs), making future IC receipt less likely.

7.2 Quantifying the housing-as-commitment channel (HACC)

For our remaining quantifications, we make use of variations of our model with the following counterfactual features and their combinations. In the counterfactual *no child*, we solve the model for a cohort of households that has no children.[55] In *no glow*, we shut down the utility benefit from owning, i.e., $\omega = 1$. In the scenario *Sweden*, a government provides a formal care subsidy equal to the cost of basic care, p_{bc}, to anyone who opts for formal care (NH or FHC), financed through a uniform increase in the payroll tax levied on the working-age population.[56] Finally, in *renting only*, we strip out the housing technology and only allow for renting.

Our illustrative model has shown that homeownership demand can arise because it enables a credible commitment to more efficient family savings. We now ask how potent this channel (HACC) is in our quantitative model. As we do so, we intentionally stay as close as possible to the U.S. economy, in which altruism, LTC, and the utility benefit of housing all mediate the strength of HACC.

To answer this question, it is first necessary to understand the reasons for owning houses in the model. These are: (i) housing provides a utility premium, ω, (ii) the housing asset has a higher after-tax return than liquid wealth (this holds even if $\omega = 1$ since housing services are not taxed),

[54]We note that owners here behave in a way that is reminiscent of what Kaplan and Violante (2014) term "wealthy hand-to-mouth" households. These households voluntarily constrain consumption unless they are hit by a sufficiently large income shock, which for our retired parents corresponds to an LTC event.

[55]This is the same environment that we used to generate the savings trajectories of childless households in Figure 11.

[56]For an NH resident, this subsidy covers the full cost of care excluding room and board, which are discretionary. For an FHC recipient, the remaining cost of care after the subsidy is $p_{fhc} - p_{bc} > 0$ since, in our calibration, care provided through FHC is more expensive than in an NH. Under our parameterization, almost no one takes up IC in Sweden.

(iii) the housing asset is riskless,[57] and (iv) HACC. We note that incentives (i)-(iii) are operative for both parents in the baseline economy and the childless in the *no child* scenario. However, only parents are affected by (iv), HACC. To gauge the strength of HACC, we thus compare scenarios with parents to the corresponding *no child* counterfactual.

Extensive margin. To quantify HACC on the extensive margin, we measure its contribution to the **homeownership rate**. When removing children from the baseline economy, the overall homeownership rate decreases from 76 to 50%. Thus, HACC accounts for about one-third of the ownership rate in the baseline economy ($= \frac{75.7-50.4}{75.7} = 33.4\%$). We obtain a very similar number when shutting off the utility benefit of owning: Ownership drops from 46 in the *no glow* scenario to 21% in the *no child+no glow* economy, so again HACC accounts for about one-third of the baseline ownership rate ($= \frac{46.0-20.6}{75.7} = 33.6\%$).[58] Appendix Figure E.1 (left panel) displays the corresponding cross-sectional ownership rates; the legend contains the average ownership rates.

Intensive margin. We measure HACC on the intensive margin by asking how the presence of children impacts a parent's **willingness to pay** for a house. For this purpose, we calculate wealth equivalent variation (WEV), which we define as the amount of wealth by which the *decision unit* needs to be compensated to be indifferent between renting and owning in the moment the owning decision takes place (i.e., at age 65). In the childless economy, the decision unit is simply the elderly household. In the baseline economy, however, both parent and child can benefit from the parent's ability to own housing.[59] For the baseline economy, we thus define *dynasty WEV* as the (minimal) sum of non-negative transfers to parent and child that makes both agents at least indifferent; we refer the reader to Appendix C.4 for a formal definition and discussion of this concept.

The upper part of Table 12 shows the distribution of WEV expressed in thousands of dollars. Considering the mean values, we see that a randomly sampled family in the baseline economy would be willing to pay \$16,000 ($= 57 - 41$) more to access the housing technology than would a typical childless household. When also removing the utility benefit from owning, the difference in the willingness to pay for access to housing is \$12,000. Our preferred intensive margin measure of HACC is WEV as a percentage of the house value, which is shown in the lower part of the table. Here, we find that HACC increases the value of homes by 10% ($= 30\% - 20\%$) on average

[57] By contrast, we assume financial wealth to be subject to (small) Brownian shocks, which are needed to solve the game with strategic interactions—for details, see Barczyk & Kredler (2014).

[58] One may argue that, ideally, one should shut down all other benefits of housing—i.e., (i)-(iii)—and then remove children to quantify HACC. However, we are unable to calculate such a counterfactual: with respect to (iii), we need (small) Brownian shocks to liquid wealth for technical reasons, and eliminating (ii) would require devising a sophisticated alternative taxation scheme that puts housing and liquid assets on the same footing.

[59] In particular, if we only compensated the parent for the absence of housing but the child still preferred owning, then the dynasty would choose to own in equilibrium since the child would pass on some of its surplus to the parent in the bargaining process.

Table 12: Value of housing technology, measured by dynasty wealth equivalent variation (WEV) at age 65

dollars ($000)	mean	p25	p50	p75	p90
baseline	57	26	55	108	145
no child	41	8	29	94	186
no glow	19	0	15	51	58
no child + no glow	7	0	2	18	53

% of home value	mean	p25	p50	p75	p90
baseline	30%	25%	36%	40%	44%
no child	20%	10%	22%	37%	48%
no glow	7%	0	7%	10%	16%
no child + no glow	2%	0	1%	5%	11%

WEV is defined by WEV_{dyn} in Appendix C.4. The upper panel shows the distribution of WEV, expressed in thousands of dollars. The lower panel shows the distribution of WEV as a percentage of the value of the purchased home. Renters enter the calculations in both panels as zeros.

when comparing the baseline and childless economies. When shutting down the utility benefit from owning, this number equals 5%.[60]

Robustness of HACC. A potential concern is that we may overstate the importance of HACC, for our model overstates bequests in the lower half of the distribution (see Table 7) and housing bequests from the median and up (see Table 8).[61] To get a sense of the severity of the issue, we study a robustness experiment in Appendix F. Specifically, with respect to the baseline calibration, we increase the expenditure share on non-housing consumption, ξ, to decrease house sizes and to obtain housing bequests more in line with the data. We then recalculate the potency of HACC. We find that along the extensive margin, HACC now accounts for 32% (with the utility benefit of owning) and 26% (without it), slightly down from the previous value of one-third. At the intensive margin, the willingness to pay is now $12,000 (down from $16,000) with the utility benefit of owning and $8,000 (down from $12,000) without. Nonetheless, our preferred measure at the intensive margin, WEV as a percentage of the house value, actually increases to 15% (from 10%), and remains unchanged at 5% without the utility benefit of owning. We conclude that our quantification of HACC is robust.

[60] We note that the quantification of HACC on the extensive margin likely overstates the true importance of HACC since a household who just slightly prefers owning over renting adds in the same way to the calculation as someone who strongly prefers to own.

[61] Future work could address this shortcoming in several ways. First, non-homothetic preferences over housing could certainly improve the fit of the house-size distribution at age 65, generating larger housing shares for wealthier households. Second, the following three channels, none of which is present in the current model, could reduce housing *bequests* (holding constant the initial house size): i) downsizing decisions, which are rare in the data but more important in the event of a spouse's death; ii) investment/repair choices (housing depreciation); and iii) transaction costs upon buying and selling houses.

7.3 The determinants of old-age savings and bequests

We now quantify the importance of the different channels through which housing, family and old-age risks affect the savings behavior of the elderly. In our analysis, we find that it suffices to focus on bequests since, in response to changes in the environment, wealth at ages 65 to 69 usually changes in the same direction as bequests (see Table E.1 in the appendix). Table 13 reports bequest distributions for an extensive set of counterfactuals (*scenarios*) and indicates which model ingredients are applicable in each scenario.[62]

i) Results when interactions are minor and HACC is absent. It is instructive to start from the most basic version of the model, i.e., one that features only basic lifecycle risks. Our **accidental** counterfactual (scenario 8), which turns off all factors other than longevity and medical expenditure risks, provides this benchmark: Bequests are smallest and only occur in the upper part of the distribution. Consider now how only the addition of homeownership and its associated benefits (excluding HACC) affects bequests (compare 4 and 8). While bequests increase for the upper part of the distribution, the effect is modest; thus, **the benefits of homeownership matter little *per se*.** Next, we isolate the contribution of altruism to bequests. We do so by adding children to the accidental benchmark (compare 7 and 8); as there is neither homeownership nor informal care, the addition of children produces no interactions. Bequests increase substantially in the top part of the distribution – by more than when adding ownership benefits – demonstrating that **altruism endogenously generates bequests as a luxury good**. Finally, we add LTC risk. Both when owner-occupied housing is available (going from 4 to 2) and when only renting is available (from 8 to 6), we find that **LTC risk increases the bequests of the childless**, providing a plausible candidate for explaining why the childless leave surprisingly large bequests in the U.S. The fact that both comparisons yield similar results suggests that there are no important interactions between homeownership and LTC risks at work for the childless.

ii) Results when interactions matter and HACC is present. We now turn to counterfactuals where interactions are important in determining bequests.

HACC generates large exchange-motivated bequests for the upper half of the wealth distribution in the U.S. We approximate the effect of HACC on bequests as the difference between the *no glow* and the *renting only* scenarios (5 and 9). Line v. shows that the effect of HACC on bequests is large and, along with altruism, contributes substantially to the luxury-good feature of

[62]Table E.2 in the appendix shows bequest distributions for all possible combinations of counterfactuals. In addition to those appearing in the main text, there we also include *no glow + no child* and *Swd.+no glow+no child*.

Table 13: Counterfactual bequest distributions

Scenario	Δ	extsv.	p25	p50	p75	p90	p95
1. baseline		75%	30	139	259	495	817
2. no child		41%	0	0	128	342	561
3. Sweden		76%	45	155	268	468	800
4. Swd.+no child		31%	0	0	67	249	440
i. U.S. family beq. gap	1 - 2	34%	30	139	131	153	256
ii. Swd. family beq. gap	3 - 4	45%	45	155	201	219	360
I. Δ family beq. gap	i - ii	-11%	-15	-16	-70	-66	-104
5. renting only		39%	0	0	134	415	715
6. no child+renting only		30%	0	0	67	293	510
7. Swd.+renting only		30%	0	0	65	324	607
8. Swd.+no child+rent. (**accdl.**)		**23%**	**0**	**0**	**4**	**193**	**377**
iii. U.S. family beq. gap rent.	5 - 6	9%	0	0	67	122	205
iv. Swd. fam. beq. gap rent. (**altr.**)	7 - 8	**7%**	**0**	**0**	**61**	**131**	**230**
II. Δ family beq. gap rent.	iii - iv	2%	0	0	6	-9	-25
9. no glow		57%	0	120	331	561	923
10. Swd.+no glow		47%	0	0	358	539	913
v. U.S. HACC beq. gap (**exchange**)	9 - 5	**18%**	**0**	**120**	**197**	**146**	**208**
vi. Swd. HACC beq. gap	10 - 7	17%	0	0	293	215	305
III. Δ HACC beq. gap	v - vi	1%	0	120	-96	-69	-97

	risk		**housing tenure**		**children**	**interactions**	
Scenario	lifecycle	LTC	owner-occupied housing	extra utility		IC	HACC
1. baseline	✓	✓	✓	✓	✓	✓	✓
2. no child	✓	✓	✓	✓			
3. Sweden	✓		✓	✓	✓		✓
4. Swd.+no child	✓		✓	✓			
5. renting only	✓	✓			✓	✓	
6. no child+rent.	✓	✓					
7. Swd.+rent.	✓				✓		
8. Swd.+no ch.+rent. (accdl.)	✓						
9. no glow	✓	✓	✓		✓	✓	✓
10. Swd.+no glow	✓		✓		✓		✓

Top: Percentiles of the bequest distributions in 1000s of 2010 dollars. Counterfactual scenarios are described in the text. Abbreviations: 'accdl.': accidental, 'altr.': altruism,'extsv.': extensive margin of leaving bequests of economic significance ($>$ 15K). Bottom: Lifecycle risk includes longevity risk and uninsured medical expenditure risk. 'LTC' refers to uninsured LTC expenditure risk (coming with means-tested MA). Owner-occupied housing comes with a tax advantage, less risk, and the possibility for FHC, but at the cost of indivisibility. Extra utility means owner-occupancy with $\omega > 1$. Children imply a residual claimant on bequests, altruism, and possibility of gifts. IC is relevant when LTC risk and children are present; HACC requires children and owner-occupancy.

bequests.[63] In the parlance of the literature, HACC falls under the **exchange motive** for bequests.[64]

LTC risk *and* housing contribute to similarity in parents' and childless' bequests in the U.S. Why do the childless in the U.S. die with wealth levels similar to those of parents? Our model points to LTC risk, in conjunction with housing, as an explanation for at least part of this similarity. To see this, we first define the *family bequest gap* as the difference in the bequest distributions between parent and childless households. Table 13 shows that the family bequest gap is *smaller*—that is, the bequests of parents and the childless are more alike—with LTC risk than without it (lines i. and ii.). It turns out that owner-occupied housing is essential for this result: In a world without owner-occupied housing, the addition of LTC risk scarcely reduces the family bequest gap at all (see iii. and iv.). The key difference is that, in the presence of homeownership, changes in LTC risk impact bequests through an additional channel, by changing the composition of families for whom HACC is relevant, which will also play a role next.

Owning-utility strengthens HACC, which props up bequests at the bottom. What explains bequests in the bottom half of the distribution? HACC in conjunction with IC props up bequests around (and above) the median in the baseline economy. However, practically no one chooses IC in Sweden, yet bequests from the median downward are higher than in the baseline. Here, the simultaneous presence of the utility benefit from owning and children is critical: When we remove either of these features in Sweden, bequests in the lower percentiles disappear (scenarios 4 and 10). Why are both elements needed? The parent is attached to the house, and due to altruism, values assets even in the event of death (*incidental valuation*). Both factors increase bequests. In addition, owning utility makes the parent more willing to keep the house which changes the composition of families for whom HACC is relevant. Now, a lower transfer from child to parent suffices to keep the parent from selling the house; thus, this form of HACC is operative in Sweden even for families with lower-productivity children and poorer parents.

No single bequest motive. In sum, our results suggest that looking for *the* bequest motive—that is, a single motive that acts in isolation and explains the bulk of bequests—is a futile endeavor. Instead, an eclectic model that allows for various factors to interact is needed. This implication is consistent with Kopczuk & Lupton (2007), who argue that bequest motives appear to be heterogeneous. Our model provides a useful step in organizing and understanding this heterogeneity and

[63] Scenarios 5 and 9 both feature children; hence, we expect the effect of altruism to cancel out. The HACC calculations here should be seen as an upper bound since our way of measuring HACC also includes the non-utility benefits of the home (less risk, lower taxes). However, the effect of such non-utility benefits on bequests is likely an order of magnitude smaller than the identified effect: Observe that bequests barely increase when adding no-glow housing to the childless economy, i.e., when moving from *no child+rent* to *no child+no glow* in Appendix Table E.2.

[64] We note that the impact of HACC on bequests in Sweden (line vi.) is even more pronounced in the upper third of the wealth distribution than in the U.S. (line v.). In Sweden, FHC is relatively cheap (basic care is financed by the state), so HACC becomes more relevant for families with higher-productivity children and wealthier parents.

offers an alternative to the egoistic bequest motive for explaining why so many childless households leave bequests: They face higher risks, especially in the form of LTC.

8 Conclusions

We conclude with some potential directions for future research. While the focus of this paper was on the economic behavior of the elderly in the U.S., the model also has the potential to explain cross-country differences in old-age behavior. For example, according to our model, in countries where old-age risks are well-insured (e.g., Sweden), homeownership rates should be lower.[65] Indeed, in a recent comparison of the elderly in the U.S. and Sweden, Nakajima & Telyukova (2019) finds precisely this pattern. As our model points out, the interplay between family and housing is likely to be essential for interpreting such differences in the economic outcomes of the elderly across countries. Finally, in terms of next steps in the study of old-age economic behavior, two areas appear particularly promising. First, future work should explore non-homothetic felicity functionals in altruistic preferences. Second, it may prove fruitful to construct reduced-form functions that capture the intra-family exchange dynamics that we document in this paper, in the same way that warm-glow bequest motives approximate altruism (for some purposes). Doing so would allow some of the insights in this paper to be transferred to settings in which only the elderly parent but not the child is modeled.

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[65] See the right panel in Figure E.1.

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Appendix

A Samples and weights

Our data are from the Health and Retirement Study (HRS). We combine data from the HRS public-use files with data from the RAND HRS Longitudinal File, the RAND HRS Family Data Files, and the Langa-Weir Classification of Cognitive Function. We use core interview data from the 1998-2010 survey waves and exit interview data from the 2004-2012 survey waves.[66] The following sections describe in detail how we select the samples used in our analysis. Tables A.1 and A.2 report counts of unique households, individuals, and person-interviews at each stage of the selection process for our core interview samples and our single decedent samples, respectively. Table A.3 provides descriptive statistics for the core interview samples. Tables A.4 and A.5 provide descriptive statistics for our samples of single decedents.

A.1 Core interview samples

All households 65+ Where our goal is to calculate statistics that are representative of the elderly population in the U.S., we pool the core interviews from the 1998-2010 survey waves of the HRS. Our sample is limited to individuals that appear in the RAND Longitudinal File in these waves. Of the 37,495 unique individuals in the universe of respondents in the RAND file, there are 32,973 individuals with data in the core interviews in the years 1998-2010. We restrict the sample to households in which the eldest member is 65 years of age or older, leaving us with a core interview sample with 13,525 households, 19,435 individuals, and 77,266 person-interviews. Summary statistics for this sample appear in the first pair of columns in Tables A.3.

Parents 65+ Because the model we develop in this paper is designed to capture the behavior of parent households, our calibration of the model in Section 5 uses core interview data from households with children. Parent status is determined by the number of living and in-contact children and stepchildren at the time of the interview. At the person-interview level, there are 70,609 observations for parents, including 17,872 unique individuals from 12,252 unique households. Summary statistics for this sample appear in the second pair of columns in Table A.3.

NH-eligible singles 65+ In Table K.1, where we assess the relationship between having children and nursing home utilization, we restrict the core interview sample to person-interviews for

[66] We begin with the 2004 exit interview data because certain important questions concerning homes were not asked for a subset of home-owning decedents in 2000 and 2002. Although the HRS took steps to correct the problem (by conducting estate call-back interviews), the data remain incomplete for many decedents in these years.

individuals who are single and who have 2 or more ADL limitations or are cognitively impaired, the latter two factors being standard criteria for nursing home eligibility. The regression sample includes 6,278 individuals who provide 14,992 person-interviews. Summary statistics for this sample appear in the final pair of columns in Table A.3.

A.2 Single decedent samples

For the purposes of measuring the distribution of estates (bequests), depicting the evolution of net worth at the end of the lifecycle, and validating the housing-as-commitment channel mechanism, we draw data from a sample of single decedents. This sample includes individuals with an exit interview in the 2004-2012 waves of the HRS who were single (neither married nor partnered) at the time of death, whose death took place during the 2000-2012 survey waves, and who appeared in at least one of the 1998-2010 core interviews. Additionally, we exclude cases where:

- The proxy either did not know or refused to provide the status of the home.
- The proxy listed the spouse as the inheritor or recipient of the home or did not know or refused to identify who inherited the home (if held until after death) or whom the home was given to (if disposed of prior to death).
- The decedent had no non-missing individual sample weights for any core interview in our 1998-2010 sample period.
- The proxy did not know, refused to answer, or was not asked whether the decedent had either a will or trust or both.
- The date of death was reported to have occurred prior to the decedent's most recently given core interview.

The primary rationale behind these additional criteria is to retain only observations where the proxy interviewee had sufficiently high quality information about the decedent's estate. We combine the exit interview data for these decedents with data from their core interviews given in the 1998-2010 waves of the HRS. The resulting sample includes 17,974 person-interviews (including core and exit) for 3,227 unique single decedents. Summary statistics for this sample are provided in the first pair of columns in Tables A.4 and the first four columns of Table A.5.

A.2.1 HACC validation regression sample

In Section 6.4, we provide regression evidence in support of the housing-as-commitment-channel (HACC) mechanism. We use data from our sample of single decedents to test the predictions of the model. Because the theory applies to parents, we drop decedents without children, leaving 16,049 person-interviews for 2,869 individuals. Because the mechanism operates for single (uncoupled) individuals, we further eliminate (core) interviews at which the decedent was coupled, leaving 13,400 person-interviews. Summary statistics for this sample are provided in the second pair of columns in Table A.4 and the middle four columns of Table A.5.

A.2.2 End-of-life net worth trajectories sample

To construct balanced panels of single decedents for plotting the trajectories of net worth at the end of life, we restrict the sample of single decedents to those with non-missing wealth data in at least four core interviews. This restriction yields 2,290 unique individuals with 14,474 person-interviews. Summary statistics for this sample are provided in the third pair of columns in Table A.4 and the last four columns of Table A.5.

A.3 Sample weights

All statistics including regression coefficients are computed using respondent-level sample weights that have been corrected for nursing home status (combining information from the RAND variables `RwWTRESP`, `RwWTR_NH`, and `RwNHMLIV`). A similar correction for household-level weights is not currently available from the HRS. (The HRS generally assigns zero weight to nursing home residents. Because a large share of decedents live in nursing homes near the ends of their lives, assigning these individuals zero weights could significantly distort our analyses.) For exit interviews, we carry forward the most recently available core interview weight. For analyses involving variables measured at the household level such as wealth, we select one observation from each couple (using the RAND variable `HwPICKHH`).

Table A.1: Core interview sample selection

Selection criterion	Person-interviews	Unique Individuals	Unique Households
RAND Longitudinal File	226,563	37,495	23,373
Core interviews 1998-2010	136,977	32,973	21,211
Age 65+	77,266	19,435	13,525
Sample: all households 65+	77,266	19,435	13,525
All households 65+	77,266	19,435	13,525
Have children at time of interview	70,609	17,872	12,252
Sample: parents 65+	70,609	17,872	12,252
All households 65+	77,266	19,435	13,525
Single	32,299	9,438	9,191
2+ ADLs or cognitive impairment	14,992	6,278	6,198
Sample: NH-eligible singles 65+	14,992	6,278	6,198

Unique individuals are identified by the HRS variables `HHID` and `PN`, which are the household and person identifiers, respectively. Unique households are identified by `HHID`. Person-interviews refer to core interviews (`RwIWSTAT=1`). ADLs are activities of daily living. Age, coupleness, whether a parent, and ADL limitations are determined using the RAND variables `RwAGEY_B`, `HwCPL`, `HwCHILD`, and `RwADLA`. In cases of couples, the age of the eldest member of the couple is used. Cognitive impairment is a value of 2 or 3 using the Langa-Weir measure `COGFUNCTION`. Two or more ADL limitations or cognitive impairment are standard criteria for nursing home eligibility.

Table A.2: Decedent sample selection

A. Sample of single decedents and HACC validation regression sample

Selection criterion	Person-interviews	Unique Individuals
Universe of HRS respondents in RAND Longitudinal File	-	37,495
Died during waves 5-11	-	9,804
Exit interview in waves 7-11	35,499	6,491
Appeared in at least one of the core waves 4-10	35,442	6,434
Single at time of death	19,679	3,543
Proxy not DK/RF home status	19,326	3,476
Neither SP/P inherits home nor DK/RF about inheritor	19,092	3,434
Proxy not DK/RF about will or trust	18,168	3,265
Date of death does not precede most recent core interview	17,974	3,227
Sample: single decedents	17,974	3,227
Parents	16,049	2,869
Interviews by parents given while single	13,400	-
Sample: HACC validation	13,400	2,869

B. Balanced panel of single decedents for end-of-life wealth trajectories

Selection criterion	Person-interviews	Unique Individuals
Single decedent sample	17,974	3,227
Wealth data non-missing for 4+ core interviews	14,474	2,290
Sample: end-of-life wealth trajectories	14,474	2,290
Sub-samples:		
Parents		2,060
Childless		230
T-1 Homeowners		1,000
T-1 Renters		1,266
T-1 Nursing home residents		555
T-1 Community residents		1,735

Unique individuals are identified by the HRS variables `HHID` and `PN`, which are the household and person identifiers, respectively. Person-interviews count core interviews from the 1998-2010 survey waves and exit interviews from the 2004-2012 survey waves. DK and RF stand for don't know and refused to answer. SP/P stands for spouse or partner. Whether a parent is determined as of the exit interview. T-1 refers to the last core interview given before the individual's death.

Table A.3: Descriptive statistics for core interview samples

	All		Parents		NH-eligible Singles	
	Mean	SE	Mean	SE	Mean	SE
Female	0.58	(0.0018)	0.58	(0.0019)	0.76	(0.0035)
Race: Black/African Amer.	0.086	(0.0010)	0.083	(0.0010)	0.18	(0.0032)
Race: Other	0.031	(0.00063)	0.031	(0.00065)	0.046	(0.0017)
Ethnicity: Hispanic	0.060	(0.00086)	0.061	(0.00090)	0.093	(0.0024)
Education: less than high school	0.26	(0.0016)	0.26	(0.0017)	0.49	(0.0041)
Education: high school or GED	0.37	(0.0017)	0.37	(0.0018)	0.32	(0.0038)
Education: some college	0.19	(0.0014)	0.19	(0.0015)	0.13	(0.0028)
Education: college and above	0.18	(0.0014)	0.18	(0.0014)	0.068	(0.0021)
Coupled	0.57	(0.0018)	0.59	(0.0019)	0	(0)
Children	0.92	(0.00098)	1	(0)	0.87	(0.0028)
Number of children (parents)	3.47	(0.0078)	3.47	(0.0078)	3.39	(0.020)
Child w/in 10 miles (parents)	0.67	(0.0018)	0.67	(0.0018)	0.75	(0.0039)
Age	75.1	(0.027)	74.9	(0.028)	80.3	(0.068)
Number of ADL limitations	0.47	(0.0040)	0.46	(0.0041)	1.40	(0.014)
Number of IADL limitations	0.46	(0.0041)	0.45	(0.0042)	1.37	(0.014)
Cognitive function: Impaired	0.20	(0.0014)	0.20	(0.0015)	0.54	(0.0041)
Cognitive function: Demented	0.10	(0.0011)	0.097	(0.0011)	0.34	(0.0039)
Household income (1000s)	54.3	(1.09)	55.1	(1.19)	29.1	(5.46)
[Median]	[32]		[33]		[14]	
Net worth (1000s)	527.3	(4.75)	535.5	(4.97)	187.4	(5.36)
[Median]	[213]		[218]		[43]	
Homeowner	0.78	(0.0015)	0.79	(0.0016)	0.49	(0.0041)
Nursing home resident	0.034	(0.00065)	0.031	(0.00065)	0.14	(0.0029)
Nursing home stay last 2 years	0.066	(0.00090)	0.063	(0.00091)	0.21	(0.0034)
Nursing home nights (if > 0)	272.5	(4.91)	264.3	(5.20)	368.9	(6.88)
Disabled (21+ hours/week LTC)	0.084	(0.0010)	0.083	(0.0010)	0.25	(0.0036)
Any LTC helper	0.20	(0.0014)	0.19	(0.0015)	0.50	(0.0041)
Any child LTC helper (LTC recipients)	0.52	(0.0040)	0.57	(0.0042)	0.70	(0.0053)
Child weekly LTC hours (if > 0)	22.2	(0.40)	22.1	(0.40)	25.6	(0.54)
Observations	77,266		70,609		14,992	
Unique individuals	19,435		17,872		6,278	
Unique households	13,525		12,252		6,198	

Means with standard errors in parentheses. HRS core interviews 1998-2010. All: households whose eldest member is age 65 or older. Parents: those with children at the time of the interview. NH-eligible singles: those who at the time of the interview were single and who had two or more ADL (activities of daily living) limitations or cognitive impairment. LTC is long-term care. IADLs are instrumental activities of daily living. All statistics use respondent-level sample weights and one observations per household-interview. Dollar amounts are 1000s of 2010 dollars.

Table A.4: Summary statistics for single decedent samples

	All Decedents		Parents		Balanced Panel	
	Mean	SE	Mean	SE	Mean	SE
Non-zero estate	0.64	(0.008)	0.65	(0.009)	0.64	(0.01)
Estate value (1000s)	226.5	(35.6)	229.5	(40.2)	207.3	(12.7)
Home bequest	0.37	(0.009)	0.37	(0.009)	0.38	(0.01)
Home bequest+ (includes IVT)	0.49	(0.009)	0.50	(0.009)	0.51	(0.01)
Avg. total weekly LTC hours	33.6	(0.6)	34.2	(0.6)	33.0	(0.7)
Avg. weekly hours from children	11.2	(0.4)	12.7	(0.4)	11.0	(0.4)
Share of interviews in NH	0.22	(0.006)	0.21	(0.006)	0.22	(0.007)
Age at death	81.9	(0.2)	82.1	(0.2)	83.1	(0.2)
Female	0.70	(0.008)	0.71	(0.009)	0.71	(0.009)
Race: white	0.86	(0.006)	0.86	(0.006)	0.87	(0.007)
Race: Black	0.12	(0.006)	0.11	(0.006)	0.11	(0.006)
Race: other	0.029	(0.003)	0.028	(0.003)	0.026	(0.003)
Hispanic	0.050	(0.004)	0.052	(0.004)	0.049	(0.005)
Education (years)	11.3	(0.06)	11.2	(0.06)	11.4	(0.07)
Has children	0.88	(0.006)	1	(0)	0.89	(0.007)
Number of children (parents)	3.32	(0.04)	3.32	(0.04)	3.35	(0.05)
Avg. household income (1000s)	30.3	(0.7)	30.3	(0.7)	31.8	(0.9)
Ever coupled	0.29	(0.008)	0.31	(0.009)	0.34	(0.010)
Ever own home	0.70	(0.008)	0.72	(0.008)	0.74	(0.009)
Interview 2004	0.19	(0.007)	0.19	(0.007)	0	(0)
Interview 2006	0.18	(0.007)	0.19	(0.007)	0.21	(0.009)
Interview 2008	0.22	(0.007)	0.22	(0.008)	0.27	(0.009)
Interview 2010	0.23	(0.007)	0.24	(0.008)	0.29	(0.010)
Interview 2012	0.17	(0.007)	0.17	(0.007)	0.23	(0.009)
Observations	3,227		2,869		2,290	

Means with standard errors in parentheses. HRS core interviews 1998-2010 and exit interviews 2004-2012. Samples—All: single decedents. Parents: single decedents with children. Balanced panel: a balanced panel of single decedents with non-missing wealth data for at least the last four core interviews before the exit interview. The unit of observation is an individual. IVT is inter-vivos transfer. LTC is long-term care. NH is nursing home. Average hours of long-term care and share of interviews in a nursing home are computed over the final six years of life using data from both core and exit interviews. Average household income is calculated over all available core interviews. All statistics use sample weights. Dollar amounts are 1000s of 2010 dollars.

Table A.5: Summary statistics for single decedent samples, comparing core and exit interviews

	All Decedents				Parents				Balanced Panel			
	Core IWs		Exit IWs		Core IWs		Exit IWs		Core IWs		Exit IWs	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Age	77.2	(0.09)	81.9	(0.2)	77.8	(0.1)	82.1	(0.2)	77.5	(0.09)	83.1	(0.2)
Female	0.71	(0.004)	0.70	(0.008)	0.75	(0.004)	0.71	(0.009)	0.72	(0.004)	0.71	(0.009)
Race: white	0.86	(0.003)	0.86	(0.006)	0.85	(0.003)	0.86	(0.006)	0.87	(0.003)	0.87	(0.007)
Race: Black	0.11	(0.003)	0.12	(0.006)	0.12	(0.003)	0.11	(0.006)	0.11	(0.003)	0.11	(0.006)
Race: other	0.026	(0.001)	0.029	(0.003)	0.028	(0.002)	0.028	(0.003)	0.025	(0.001)	0.026	(0.003)
Hispanic	0.047	(0.002)	0.050	(0.004)	0.049	(0.002)	0.052	(0.004)	0.046	(0.002)	0.049	(0.005)
Education (years)	11.3	(0.03)	11.3	(0.06)	11.2	(0.03)	11.2	(0.06)	11.4	(0.03)	11.4	(0.07)
Coupled	0.17	(0.003)	0	(0)	0	(0)	0	(0)	0.19	(0.004)	0	(0)
Has children	0.89	(0.003)	0.88	(0.006)	1	(0)	1	(0)	0.89	(0.003)	0.89	(0.007)
Number of children (parents)	3.24	(0.02)	3.32	(0.04)	3.18	(0.02)	3.32	(0.04)	3.26	(0.02)	3.35	(0.05)
Any child within 10 miles (parents)	0.72	(0.004)			0.73	(0.004)			0.71	(0.004)		
Household net worth (1000s)	261.9	(6.6)			224.0	(7.1)			274.4	(7.7)		
Household income (1000s)	31.0	(0.6)			26.4	(0.7)			31.8	(0.7)		
Own home	0.58	(0.004)	0.37	(0.009)	0.54	(0.005)	0.37	(0.009)	0.60	(0.004)	0.38	(0.01)
Number of ADL limitations	0.93	(0.01)	3.29	(0.04)	1.00	(0.01)	3.35	(0.04)	0.87	(0.01)	3.34	(0.04)
Number of IADL limitations	1.11	(0.01)	3.56	(0.03)	1.20	(0.02)	3.59	(0.03)	1.06	(0.01)	3.62	(0.03)
Ever had memory disease	0.14	(0.003)	0.46	(0.009)	0.15	(0.004)	0.47	(0.009)	0.14	(0.003)	0.48	(0.01)
Nursing home resident	0.096	(0.002)	0.42	(0.009)	0.11	(0.003)	0.41	(0.009)	0.091	(0.003)	0.43	(0.01)
Any LTC helper	0.36	(0.004)	0.89	(0.005)	0.39	(0.005)	0.90	(0.006)	0.35	(0.004)	0.91	(0.006)
Weekly LTC hours (if > 0)	41.5	(0.7)	83.9	(1.1)	41.8	(0.7)	84.1	(1.1)	40.0	(0.7)	83.3	(1.3)
Weekly LTC hours from children (if > 0)	23.3	(0.6)	37.7	(1.0)	23.7	(0.7)	37.8	(1.0)	21.9	(0.7)	36.2	(1.2)
$> 50\%$ LTC from children (LTC recipients)	0.41	(0.007)	0.29	(0.008)	0.48	(0.008)	0.32	(0.009)	0.41	(0.008)	0.29	(0.010)
Interview 1998	0.19	(0.003)	0	(0)	0.16	(0.004)	0	(0)	0.17	(0.003)	0	(0)
Interview 2000	0.20	(0.003)	0	(0)	0.18	(0.004)	0	(0)	0.18	(0.003)	0	(0)
Interview 2002	0.20	(0.003)	0	(0)	0.21	(0.004)	0	(0)	0.19	(0.004)	0	(0)
Interview 2004	0.17	(0.003)	0.19	(0.007)	0.17	(0.004)	0.19	(0.007)	0.19	(0.004)	0	(0)
Interview 2006	0.13	(0.003)	0.18	(0.007)	0.14	(0.003)	0.19	(0.007)	0.15	(0.003)	0.21	(0.009)
Interview 2008	0.083	(0.002)	0.22	(0.007)	0.097	(0.003)	0.22	(0.008)	0.095	(0.003)	0.27	(0.009)
Interview 2010	0.034	(0.001)	0.23	(0.007)	0.038	(0.002)	0.24	(0.008)	0.038	(0.002)	0.29	(0.010)
Interview 2012	0	(0)	0.17	(0.007)	0	(0)	0.17	(0.007)	0	(0)	0.23	(0.009)
Observations	14,747		3,227		10,531		2,869		12,184		2,290	

Means with standard errors in parentheses. HRS core interviews 1998-2010 and exit interviews 2004-2012. Samples—All: single decedents. Parents: single decedents with children. Balanced panel: a balanced panel of single decedents with non-missing wealth data for at least the last four core interviews before the exit interview. The unit of observation is a person-interview. For the sample of parents, we drop core interviews at which the decedents are coupled. IWs stands for interviews. LTC is long-term care. $> 50\%$ LTC from children means more than half of LTC hours are from children and no nursing home care is received. All statistics use sample weights. Dollar amounts are 1000s of 2010 dollars.

B Theory appendix: Details of the illustrative models

This appendix completes the analysis of the illustrative model presented in Section 3. We first trace out the Pareto frontier and solve for the efficient allocations in this environment. We then solve for the equilibrium of the non-cooperative game, featuring the housing trust. Finally, we discuss the equilibrium in the absence of the housing asset, which serves to define the commitment allocations. Equations (1) to (9) that we reference here are found in Section 3.

B.1 Basic illustrative model

Planner's problem. We first solve for the allocation that a family planner would choose who places weight $\eta \in [0,1]$ on the parent and weight $(1-\eta)$ on the child. The planner's continuation value after the parent's death is $B_\eta = (1-\eta)B$ at high wealth and zero otherwise. The planner's problem when the parent is alive and has low wealth is

$$(\rho+\delta)V_0^\eta = \max_Q \Big\{\eta u(y^p - r - Q) + (1-\eta)u(y^k + Q)\Big\}, \tag{10}$$

since the parent has to expend a flow r for renting. The optimal transfer $Q_{\eta,0}$ is pinned down by the first-order condition (FOC)

$$\eta u'(y^p - r - Q_{\eta,0}) = (1-\eta)u'(y^k + Q_{\eta,0}). \tag{11}$$

We calculate $Q_{\eta,0}$ from (11) and then obtain V_0^η from (10). For the high-wealth state, the planner's HJB is then

$$(\rho+\delta)V_1^\eta = \delta B_\eta + \max_{c^p,Q} \Big\{\eta u(c^p) + (1-\eta)u(y^k+Q) + (y^p - Q - c^p)(V_1^\eta - V_0^\eta)\Big\}, \tag{12}$$

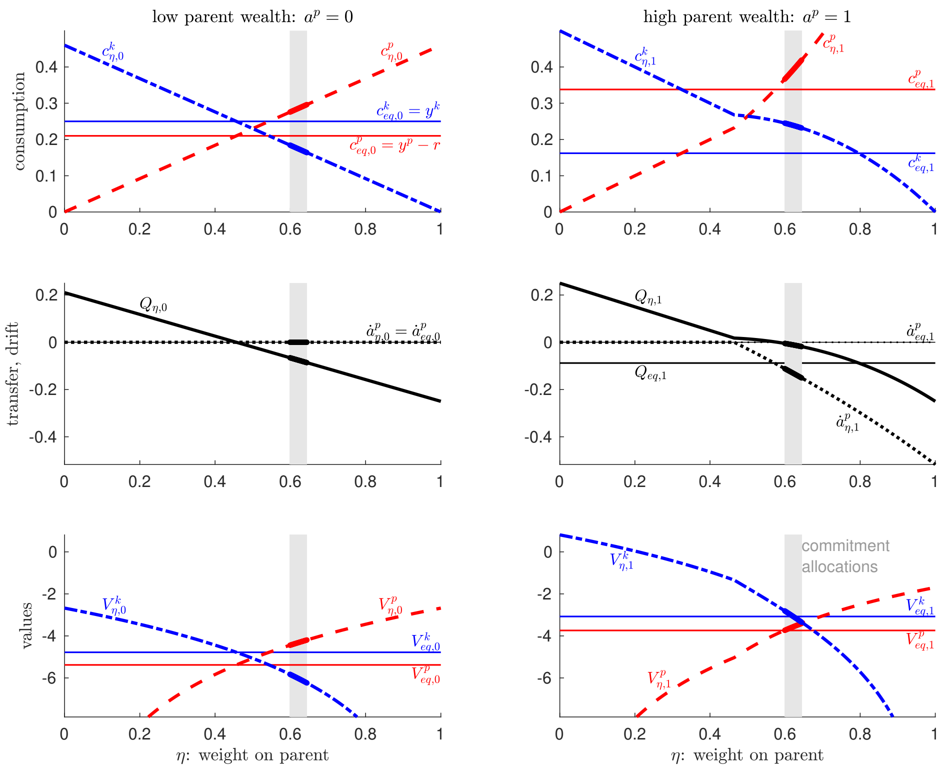
where we recall that i) using liquid wealth (renting) is the dominant strategy for the planner, and hence there is no constraint on c^p and Q, and ii) the interest flow r pays for the parent's rent and therefore does not show up. The FOCs for this problem at an interior solution are

$$u'(c^p_{\eta,1}) = V_1^\eta - V_0^\eta, \tag{13}$$

$$u'(y^k + Q_{\eta,1}) = V_1^\eta - V_0^\eta. \tag{14}$$

We solve the HJB (12) as follows: i) Guess some V_1^η ii) obtain $c^p_{\eta,1}$ and $Q_{\eta,1}$ from the FOCs (13) and (14), iii) check if the HJB (12) is fulfilled and, if not, iv) adjust the guess in Step i) up- or downward. Figure B.1 shows the planner's allocations as a function η.

Figure B.1: Planner's solutions in illustrative model



Parameters are as in Fig. 6. Variables with subscript *eq* refer to equilibrium values from the non-cooperative game with the housing trust. For a comparison of the commitment allocations with the no-housing equilibrium, see Table B.1 below.

Solving the non-cooperative game (with housing trust). For the case in which the parent has high wealth, we now go in detail over the backward induction over the stages of the game.

In the **consumption stage**, there is nothing to decide if the parent has committed herself to own in the bargaining stage, in which case her consumption is given by $c^p_t = y^p - Q$. If the parent rents, then her consumption is determined by the standard FOC

$$u'(c^p_{rent}) = \Delta V^p. \tag{15}$$

Now, go one step back to the **gift stage**. Denote the child's gift by $\tilde{Q} \geq 0$ to distinguish it from the exchange transfer Q. If the two parties have entered an agreement in the bargaining stage, then there is nothing to decide. Under the outside option with renting, the relevant Hamiltonians are given by

$$H^k_{gift}(\tilde{Q}) = u(y^k + \tilde{Q}) + (y^p - c^p_{rent} - \tilde{Q})\Delta V^k, \tag{16}$$

$$H^p_{gift}(\tilde{Q}) = u(c^p_{rent}) + (y^p - c^p_{rent} - \tilde{Q})\Delta V^p. \tag{17}$$

The optimal gift for the child is then determined by the FOC

$$u'(y^k - \tilde{Q}^*) \geq \Delta V^k, \tag{18}$$

which must hold with equality for an interior solution $\tilde{Q}^* < 0$. In the parameterization of our numerical example, the child is a natural borrower and will not want to save through the parent. As a consequence, the child always chooses the corner solution $\tilde{Q}^* = 0$ in this subgame.

Going one step back to the **housing stage**, observe that the parent must own if she entered an agreement to do so in the bargaining stage. If the parent has the choice between renting and owning, she will always choose to rent in this stage since renting opens a wider array of consumption choices but comes at the same cost as owning.

Finally, in the **bargaining stage** the child's optimal offer is then determined by the program in Eq. (6)-(8) in the main text. We guess again that the value differentials ΔV^p, ΔV^k are positive in equilibrium, which we then verify ex post. Under this guess, $H^p_{in}(Q)$ is decreasing in Q and the child chooses Q under the inside option such that the parent's participation constraint (7) binds, i.e.,

$$H^p_{in}(Q_{in}) = H^p_{out} \tag{19}$$

that characterizes the transfer Q_{in} under the inside option. We will look for housing equilibria in which the equilibrium transfer $Q_{eq} = Q_{in}$ pins down the parent's value from the HJB

$$(\rho + \delta)V^p_1 = H^p_{in}(Q_{eq}). \tag{20}$$

Finally, we need to check that the child indeed prefers the inside (housing) option over the outside (renting) option, i.e., that

$$H^k_{in}(Q_{eq}) \geq H^k_{out}. \tag{21}$$

Our **solution algorithm** to solve for a housing equilibrium is the following:

1. Guess Q on the feasible range $Q \in (-y^k, 0]$.

2. Given Q, obtain parent value $\tilde{V}^p_1(Q)$ from (20) in a housing equilibrium, which is strictly decreasing in Q (we use tildes to mark objects that depend on our guess for Q in the algo-

rithm).

$$(\rho + \delta)\tilde{V}_1^p(Q) = u(y^p - Q), \tag{22}$$

$$(\rho + \delta)\tilde{V}_1^k(Q) = u(y^k + Q) + \delta B. \tag{23}$$

3. For the renting subgame, obtain $\tilde{c}^p_{rent}(Q)$ from (15), $\tilde{Q}(Q)$ from Eq. (18) and then $\tilde{H}^p_{out}(Q)$ from Eq. (8), where $V_1^p = \tilde{V}_1^p(Q)$ and where we take V_0^p from (20). $\tilde{c}^p_{rent}$ is strictly increasing and $\tilde{Q}$ is weakly increasing in Q, thus $\tilde{H}^p_{out}$ is increasing and $\tilde{H}^k_{out}$ is decreasing in Q.

4. Similarly, for the housing subgame, obtain the Hamiltonian $\tilde{H}^p_{in}(Q)$ from Eq. (9) as a function of the guess Q, where $\tilde{H}^p_{in}$ is decreasing in Q.

5. Next, evaluate $IC^p(Q) \equiv \tilde{H}^p_{in}(Q) - \tilde{H}^p_{out}(Q)$, where IC is stands for "incentive compatibility". IC^p is a decreasing function of Q. If $IC^p(Q) = 0$, the guess is an equilibrium candidate, $Q = \hat{Q}_{eq}$, since it satisfies (19).

6. Finally, check if the child indeed prefers the housing regime for the candidate $\hat{Q}_{eq}$, i.e. if the inequality (21) holds. We do this by defining another function $IP^k(Q) \equiv \tilde{H}^k_{in}(Q) - \tilde{H}^k_{out}(Q)$, which can be shown to be strictly increasing in Q by following the same steps as for IC^p.

We operationalize the algorithm by defining a function $IC^p(Q)$ and finding its unique zero $\tilde{Q}_{eq}$ on the range $(-y^k, 0]$, which is the unique candidate for a housing equilibrium. If this guess passes the check, i.e., if $IC^k(\tilde{Q}_{eq}) \geq 0$, then we have found a housing equilibrium. If it fails the test and $IC^k(\tilde{Q}_{eq}) < 0$, then there cannot be any housing equilibrium (this follows directly from the monotonicity properties of IC^k and IC^p). A renting equilibrium can then be found by guessing that $Q_{in} = 0$ and solving the parent's HJB for the optimal consumption choice c^p_{rent}, coupled with the parent value V_1^p. We omit a further description since this type of equilibrium is not of interest for illustrating the housing-as-commitment mechanism, but have considered this case in our codes.

Solving the non-cooperative game without housing. We also solve for the (non-cooperative) equilibrium of the basic illustrative model when stripping out the housing asset, i.e., forcing the parent to always rent. The solution is obtained in the same fashion as in the case with the housing asset, but omitting all steps that involve housing, and is shown as *no-housing equilibrium* in Table B.1. It should be noted that, in principle, the no-housing equilibrium is different from the renting subgame outcome depicted in Fig. 6: The renting subgame outcome is what would occur in a one-shot deviation from the housing-trust equilibrium, i.e. in a short interval dt in which the parent rents, but both players take as given the continuation values from the housing-trust equilibrium. In the no-housing equilibrium, the parent rents as well over each dt, but the continuation values come from the *renting* outcome. However, it turns out that under our assumptions, the

Table B.1: Allocations in basic illustrative model

		c^i_1	c^i_0	$\dot{a}^p_1$ (drift)	V^i_1
parent (i=p):	housing-trust equilibrium	0.338	0.210*	0.000	-3.74
	commitment allocations	[0.366,0.420]	[0.275,0.296]	[-0.111,-0.151]	[-3.74,-3.41]
	no-housing equilibrium	0.610	0.210	-0.360	-3.74
child (i=k):	housing-trust equilibrium	0.162	0.250*	0.000	-3.08
	commitment allocations	[0.245,0.232]	[0.185,0.164]	[-0.111,-0.151]	[-2.80,-3.35]
	no-housing equilibrium	0.250	0.250	-0.360	-3.35

Parameters as in Fig. 6; *housing-trust equilibrium*: Equilibrium of basic illustrative model, i.e., non-cooperative environment with housing asset; *commitment allocations*: range of long-run planner allocations that Pareto-dominate the no-housing equilibrium outcome (starting the game at high wealth), here with Pareto weights $\eta \in [0.598, 0.644]$; *no-housing equilibrium*: equilibrium of non-cooperative model without housing asset. *: not reached on equilibrium path.

consumption and transfer allocations under the the renting subgame outcome and the no-housing allocations coincide: Since the child has all bargaining power, the parent's continuation value in the housing-trust equilibrium is the same as in the no-housing equilibrium, thus the parent chooses the same consumption, c^p_{rent}. Furthermore, due to our assumptions on the continuation value B, the child chooses a zero transfer $Q = 0$ in both scenarios.

Finally, we define the ***commitment allocations*** as the set of efficient allocations that Pareto-dominate the outcome of the no-housing game. See again Table B.1 for a numerical comparison to the equilibria of the two non-cooperative games just described. Note that the child's value in the no-housing game is lower than in the housing-trust equilibrium, hence the commitment allocations under our definition are a larger set than if we defined them as Pareto improvements over the housing-trust equilibrium. However, for our purposes it is largely inconsequential which definition we choose since the allocations under both definitions have the same qualitative features.

Proposition 1 (Existence of Pareto improvements) *Suppose $\Delta V^p > 0$ and $\Delta V^k > 0$. Then a Pareto lens opens to the lower left of the renting outcome. To be precise, the set $P = \{(Q, c^p) : Q < 0, c^p < c^p_{rent}, H^p(Q, c^p) \geq H^p(0, c^p_{rent}), H^k(Q, c^p) \geq H^k(0, c^p_{rent})\}$ is non-empty and $(0, c^p_{rent})$ is in the closure of P.*

Proof: Observe that the parent's indifference curve has slope

$$\frac{dc^p}{dQ} = \frac{\Delta V^p}{u'(c^p) - \Delta V^p}, \qquad \frac{dc^p}{dQ}\Big|_{rent} = \frac{\Delta V^p}{u'(c^p_{rent}) - \Delta V^p} = \infty,$$

which we see to be infinite at the renting equilibrium since $u'(c^p) = \Delta V^p$, where $\Delta V^p > 0$ by assumption. The child's indifference curve has slope,

$$\frac{dc^p}{dQ} = \frac{u'(y^k + Q) - \Delta V^k}{\Delta V^k}, \qquad \frac{dc^p}{dQ}\bigg|_{rent} = \frac{u'(y^k) - \Delta V^k}{\Delta V^k},$$

which is a finite number since we assumed $\Delta V^k > 0$. Since the parent's better set lies left and the child's better set lies below the renting outcome, it follows that the Pareto lens must open going marginally southwest from (Q_{rent}, c^p_{rent}), as claimed in the proposition. ■

Remark: The proof also goes through for the pathological case that $u'(y^k) < \Delta V^k$, which means that the child wants to save through the parent. This implies that the child gives a positive transfer in the gift-giving stage of the renting subgame, this transfer satisfying $u'(y^k - Q_{rent}) = \Delta V^p$. The child's indifference curve that passes through(Q_{rent}, c^p_{rent}) would then be horizontal. In our example, this case is precluded by the choice of B, which makes the child a natural borrower. In the quantitative model, the case does not occur since the child would then always prefer to save in her private assets, a^k, then.

B.2 Illustrative model with LTC

This section adds a long-term care choice to the basic illustrative model from Sections 3 and B.1. We now assume that the parent, while alive, has a need for care that must be covered. There is no utility preference for different care forms. The care forms available are as in the quantitative model, which we repeat here:

1. *Informal care* (IC): The child incurs a loss of a fraction $\beta \in (0, 1]$ of her flow income y^k.
2. *Formal care* (FC):
   (a) Means-tested *Medicaid* (MA): Available to the parent when having low wealth ($a^p_t = 0$) and insufficient income to cover the cost of formal care. If the parent chooses MA, the government obtains the parent's endowment and provides care and a consumption floor C_{ma}.
   (b) Privately-paid care (PP):
      i. *nursing home care* (NH): When renting, the parent pays $p_{nh} = r + p_{bc}$, i.e., rent plus the price of basic care services.
      ii. *formal home care* (FHC): When owning, the parent pays p_{fhc} for basic care services.

Timing protocol. The game over an instant $[t, t + dt)$ unfolds as follows:

1. Bargaining stage: Child and parent bargain over IC and the owning decision. The outside option is formal care, the parent deciding unilaterally if to own or not (see stages below). For wealthy parents, we assume joint bargaining over IC and owning, in the following sense. The child proposes one of the following three *inside options* in conjunction with a transfer $Q_t \in \mathbb{R}$[67]: i) *IC+own*, ii) *IC+rent* or iii) *FHC+own*. For parents with zero wealth, the only available inside option is *IC+rent*. The parent then accepts or rejects the proposed bargain.

2. Housing stage: If the parent has high wealth and has rejected the bargain, the parent decides unilaterally if to own or rent over $[t, t + dt)$. Parents who accepted the bargain must own. Low-wealth parents must rent.

3. Gift stage: If no bargain has been reached, the child and the parent decide unilaterally on gifts, $g_t^k \leq 0$ and $g_t^p \geq 0$, respectively. We denote the net transfer flow in this stage by $\tilde{Q}_t \equiv g_t^p - g_t^k$.[68]

4. Care stage: If no bargain has been reached in the bargaining stage, the parent unilaterally decides between NH, FHC and MA, subject to the MA means test. Otherwise, the parent has to honor the bargain.

5.+6: Consumption and wealth: As Stages 4.+5. in the basic illustrative model.

Assumptions. For the sake of the illustrative model we make two assumptions on parameters, which we relax in the quantitative model: A1) $C_{ma} > y^p - \beta y^k$ and A2) $p_{fhc} = p_{bc}$. A1 implies that a low-wealth parent always opts for Medicaid.[69] A2 implies that FHC has the same (effective) cost as NH for high-wealth parents. Yet, since FHC has the disadvantage that it restricts the parent's consumption choices, FHC is an inferior technology to NH, just as owning was inferior to renting in the basic model. We make this assumption to make the following point: The FHC+own arrangement can commit the family to a high-bequest equilibrium and thus be valuable to families (with high-opportunity cost children). Finally, it is convenient to denote the cost advantage of IC over NH by $D_{ic} \equiv p_{nh} - \beta y^k$. As is intuitive, the sign of D_{ic} determines if the equilibrium features IC or not. As in the model without care, we set the child's continuation value at a high bequest to $B = [u(y^k + r) - u(y^k)]/\rho$.

HJBs for poor parent. As before, we solve the game by backward induction on its stages. Consider first the situation in which the parent has low wealth. If offering IC, the child asks for a transfer $Q \geq \beta y^k$ to be compensated for giving IC, which will be rejected by the parent due to A2.

[67] Note that we now also allow for positive transfers since the parent may receive a service from the child in the form of IC, which makes $Q_t > 0$ a reasonable outcome.

[68] Since there is no altruism in this illustrative model, optimal gifts will always be zero in this stage. Again, we include them merely so that the renting technology is not at an inherent disadvantage with respect to owning.

[69] This is so because the child asks for a transfer of at least βy^k to be compensated for giving IC, which the parent then rejects.

Thus the outcome is Medicaid and the HJBs at low wealth are given by

$$(\rho+\delta)V_0^k = u(y^k), \tag{24}$$

$$(\rho+\delta)V_0^p = u(C_{ma}). \tag{25}$$

Hamiltonians for wealthy parent. Consider now the situation in which the parent has high wealth. As in the basic model, the parent's value from different tuples (c^p, Q) under different regimes $reg \in \{$NH, IC+rent, IC+own,FHC+own$\}$ given the equilibrium continuation values V_1^p and V_0^p is, to a first order,

$$\tilde{V}_1^p \simeq (1-\rho dt-\delta dt)V_1^k + \big[\underbrace{u(c^p)+(y_{reg}^p - c^p - Q)\Delta V^p}_{\equiv H_{reg}^p(c^p,Q)}\big]dt,$$

where y_{reg}^p is the parent's endowment minus the cost of care under regime reg and where we denote again $\Delta V^p = V_1^p - V_0^p$. The regime-specific Hamiltonian functions $\{H_{reg}(c^p, Q)\}$ defined here summarize the parent's preferences over allocations (c^p, Q) in the limit as $dt \to 0$. Before we write out these Hamiltonians, we state Bellman's Principle also for the child:

$$\tilde{V}_1^k \simeq (1-\rho dt-\delta dt)V_1^k + \delta dt B + \big[\underbrace{u(y_{reg}^k + Q)+(y_{reg}^p - c^p - Q)\Delta V^k}_{\equiv H_{reg}^k(c^p,Q)}\big]dt,$$

where y_{reg}^k is the child's endowment minus the (potential) cost of caregiving in regime reg and where again the Hamiltonian functions $\{H_{reg}^k\}$ are specific to each regime. We will now state the Hamiltonian functions explicitly and solve for the child's optimal transfer offer Q_{reg} for all four regimes.

1. **Outside option**: Having high wealth, MA is not an option for the parent, so the parent can either obtain FHC at price p_{fhc} (and own) or by entering a NH (and rent) at cost $p_{nh} = r + p_{bc}$. By Assumption A2, $p_{fhc} = p_{bc}$ and thus the two options have the same effective cost. Since renting (NH) increases the feasible set of consumption choices, the parent will always choose to rent and again chooses consumption according to the FOC $u'(c_{rent}^p) = \Delta V^p$. In the gift-giving stage, the parent chooses $g^p = 0$ since she is not altruistic towards the child. The child chooses the gift $g^k \leq 0$ according to the FOC $u'(y^k - g^k) \geq \Delta V^k$, which holds with inequality for corner solutions $g^{k^*} = 0$ and with equality otherwise. As in the basic model, it could occur that $g^k > 0$ and that the child wants to save through the parent, depending on the parameter configuration. But our choice of the child's continuation value at death B, however, again ensures that the child is a natural borrower, i.e., her consumption path is weakly increasing over time. Players' Hamiltonians under the outside option are thus given

by

$$H^p_{out} = u(c^p_{rent}) + (y^p - p_{nh} - c^p_{rent})\Delta V^p, \tag{26}$$
$$H^k_{out} = u(y^k) + (y^p - p_{nh} - c^p_{rent})\Delta V^k. \tag{27}$$

2. **FHC+own**: Next to the outside option, the second arrangement involving formal care is *FHC+own*. Given a transfer Q, the Hamiltonians for this arrangement are given by

$$H^p_{fhc,own}(Q) = u(y^p - p_{fhc} - Q), \tag{28}$$
$$H^k_{fhc,own}(Q) = u(y^k + Q). \tag{29}$$

   Again, by the monotonicity properties of these Hamiltonians the child's optimal transfer choice in this regime is the transfer $Q_{fhc,own}$ that makes the parent indifferent to the outside option:

$$H^p_{fhc,own}(Q_{fhc,own}) = H^p_{out}. \tag{30}$$

   The FHC+own allocation can be a Pareto-improvement over the outside option, as is the case in the example depicted in the left panel of Figure B.2. The logic of this graph is entirely analogous to the graph for the model without LTC (see Fig. 6 in the main text). The only change is that the parent endowment is reduced by p_{nh} since formal care is taking place. We will now turn to the allocations involving IC, which are novel with respect to the basic model.

3. **IC+rent**: If the child proposes the inside option IC+rent, this implies that parent wealth is liquid and the parent chooses consumption c^p_{rent} as under the outside option. Gifts are zero and the housing choice is specified by the contract, thus the players' Hamiltonians for a given transfer Q are

$$H^p_{ic,rent}(Q) = u(c^p_{rent}) + (y^p - c^p_{rent} - Q)\Delta V^p, \tag{31}$$
$$H^k_{ic,rent}(Q) = u\big((1-\beta)y^k + Q\big) + (y^p - c^p_{rent} - Q)\Delta V^k, \tag{32}$$

   where we note that now the child's income is modified, not the parent's. If the child offers IC+rent in the bargaining stage, it will offer the transfer $Q_{ic,rent}$ that maximizes her Hamiltonian subject to the parent being least as well off as under the outside option. The child's problem for the optimal offer in this regime is thus

$$\max_{Q \in \mathbb{R}} H^k_{ic,rent}(Q)$$
$$\text{s.t. } H^p_{ic,rent}(Q) \geq H^p_{out}.$$

We obtain the maximizer $Q_{ic,rent}$ for this problem by solving

$$H^p_{ic,rent}(Q_{ic,rent}) = H^p_{out}. \tag{33}$$

Comparing the parent's outside option in (26) and her payoff under the inside option (31), we see that the solution is the transfer offer $Q_{ic,rent} = p_{nh} = \beta y^k + D_{ic}$, under which the child extracts the entire surplus from IC and makes the parent exactly indifferent to entering a nursing home. We then verify that $H^k_{ic,rent}$ is increasing in Q for $Q \leq Q_{ic,rent}$, i.e., that the child really wants to maximize the transfer and not save through the parent (which is again insured by our choice for B). Figure B.2 shows this as the *IC+rent subgame outcome*. Note that for the parent, this allocation is (value-)equivalent to the outside option; we thus call this point the parent's *as-if outside option*. We similarly mark an as-if outside option for the child under IC: Note that the child consumes the same as under the outside option if receiving a transfer βy^k and that the parent spends down wealth at the same pace as under the outside option when consuming $c^p_{rent} + D_{ic}$ (since the parent saves $D_{ic} = p_{nh} - \beta y^k$ under IC). The two as-if outside options then lead to the grey lens with Pareto improvements over the outside option. The widening of the lens with respect to the left panel (FHC) reflects the efficiency advantage of IC, i.e. the fact that $D_{ic} > 0$.

4. **IC+own**. If the child proposes IC and the parent to own, the parent must choose zero savings. Gifts are again zero and the Hamiltonians as a function of the transfer Q are

$$H^p_{ic,own}(Q) = u(y^p - Q), \tag{34}$$
$$H^k_{ic,own}(Q) = u\big((1-\beta)y^k + Q\big). \tag{35}$$

These Hamiltonians are equivalent to the game without LTC, with the exception that the transfer Q can now be either positive and negative. The child will set the maximal Q that makes the parent prefer the bargain over the outside option. Since $H^k_{ic,own}$ is strictly increasing in Q and $H^p_{ic,own}$ is strictly decreasing in Q, the optimal transfer $Q_{ic,own}$ offered by the child in this regime solves

$$H^p_{ic,own}(Q_{ic,own}) = H^p_{out}. \tag{36}$$

Figure B.2: Payoffs from dt-allocations involving IC ($a_t^p = 1$, illustrative model with LTC)

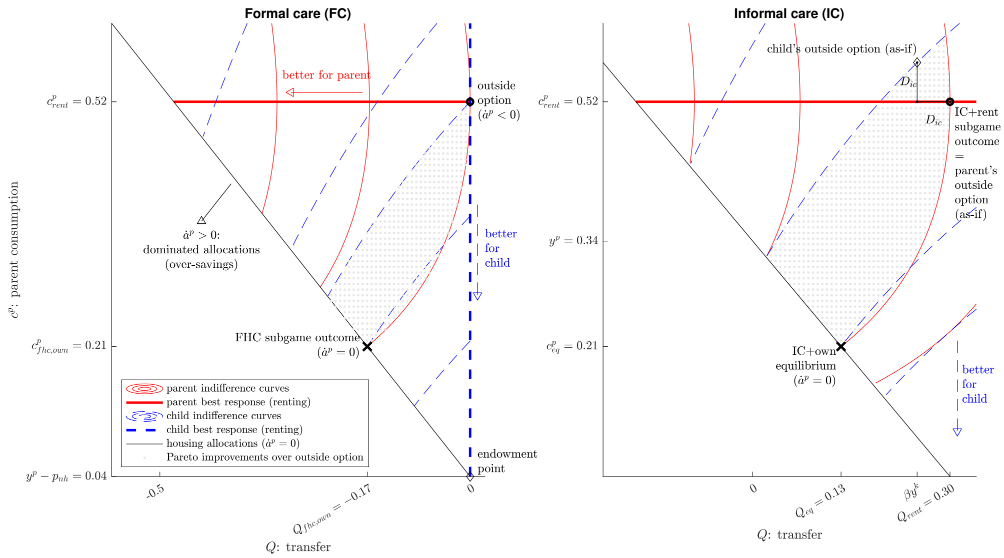


Figure shows level lines of players' Hamiltonians under FC in left panel (functions $H^i_{reg=fc}(c^p, Q)$ for $i \in \{k, p\}$ with incomes$y^k_{reg=fc} = y^k$ and $y^p_{reg=ic} = y^p - p_{nh}$) and under IC in right panel (functions $H^i_{reg=ic}(c^p, Q)$ for for $y^k_{reg=ic} = (1-\beta)y^k$ and $y^p_{reg=ic} = y^p$) for illustrative model with LTC in the situation in which parent has high wealth. Parameters : $u(c) = \ln(c)$, $\rho = r = 0.04$, $y^k = 1$, $y^p = 0.34$, $\delta = 1/3$; $B = [u(y^k + r) - u(y^k)]/\rho$, $\beta = 0.25$, $p_{nh} = 0.3$, $C_{ma} = 0.1$.

This outcome is shown in Figure B.2 as the *IC+own equilibrium*. The child will prefer to offer this allocation to the IC+rent outcome if it lies on a higher indifference curve, which is the case under the chosen parameterization. We thus have an IC+own equilibrium and $Q_{eq} = Q_{ic,own}$.

HJBs when parent wealthy. Putting all options together, the child picks the most advantageous out of the four possible regimes. The child's HJB for $a^p = 1$ thus reads

$$(\rho + \delta)V_1^k = \delta B + \max\left\{H^k_{out}, H^k_{ic,rent}(Q_{ic,rent}), H^k_{ic,own}(Q_{ic,own}), H^k_{fhc,liq}(Q_{fhc,liq})\right\}. \tag{37}$$

The parent's HJB is given simply by

$$(\rho + \delta)V_1^p = H^p_{reg^*}(Q_{reg^*}), \tag{38}$$

where reg^* is the optimal regime picked by the child in (37).

D_{ic} **determines IC.** By standard arguments from bargaining theory, the optimal child offer induces the efficient care form. This means that the child offers an option involving IC if and only if $D_{ic} = p_{bc} - \beta y^k > 0$, i.e. if the child's opportunity cost of giving care is lower than the market price of care.

Algorithm. The algorithm to solve for an equilibrium is as follows.

$D_{ic} < 0$: If IC is inefficient, it will not be part of the equilibrium and the game can be solved in the same fashion as the basic illustrative model, but re-defining the parents endowment net of the cost of formal care, $y^p_{fc} = y^p - p_{bc}$. There can then be a housing equilibrium (FHC+own) or a renting equilibrium (rent+NH).

$D_{ic} \geq 0$: If IC is efficient, it will be part of the equilibrium. The solution algorithm has to be modified then, but only slightly. We can find a housing equilibrium (IC+own) following exactly the same steps as for the basic illustrative model, but changing the child's endowment to $(1-\beta)y^k$. In the Step 6 of the algorithm, we then have to check that the option IC+own dominates IC+rent for the child, i.e. if $H^k_{ic,own}(Q_{ic,own}) \geq H^k_{ic,rent}(Q_{ic,rent})$.[70]

Planner's problem: Never entering MA is an efficient outcome. In the main text, we claim that avoiding MA in favor of IC is part of ex-ante efficient allocations that agents would contract on if they had the power to commit. We now show that in the numerical example from Figure B.2, all ex-ante Pareto-improving allocations are indeed such that the parent receives IC (and not MA) once the parent has arrived at low wealth.

We first show how to find the ex-ante efficient allocations in this economy. Consider a social planner who puts weight $\eta \in [0,1]$ on the parent and weight $(1-\eta)$ on the child. We only consider the case $D_{ic} > 0$, i.e., IC dominates formal care (but not necessarily MA). We proceed again by backward induction. Once the parent is dead, the planner's value is zero if the parent has low wealth and it is $B_\eta = (1-\eta)B$ if the bequest is high. When the parent is alive and has low wealth, the planner's HJB is

$$(\rho+\delta)V^\eta_0 = \max\{U^\eta_{ma}, U^\eta_{ic}\}, \tag{39}$$

$$\text{where } U^\eta_{ma} = \eta u(C_{ma}) + (1-\eta)u(y^k) \tag{40}$$

$$\text{and } U^\eta_{ic} = \max_{Q\in\mathbb{R}} \left\{\eta u(y^p - Q) + (1-\eta)u\big((1-\beta)y^k + Q\big)\right\}, \tag{41}$$

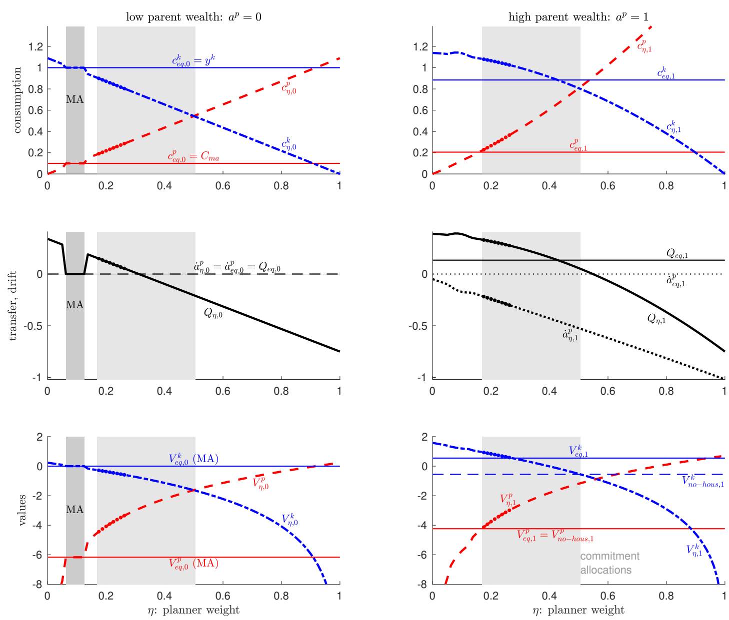
that is, the planner chooses between Medicaid and the best allocation that is attainable under IC. Denote by $Q_{\eta,0}$ the maximizing transfer under IC in (41), which is characterized by the FOC

$$\eta u'(y^p - Q_{\eta,0}) = (1-\eta)u'\big((1-\beta)y^k + Q_{\eta,0}\big). \tag{42}$$

The left panels of Figure B.3 show the planner's solution for the low-wealth state for the numerical example from Fig B.2. We see a similar picture as in the basic model without LTC, but the planner sends the parent to Medicaid for low values of η. For very low weights on the parent, however, the planner does not use Medicaid but chooses IC in order to extract even more transfers from parent

[70] We do not have to check that IC+own dominates the outside option, since the child automatically prefers IC+rent over the outside option when offering $Q_{ic,rent} = p_{nh} = \beta y^k + D_{ic}$ to the parent under our assumption on D_{ic}.

Figure B.3: Planner's solution in illustrative model with LTC



Parameters as in Fig. B.2. Solution to planner's problem in illustrative model with LTC, varying weight $\eta \in [0, 1]$. Variables with subscript eq refer to equilibrium values from the non-cooperative game with the housing trust. Dark grey areas: Planner chooses Medicaid. Light grey areas: commitment allocations, i.e., Pareto improvements over non-cooperative equilibrium in model without housing. Dotted line segments: Pareto improvements over (housing-trust) equilibrium.

in favor of the child.

Consider now the planner's problem for the high-wealth state. Obviously, the planner chooses renting since it (weakly) dominates owning (the renting option includes zero savings as one possible option). Also, since we assumed $D_{ic} > 0$, IC is preferred to FC. Thus, the planner's HJB when the parent has high wealth is

$$(\rho+\delta)V_1^\eta = \delta B^\eta + \max_{c^p\geq 0, Q\in\mathbb{R}} \Big\{ \underbrace{\eta u(c^p) + (1-\eta)u((1-\beta)y^k + Q) + (y^p - Q - c^p)\Delta V^\eta}_{\equiv H^\eta(c^p, Q; \Delta V^\eta)} \Big\}, \quad (43)$$

where we define $\Delta V^\eta \equiv V_1^\eta - V_0^\eta$. The first-order conditions for c^p and Q at an unconstrained solution (i.e., one with non-positive savings)

$$\eta u'(c^p_{\eta,1}) = \Delta V^\eta, \quad (44)$$

$$(1-\eta)u'(\underbrace{y^k + Q_{\eta,1}}_{=c^k_{\eta,1}}) = \Delta V^\eta. \quad (45)$$

Suppose the expressions (44) and (45) imply that savings are positive, i.e., $y^p - Q_{\eta,1} - c^p_{\eta,1} > 0$.

Since wealth cannot increase when $a^p = 1$, this cannot be optimal. Instead, the solution is then given by the constrained solution, in which the planner chooses the zero-savings allocation that maximizes the planner's utility. But this is the same allocation as the one from the problem with zero wealth, so that we have $Q_{\eta,1} = Q_{\eta,0}$ and $c^p_{\eta,1} = y^p - Q_{\eta,1} = c^p_{\eta,0}$ in this case.

The planner's problem has a unique solution by standard arguments. We solve for the planner's solution using the following algorithm, fixing some $\eta \in [0, 1]$:

1. Obtain the allocation and the value V_0^η for low wealth by solving the program in (39)-(41).

2. To obtain the allocation under high wealth, guess some $\Delta V^\eta \geq 0$.

3. Obtain $c^p_{\eta,1}$ from (44) and $Q_{\eta,1}$ from (45). If $y^p - c^p_{\eta,1} - Q_{\eta,1} > 0$ (savings positive), take the constrained solution and set $c^p_{\eta,1} = c^p_{\eta,0}$ and $Q_{\eta,1} = Q_{\eta,0}$.

4. Verify whether the allocation obtained in Step 3 satisfies the HJB (43), i.e. check the equality

$$H^\eta(c^p_{\eta,1}, Q_{\eta,1}; \Delta V^\eta) + \delta B_\eta - (\rho + \delta)(V_0^\eta + \Delta V_1^\eta) = 0,$$

   If the equality holds, the guess ΔV^η from Step 2 is the solution.

5. If the equality in the last step is violated, adjust the guess for ΔV^η up or downward. Since the Hamiltonian H^η in the last equation is decreasing in ΔV^η (note here that $c^p_{\eta,1}$ and $Q_{\eta,1}$ are deceasing in ΔV^η), this procedure must yield a unique solution to the HJB (43).

The two right panels in Figure B.3 show the planner's solution for the high-wealth state. The lower-right panel compares the resulting value functions to the non-cooperative equilibrium outcome (i.e., the housing-trust allocation) for both agents. Again, we mark in light grey the commitment allocations (allocations that Pareto-dominate the allocation ex ante that obtains in the non-cooperative equilibrium of the model without housing, i.e. where only regimes IC+rent and NH+rent are feasible). We see that under all these allocations, the child promises the parent to give IC in the low-wealth state. Go back to the two panels on the left to see this and observe that the commitment allocations (light grey) do not overlap with the Medicaid area (darker grey). From this we conclude that avoiding MA is an outcome of a housing equilibrium that is ex-ante desirable in this example, as was claimed. Furthermore, observe that the grey area is now much larger than in the case without LTC in Fig. B.1, reflecting that the efficiency gains from HACC are much larger with the added LTC risk.

C Theory appendix: Quantitative model

C.1 Care technologies and the government

We assume the following linear production technologies for the consumption good (indexed by c), basic care services in nursing homes (bc), and formal-home-care services (fhc):

$$Y_c = L_c, \qquad Y_{bc} = A_{bc} L_{bc}, \qquad Y_{fhc} = A_{fhc} L_{fhc}, \tag{1}$$

where Y_i is the quantity produced in sector i, L_i is the labor input, and A_i is productivity. We normalize $A_c = 1$. Markets for the three goods are perfectly competitive, thus firms' profits are zero equilibrium prices of care in terms of the consumption good are

$$p_{bc} = \frac{1}{A_{bc}}, \qquad p_{fhc} = \frac{1}{A_{fhc}}. \tag{2}$$

The government provides Medicaid slots, paying p_{bc} for care services from nursing homes and y_{ma} units of the consumption good to provide for room, board etc. y_{ma} is a parameter for which we allow $y_{ma} > C_{ma}$, since Medicaid may have stigma effects.

The government runs a balanced budget in each period. The budget constraint is

$$\begin{aligned} &\underbrace{\int \left[T^p(z) + T^k(z, i^*(z))\right] \mathrm{d}\lambda(z)}_{\text{tax revenue}} \\ &= \underbrace{\int (1 - i^*(z)) \Big[m^*(z) \big(p_{bc} + y_{ma} - y_{ss}(\epsilon^p)\big) + (1 - m^*(z)) s_{pp} \Big] \mathrm{d}\lambda(z)}_{\text{spending on Medicaid and formal-care subsidy}} \\ &+ \underbrace{\int \int \left[\max\{M - a^p, 0\} \mathrm{d}F_m(M)\right] \delta_m(z) \mathrm{d}\lambda(z)}_{\text{means-tested benefits covering medical expenditures}} + \underbrace{G}_{\text{other expenditures}} \end{aligned} \tag{3}$$

where $i^*(\cdot)$ and $m^*(\cdot)$ are the equilibrium policy functions for IC and MA and where $\lambda(z)$ denotes the ergodic measure of families over the state space in equilibrium. $T^p(z)$ and $)T^k(z)$ are tax revenues from a parent or child in state z, respectively. G are other government expenditures, which we hold constant across counterfactuals. s_{pp} is a subsidy to formal-care services (both in nursing homes and at home); this subsidy is zero in the baseline and in all counterfactuals except *Sweden*, in which we set it equal to p_{bc}. In this budget constraint, we omit revenue to the government from assets (a^p) and transfers ($Q + g^k$) that fall prey to the Medicaid means test; these are zero in equilibrium since the parent endogenously spends down all resources before entering Medicaid.

C.2 Agents' problems

Here, we characterize the agents' problems by stating the Hamilton-Jacobi-Bellman (HJB) equations. We do so by backward induction over the five stages of the instantaneous game. For this purpose, let $V^{u,n}(\cdot)$ denote the value function for player $u \in \{k, p\}$ when entering stage $n \in \{1, \ldots, 5\}$ and let $V^u = V^{u,1}$ denote the value function before the first stage. Let $H^{u,n}(\cdot)$ denote the corresponding Hamiltonian functions, which take the vector $V_a \equiv [V^k_{a^k}, V^k_{a^p}, V^p_{a^k}, V^p_{a^p}]$ of the partial the derivatives of *both* players' value functions as their arguments.[71] Furthermore, denote by $y_{u,n}$ player u's flow-income-on-hand in Stage n of the game, which is determined by decisions in the stages before n; also, let $y_n \equiv [y_{k,n}, y_{p,n}]$ denote the vector of both incomes. Since Stages 3 to 5 are about temporary decisions that involve only flow variables, we use the Hamiltonians to characterize decisions in these stages. However, we then have to switch to the value functions for Stages 1 and 2 since decisions in these stages have permanent effects on the state variables.

Stage 5 (consumption). We will first state an indirect felicity function to facilitate the exposition. Denote by e^u household u's expenditure flow on housing and consumption jointly, where $u \in \{k, p\}$. Given a fixed expenditure level e^u, the split between consumption and housing is determined from the problems

$$\tilde{u}^k(e^k; z) = \max_{c^k \geq 0, \tilde{h}^k \geq 0} u\big(c^k, \tilde{h}^k; n(j^k, s)\big) \tag{4}$$

$$\text{s.t. } c^k + (r + \delta)\tilde{h}^k \leq e^k,$$

$$\tilde{u}^p(e^p; z, m) = \begin{cases} \max_{c^p \geq 0, \tilde{h} \in \tilde{H}(h)} u\big(c^p, \tilde{h}^p; n(j^p, s)\big) \ \text{ s.t. } \ c^p + E_h(h; \tilde{h}) \leq e^p & \text{if } m = 0, \\ \frac{C_{ma}^{1-\gamma}}{1-\gamma} & \text{if } m = 1. \end{cases} \tag{5}$$

Note here that the child always rents and the parent consumes the consumption floor when in Medicaid ($m = 1$). Appendix C.3 derives the functional form of $\tilde{u}^k(\cdot)$ and $\tilde{u}^p(\cdot)$. Using these indirect utility functions and taking the decisions from the previous stages (IC, housing, gifts and

[71] The derivatives of the other player's value function enter here since decisions of both agents are intertwined, i.e., we are dealing with a game instead of the more usual situation of a one-player optimization problem.

MA) and Stage-5 incomes as given, the Stage-5 Hamiltonians are

$$H^{k,5}(z, V_a; y_5, i, m) = \max_{e^k \in \mathbb{E}^k} \left\{ \alpha^k \tilde{u}^p(e^p; z, m) + \tilde{u}^k(e^k; z) + \dot{a}^p V^k_{a^p} + \dot{a}^k V^k_{a^k} \right\}, \tag{6}$$

$$H^{p,5}(z, V_a; y_5, i, m) = \max_{e^p \in \mathbb{E}^p} \left\{ \tilde{u}^p(e^p; z, m) + \alpha^p \tilde{u}^k(e^k; z) + \dot{a}^p V^p_{a^p} + \dot{a}^k V^p_{a^k} \right\}, \tag{7}$$

$$\text{where} \qquad \mathbb{E}^u = \begin{cases} [0, \infty) & \text{if } a^u > 0, \\ [0, y_{u,5}] & \text{otherwise,} \end{cases}$$

$$\dot{a}^u = \begin{cases} 0 & \text{if } u = p \text{ and } m = 1, \\ y_{u,5} - e^u & \text{otherwise.} \end{cases}$$

This says that both players optimally trade off instantaneous felicity and the marginal value of savings. Note here that consumption cannot exceed flow income once wealth is depleted ($a^j = 0$), in which case the agent may be constrained.[72] Parents in MA are bound to consume the consumption floor given to them by the government and cannot save.[73]

Stage 4 (Medicaid). We guess for now that the parent will only choose MA once she has zero assets. We will later verify that the parent's value function is increasing in a^p, which is sufficient for this choice to be optimal.[74] Given the IC decision, i, and Stage-4 incomes, y_4, the Stage-4 Hamiltonians are

$$\begin{aligned} H^{u,4}(z, V_a; y_4, i) = {} & m H^{u,5}(z, V_a; [y_{k,4}, C_{ma}], 0, 1) \\ & + (1-m) H^{u,5}(z, V_a; [y_{k,4}, y_{p,4} - p_{pp}(h)], i, 0), \qquad \text{for } u \in \{k, p\}, \end{aligned} \tag{8}$$

$$\text{where} \qquad m = \begin{cases} 1 & \text{if } s \in \{1,2\} \text{ and } i = 0 \text{ and } a^p = 0 \text{ and} \\ & H^{p,5}(\cdot; [y_{k,4}, C_{ma}], 0, 1) > H^{p,5}(\cdot; [y_{k,4}, y_{p,4} - p_{pp}(h)], 0, 0), \\ 0 & \text{otherwise.} \end{cases}$$

$$\text{and} \quad p_{pp}(h) = \mathbb{I}(h = 0) p_{bc} + \mathbb{I}(h > 0) p_{fhc}.$$

The second equation gives the optimal MA decision, which is relevant only if the family has decided for formal care ($s = 1$ and $i = 0$) and the parent has no financial wealth ($a^p = 0$). The parent chooses MA if the value from doing so in Stage 4 is higher than that of choosing private-

[72] Also, we formally allow for negative flow income for the parent in Stage 5, $y_{p,4} < 0$, in which case we set $\mathbb{C}^p = \emptyset$ and $H^p_5 = -\infty$. This occurs when the nursing home cost exceeds the parent's income.

[73] We are not covering the case when parents choose Medicaid having positive financial assets, $a^p > 0$, in which case they would lose a^p; we rule this case out by guess-and-verify, see Stage 4 (Medicaid).

[74] To see this, note that the parent could always delay MA by an instant, buy PP instead, and choose expenditure $e^p > C_{ma}$ as a renter. This strategy obviously yields a higher utility flow and higher assets (and thus more future options) after an instant $\mathrm{d}t$ than handing in a positive stock of wealth to the government.

payer (PP) care. The last line specifies that when paying privately for care, renters pay the price of basic care in a nursing home, p_{bc}, while owners pay the price for FHC, p_{fhc}.

Stage 3 (gift-giving). Since the decisions in Stages 1 and 2 entail permanent changes in the state variables, we now switch from Hamiltonians to value functions in levels. Given the IC decision and Stage-3 incomes, the Stage-3 values satisfy the HJBs

$$
\begin{aligned}
V^{u,3}(z, V_a; y_3, i) =& V^u(z) + \mathrm{d}t\Big[\max_{g^u \in \mathbb{G}^u} H^{u,4}(z, V_a; [y_{k,3} + g^p - g^k, y_{p,3} - g^p + g^k], i)\Big] \\
&+ \mathrm{d}t\Big[V^u_{j^u}(z) - \rho V^u(z) + J^u(z)\Big] \qquad \text{for } u \in \{k, p\}
\end{aligned} \tag{9}
$$

,

$$
\text{where} \qquad \mathbb{G}^u = \begin{cases} \big[0, \bar{T}_u(z)\big) & \text{if } a^u > 0, \\ \{0\} & \text{if } u = p \text{ and } s \in \{1,2\} \text{ and } i = 0 \text{ and } a^p = 0, \\ [0, y_{u,3}] & \text{otherwise,} \end{cases}
$$

where we recall that $V^u(\cdot)$ denotes the value function before Stage 1 and where $\{\bar{T}_u(z)\}_{u\in\{k,p\}}$ are (large) exogenous bounds that we impose on transfer flows.[75] The age derivative $V^u_{j^u}$ enters in this HJB since age is a state variable. $J^u(z)$ stands for a series of jump terms, encoding shocks to productivity, health, and medical spending, which we define below. Players choose non-negative gift flows, which are constrained to their income-on-hand in case they have zero wealth. We rule out gifts by parents in formal care when they have zero wealth. We find that the vast majority of gifts flow when the recipient is constrained, which is quantitatively in line with previous work by Barczyk & Kredler, who guessed and verified that gifts flow only to constrained recipients.[76]

Stage 2 (unilateral house-selling). Given a bargaining outcome $b = [b_i, b_k]$ from the first stage (where b_i denotes the IC arrangement and b_k is an indicator if the house is to be kept under the

[75] We set these bounds as multiples of the receiving agents' incomes in the computations. They only bind on the interior of the asset space in equilibrium.

[76] Here we find positive gifts to non-constrained recipients for very rich dynasties at high ages. These gifts are infrequent in the economy and play no important economic role. However, it is crucial to allow for them in order for our value-function-iteration algorithm to work.

bargaining arrangement), the Stage-2 value functions are

$$V^{u,2}(z, V_a; y_2, b) = xV^{u,3}([\cdot, a^p + h, \cdot, 0], V_a; y_2, b_i) + (1-x)V^{u,3}(z, V_a; y_2, b_i)$$
$$\text{for } u \in \{k, p\},$$
$$\text{where } x = \begin{cases} 1 & \text{if } h > 0 \text{ and } b_k = 0 \text{ and} \\ & \mathbb{I}\{V^{p,3}([\cdot, a^p + h, \cdot, 0], \cdot) > V^{p,3}([\cdot, a^p, \cdot, h], \cdot)\}. \\ 0 & \text{otherwise.} \end{cases}$$

This says that parents who are not bound by a bargaining agreement ($b_k = 0$) decide to sell the house if and only if their value as renters with additional financial wealth h is higher than the value of keeping the house.

Stage 1 (bargaining). Finally, in Stage 1 the parent proposes her preferred arrangement among those that make the child at least indifferent to the outside option. Let s ("strong") denote the index of the player who holds bargaining power and let w ("weak") be the index of the other player; then the bargaining solution satisfies

$$[b^*, Q^*] = \arg\max_{b,Q} V^{2,s}\big(z, V_a; [y_1^k + Q - b_i\beta y(\epsilon^k, j^p), y_1^p - Q], b\big) \tag{10}$$
$$\text{s.t. } b \in \mathcal{B}(z), \qquad Q \in [\bar{Q}_l(z, b), \bar{Q}_u(z, b)],$$
$$V^{2,w}\big(z, V_a; [y_1^k + Q - b_i\beta y(\epsilon^k, j^p), y_1^p - Q], b\big) \geq V^{2,w}\big(z, V_a; [y_1^k, y_1^p], out\big).$$

Note here that the bargaining transfer modifies Stage-2 flow income for both agents, i.e., the vector y_2, and that any arrangement involving IC lowers the child's labor income by $\beta y(\epsilon^k, j^p)$. Finally, given this bargaining outcome the value functions entering Stage 1 are

$$V^u(z) = V^{u,2}\big(z, V_a; [y_1^k + Q^* - b_i^*\beta y(\epsilon^k, j^p), y_1^p - Q^*], b^*\big) \qquad \text{for } u \in \{k, p\}, \tag{11}$$

where (b^*, Q^*) denotes the strong party's optimal choice in (10) (which equals the outside option if there is no surplus from any inside option). This completes our recursive characterization of the value functions over the game's stages.

C.3 HJBs and solution of the game

Jump terms. First, we define the jump term $J^u(z)$ to complete the statement of the HJB, Eq. (9):

$$J^u(z) = \underbrace{\sum_{s' \in S} \delta_s(j^p, \epsilon^p, s)[s, s'] V^u\big(z'_s(z; s')\big)}_{\text{health and death shock}} + \underbrace{\sum_{\epsilon' \in E} \delta_\epsilon[\epsilon_k, \epsilon'] V^u(\cdot, \epsilon')}_{\text{shock to income}} + \\ + \delta_m(j^p, \epsilon^p, s) \underbrace{\int_0^{\bar{m}} \left(V^u(\max\{a^p - m, 0\}, \cdot) - V^u(z)\right) \mathrm{d}M(m)}_{\text{medical spending shock}}, \tag{12}$$

$$\text{where } z'_s(z; s') \equiv \begin{cases} [a^k + a^p + h, 0, s = 3, \epsilon^k, \epsilon^p, h = 0, j^p] & \text{if } s' = 3 \text{ (death shock)}, \\ z & \text{otherwise}, \end{cases} \tag{13}$$

where we use square brackets to index the hazard matrices that are a function of the state z, e.g., $\delta_s(z)[j, k]$ denotes the row-j, column k element of the health hazard (s) matrix δ_s that is contingent on state z. Eq. (13) introduces a function $z'_s(\cdot; s')$ that returns the new state after a health transition to state s' has taken place. Note that the state variables change only if the shock is death, in which case parent assets (both financial and housing) become zero and are inherited to the child. Also the medical-spending shock entails a jump in the asset variables since these shocks are assumed to be lumpy. When a medical shock hits (the lump sum m), the parent's wealth falls by m, but not below zero since the government steps in in this case. Finally, notice that the sums over health and productivity shocks also contain the familiar negative terms since we defined the diagonal elements of the hazard matrices such that the rows of the matrices sum up to zero.

Indirect utility function. The FOCs for a renter with respect to consumption, c, and housing, h, given total expenditures e in the Problems (4) and (5) yield

$$c = \xi e, \qquad\qquad x = (1 - \xi) \frac{e}{r + \delta}.$$

Thus, the Cobb-Douglas aggregate for a renter is given by

$$c^\xi x^{1-\xi} = \xi^\xi e^\xi \left(\frac{1 - \xi}{r + \delta}\right)^{1-\xi} e^{1-\xi} = \xi^\xi \left(\frac{1 - \xi}{r + \delta}\right)^{1-\xi} e,$$

which is homogeneous of degree one in e. For a homeowner, the house size is pre-determined and so the solution to the intra-temporal problem is simply to set $c = e - \delta h$, the aggregate becoming

$$c^\xi x^{1-\xi} = (\omega h)^{1-\xi} \tilde{e}^\xi,$$

which is homogeneous of degree ξ in after-housing-depreciation expenditures $\tilde{e} \equiv e - \delta h$. Flow utility for a renter household is then given by

$$u(c, x; n, 0) = \underbrace{n \left(\left(\frac{\xi^{\xi}}{\phi(n)} \right) \left(\frac{1-\xi}{r+\delta} \right)^{1-\xi} \right)^{1-\gamma}}_{\equiv A(n,0)} \frac{e^{1-\gamma}}{1-\gamma},$$

where we have introduced the utility shifter $A(\cdot)$, which we will also define for owners now. For a homeowner optimal expenditure yields utility

$$u(c, x; n, h) = \underbrace{n\xi \left(\frac{(\omega h)^{(1-\xi)}}{\phi(n)} \right)^{1-\gamma}}_{\equiv A(n,h), \text{ for } h>0} \frac{\tilde{e}^{\xi(1-\gamma)}}{\xi(1-\gamma)}.$$

Upon substituting optimal expenditure we obtain the indirect felicity function

$$\tilde{u}(e; n, h) = \begin{cases} A(n,0)\frac{e^{1-\gamma}}{1-\gamma} & \text{if } h = 0 \text{ (renter)}, \\ A(n,h)\frac{\tilde{e}^{\xi(1-\gamma)}}{\xi(1-\gamma)} & \text{if } h > 0 \text{ (owner)}. \end{cases} \tag{14}$$

Consumption. As has been discussed in our previous work, the determination of expenditure is straightforward despite the fact that game-theoretic considerations are present; this occurs since consumption expenditures of the other player over a short horizon have a negligible impact on the asset stock and thus affect the marginal value of savings only to a second order. The FOC which determines optimal expenditure e^j of player j is

$$\tilde{u}_e(e^j; n, h) \geq V^j_{a^j} \quad \text{with equality if unconstrained,} \tag{15}$$

where $\tilde{u}$ is given by Equation (14) and $\tilde{u}_e$ denotes the partial derivative of $\tilde{u}$ with respect to e^j.

Medicaid. The Medicaid decision is solved for in the same way as in Barczyk & Kredler (2018), see Section 2.1.2 of their online appendix for the details.

Notation and auxiliary gift variables. Before discussing the optimal gift-giving choices and the bargaining outcome, it is useful to establish some notation. First, the "diagonal derivatives" of players' value functions are key for transfer decisions; we will use these derivatives repeatedly in this section. Define player u's *diagonal derivative* in state z as

$$\mu^u(z) \equiv V^u_{a^{-u}}(z) - V^u_{a^u}(z). \tag{16}$$

In order to determine equilibrium gifts, we make use of auxiliary gift variables, which arise in variations of our setting that we describe now. Fix state $z = (a^k, a^p, s, y^k, y^p, h)$ and assume that either the child is broke, $a^k = 0$, or the parent is broke, $a^p = 0$. Define agents' *unconstrained consumption* as the levels of consumption they would choose if facing no borrowing constraints, i.e., define them implicitly as the solution to the consumption first-order condition (FOC)

$$u_c^k(c_{unc}^k(z)) = V_{a^k}^k(z), \qquad u_c^p(c_{unc}^p(z)) = V_{a^p}^p(z). \tag{17}$$

We will drop the conditioning of c_{unc}^i and other variables on z from now on for better readability.

Consider the following two *dictator* problems. Let variables with a prime refer to the broke agent, e.g. $a' = 0$:

$$\max_{c\geq 0, c'\geq 0} \{u(c) + \alpha u(c') + (ra + y + y' - c - c')V_a\}, \tag{18}$$

$$\max_{c\geq 0, g} \{u(c) + \alpha u(c'(g)) + (ra + y - g - c)V_a + (y' + g - c'(g))V_{a'}\}, \tag{19}$$

$$\text{where} \quad c'(g) = \min\{y' + g, c'_{unc}\},$$

where we assume $V_a > V_{a'}$ and where $u(\cdot)$ is a utility function satisfying $u' > 0$, $u'' < 0$, and Inada conditions. In the first problem, the dictator agent can directly set the broke agent's consumption. In the second problem, the dictator agent sets a (possibly negative) transfer and the broke agent's consumption then realizes from the broke agent's optimal decision given the unconstrained consumption level, c'_{unc}. We now define two *desired consumption* levels from these problems: Let $\tilde{c}^p$ denote the parent's consumption if the child could dictate it and let $\tilde{c}^k$ denote child's consumption if the parent could dictate it. Formally, $\tilde{c}^p$ and $\tilde{c}^k$ are implicitly defined from the FOCs for Problem (18):

$$\alpha^p u_c^k(\tilde{c}^k) = u_c^p(c_{unc}^p), \qquad \alpha^k u_c^p(\tilde{c}^p) = u_c^k(c_{unc}^k). \tag{20}$$

We will call the transfer associated with this consumption level the *first-best transfer* in the gift-giving game; the values $g_{f.b.}^p \in (-\infty, \infty)$ and $g_{f.b.}^k \in (-\infty, \infty)$ are defined as

$$g_{f.b.}^p = \tilde{c}^k - y^k, \qquad g_{f.b.}^k = \tilde{c}^p - y^p. \tag{21}$$

It is important to note that these first-best transfers can be *negative*. In the second dictator problem, Problem (19), this first-best transfer is also optimal, unless the broke agents starts to save some of the transfer. We define the *second-best transfer* as the solution to this problem, which is:

$$g^p_{s.b.} = \min\{g^p_{f.b.}, c^k_{unc} - y^k\}, \qquad g^k_{s.b.} = \min\{g^p_{f.b.}, c^p_{unc} - y^p\}. \tag{22}$$

For the case in which both agents are broke, we will also make use of *static* first- and second-best transfers, which arise in a static gift-giving setting. They are defined implicitly as the numbers $g^p_{stat,f.b.} \in (-\infty, \infty)$ and $g^k_{stat,f.b.} \in (-\infty, \infty)$ that solve the gift-giving FOCs

$$u^p_c(y^p - g^p_{stat,f.b.}) = \alpha^p u^k(y^k + g^p_{stat,f.b.}), \tag{23}$$

$$u^k_c(y^k - g^k_{stat,f.b.}) = \alpha^k u^p(y^p + g^k_{stat,f.b.}), \tag{24}$$

Analogously to before, we define the second-best static transfer as the gift that arises when the transfer recipient decides on savings:

$$g^p_{stat,s.b.} = \min\{g^p_{stat,f.b.}, c^k_{unc} - y^k\}, \qquad g^k_{stat,s.b.} = \min\{g^k_{stat,f.b.}, c^p_{unc} - y^p\}. \tag{25}$$

Gift-giving. For optimal gift-giving, we have to distinguish if players are broke or not. In the following, only Case 1. (no agent broke) is new with respect to our previous work since we have to solve for gifts within the state space. In Cases 2.-4. (at least one agent broke), the solution from Barczyk & Kredler (2014, QE) applies; we only state the solutions here and refer the reader there for details.[77]

1. No agent broke: $a^p > 0$ and $a^k > 0$. In this case, agents' diagonal derivatives $\mu^u(z)$ determine the solution. It is obvious from Eq. (9) that the optimal policy is of bang-bang type:

   (a) $\mu^u(z) \geq 0$: The optimal gift choice is to set gifts as high as possible, i.e., $g^u(z) = \bar{T}_u(z)$.

   (b) $\mu^u(z) \leq 0$: This is the more common case, in which the agent prefers to hold on to own wealth and thus sets $g^u(z) = 0$.

2. Only child broke: $a^p > 0$ and $a^k = 0$. The solution is $g^p(z) = \max\{0, g^p_{s.b.}(z)\}$ and $g^k(z) = 0$.

3. Only parent broke: $a^p = 0$ and $a^k > 0$. The solution is $g^p(z) = 0$ and $g^k(z) = \max\{0, g^k_{s.b.}(z)\}$.

[77] If the parent chooses Medicaid in the ensuing stage, also the threshold gift at which the parent stays out of Medicaid has to be taken into account. We follow Barczyk & Kredler (2018) to do this and refer the reader to their paper for details.

4. Both agents broke: $a^p = a^k = 0$. The following cases have to be distinguished (note that (a) and (b) can be shown to be mutually exclusive):

   (a) If $g^p_{stat,f.b.}(z) > 0$, then the solution is $g^p(z) = g^p_{stat,s.b.}(z)$ and $g^k(z) = 0$.

   (b) If $g^k_{stat,f.b.}(z) > 0$, then the solution is $g^p(z) = 0$ and $g^k(z) = g^k_{stat,s.b.}(z)$.

   (c) Otherwise, no gifts flow: $g^p(z) = g^k(z) = 0$.

Bargaining. In order to reduce the set of inside options, we will first show that for disabled homeowners, we can drop the inside option *sell+IC* from the bargaining set. It turns out that the option *sell+IC* is irrelevant since its outcome is equivalent to the house being sold under the outside option. Technically, this is due to the continuous-time setup and the no-commitment assumption. The intuition is very simple: There is no commitment to what happens after the house is sold, thus the care choice will immediately switch to whatever is the bargaining outcome that prevails for renting families (at the state that the family ends up in), thus the current care bargain is irrelevant in the limit.

Proposition 2 (Irrelevance of inside option *IC+sell*) *Consider an allocation $\mathcal{A}$ and an alternative allocation $\mathcal{A}'$ that is equal to $\mathcal{A}$, but for which we replace the bargaining outcome $(sell, IC)$ by the outside option being played and the parent selling the house (i.e., $x = 1$). $\mathcal{A}$ and $\mathcal{A}'$ are equivalent in the sense that*

1. *both players' value functions are the same under the two allocations,*

2. *both are an equilibrium, and*

3. *for a given realization of a shock history, the allocation (care, consumption, gifts etc.) coincide for almost all t (i.e., except a set of Lebesgue-measure zero).*

Proof: In any state $z = (\cdot, a^p_t, h_t, t)$ in which the inside option (sell,IC) is played in allocation $\mathcal{A}$, the value for agent $j \in \{p, k\}$ is

$$V^j_{sell,IC}(\cdot, a^p_t, h, t; Q) = U^j_{sell,IC}(\cdot)dt + e^{-\rho dt}\mathbb{E}_{t,Q}\left[V^j(\cdot, a^p_{t+dt}, h = 0, t + dt)\right],$$

where $U^j_{sell,IC}(\cdot)$ is agent j's flow utility under option (sell,IC) and where $\mathbb{E}_{t,Q}$ is the conditional expectation given the equilibrium transfers Q. As we let $dt \to 0$, this converges to the value of renting, i.e.

$$\lim_{dt\to 0} V^j_{sell,IC}(\cdot, a^p, h, t; Q) = V^j(\cdot, a^p + h, h = 0, t), \tag{26}$$

where $V^j(\cdot, a^p + h, 0, t)$ is entirely determined by whichever care choice (IC or FC) is played in equilibrium at point $z' = (\cdot, a^p + h, h = 0)$; we note that this occurs since players cannot commit to future bargaining outcomes. The value under allocation $\mathcal{A}'$ is equal to the value under $\mathcal{A}$, by the same argument. Since all other elements of the two allocations are the same, the first claim of the proposition follows.

The second claim then follows immediately: Since players are indifferent between allocations $\mathcal{A}$ and $\mathcal{A}'$, replacing one choice by the other has the same value, thus it must also be a bargaining solution.

After the house is sold, IC is only given for an infinitesimal amount of time $\mathrm{d}t$, before the family reverts to the bargaining solution for IC, $i(\cdot, a^p_h, h = 0, t)$, that prevails under renting. Letting $\mathrm{d}t \to 0$, the third claim of the proposition follows. ■

We now turn to the question if an inside option is played and if so, which transfer Q is given in equilibrium. It turns out that it is fruitful to think about the gift-giving and bargaining stages jointly, since both of them involve monetary transfers that may net out. Our first task will be to solve for the equilibrium of the gift-giving sub-game (Stage 3) for any conceivable transfer $Q \in (-\infty, \infty)$ in the bargaining stage; we will impose the feasibility bounds for the different inside options later in order to have a unified treatment here, i.e., we will aim for solving the gift-giving game for all possible combinations in the Stage-3 income vector y_3. It turns out that a simplification then arises since both agents are altruistic: Transfers of large absolute magnitude will often be returned – or *undone*, at least partly – by the recipient in the gift-giving stage if the transfer goes beyond a level of consumption inequality that is tolerated by the recipient.

We start with the most complicated case, which is when both players are broke. The following proposition gives us the transfer Q that each of the agents would prefer to see in the bargaining stage in this situation; this quantity will be key to characterize the best responses in the gift-giving game.

Lemma 1 (Bliss points of gift-giving game when both agents are broke.) *Fix a state $z = (a^k, a^p, \dots)$ such that $a^k = a^p = 0$, $\mu^k(z) < 0$, and $\mu^p(z) < 0$. Then any $Q \in (-\infty, Q^p_{bliss}(z)]$, where*

$$Q^p_{bliss}(z) = \min\left\{g^p_{s.b.}(z), g^p_{stat,f.b.}(z)\right\}$$

attains the maximum in the problem

$$\max_{Q \in (-\infty,\infty)} H^{p,3}\big(z, V_a; [y^k + Q, y^p - Q], i\big),$$

i.e., any transfer $Q \leq Q^p_{bliss}(z)$ in the bargaining stage induces the globally preferred allocation for the parent going into the gift-giving stage at z. Similarly, any $Q \in [Q^k_{bliss}(z), \infty)$, where

$$Q^k_{bliss}(z) = -\min\{g^k_{s.b.}(z), g^k_{stat,f.b.}(z)\},$$

attains the maximum in the child's value going into the gift-giving stage, i.e.

$$\max_{Q\in(-\infty,\infty)} H^{k,3}(z,V_a;[y^k+Q,y^p-Q],i).$$

Proof: We will only show the statement for Q^p_{bliss}; the argument for Q^k_{bliss} is exactly the same, making the obvious adjustments. Note that to find the parent's preferred allocation in the gift-giving stage, it is sufficient to consider the situation in which the parent has ownership of all of the family's flow income, y^p+y^k, since this gives the parent the possibility to induce any split of resources in the transfer stage. The parent's problem in the gift-giving stage, when endowed with the entirety of family income, is

$$\max_{c^p,g^p}\Big\{u^p(c^p)+\alpha^p u^k(\min\{g^p,c^k_{unc}\})+\max\{g^p-c^k_{unc},0\}V^p_{a^k}-[c^p+g^p]V^p_{a^p}\Big\},$$
$$\text{s.t. } c^p+g^p\le y^p+y^k,\qquad c^p\ge 0,\qquad g^p\ge 0.$$

By the Inada conditions on $u^p(\cdot)$ and $u^k(\cdot)$, the non-negativity constraints on c^p and g^p will never bind. Also, since $V^p_{a^p}>V^p_{a^k}$ (by the assumption $\mu^p<0$), the parent will never give a gift that goes into the child's savings. Thus we can re-write the problem as

$$\max_{c^p,g^p}\Big\{u^p(c^p)+\alpha^p u^k(g^p)-[c^p+g^p]V^p_{a^p}\Big\}, \tag{27}$$
$$\text{s.t. } c^p+g^p\le y^p+y^k, \tag{28}$$
$$g^p\le c^k_{unc}. \tag{29}$$

Putting Lagrange multipliers λ_1 and λ_2 on the two constraints, the FOCs for this problem are

$$u^p_c(c^p)=V^p_{a^p}+\lambda_1,$$
$$\alpha^p u^k_c(g^p)=V^p_{a^p}+\lambda_1+\lambda_2.$$

Taking the two FOCs together, we have

$$u^p_c(c^p)+\lambda_2=\alpha^p u^k_c(g^p),$$

From this equation, together with the budget constraint (28), we can construct a function that tells us the optimal gift given a guess c^p for the parent's consumption. We define

$$\hat{g}^p(c^p)=\min\Big\{\hat{c}^k(c^p),c^k_{unc}\Big\},$$
$$\text{where } \hat{c}^k(c^p)=(u^k_c)^{-1}\big(u^p_c(c^p)/\alpha^p\big).$$

In words, the function $\hat{g}^p(c^p)$ is such that it sets (altruistic) marginal utility that the parent derives from her child's consumption equal to the marginal utility of the parent's own consumption as long as the child does not save. Once the child saves additional transfers $\hat{g}^p(c^p)$ stays flat. We note that $\hat{c}(\cdot)$ is an increasing function: The higher c^p, the lower marginal utility u^p_c, and the higher $\hat{c}^k$ (since u^k_c is a decreasing function). This implies that $\hat{g}^p(\cdot)$ is weakly increasing in c^p.

Now, we can re-write the parent's problem from (27) in just one choice variable:

$$\max_{c^p}\Big\{u^p(c^p) + \alpha^p u^k\big(\hat{g}^p(c^p)\big) - \big[c^p + \hat{g}(c^p)\big]V^p_{a^p}\Big\},$$
$$\text{s.t. } c^p + \hat{g}^p(c^p) \leq y^p + y^k.$$

Since $\hat{g}^p(\cdot)$ is weakly increasing, there is a maximal consumption choice c^p_{max} that makes the constraint of this problem bind, associated with a gift choice $g^p = \hat{g}^p(c^p) = \min\{g^p_{stat,f.b.}, c^k_{unc}\}$. Clearly, if and only if $c^p_{unc} < c^p_{max}$ we have an interior solution with optimal transfer $g^p = \hat{g}^p(c^p_{unc}) = g^p_{s.b.} = \min\{\tilde{c}^k, c^k_{unc}\}$. Otherwise, the constraint must bind and the parent's preferred transfer is $g^p_{stat,s.b.} = \min\{g^p_{stat,f.b.}, c^k_{unc}\}$. This establishes that the optimal transfer is $g^* = \min\{g^p_{s.b.}, g^p_{stat,f.b.}\}$; note that if $g^p_{stat,f.b.}$ is such that it goes into savings of the child, then the min-operator will select c^k_{unc} in the expression for $g^p_{s.b.}$ in Eq. (22).

Finally, note that any transfer Q in the bargaining stage that gives the parent a Stage-3 income of $y^p_3 \geq y_p - g^*$ (i.e., a higher share of resources than under the parent's optimum) will allow the parent to attain her preferred allocation and is thus equivalent, as the Proposition claims. ■

With this result in place, we now turn to the more general problem when at least one of the players is broke. It turns out that there exist threshold transfers in the bargaining stage beyond which agents return part of the transfer by giving altruistic gifts:

Lemma 2 (Indifference thresholds Q^*_l and Q^*_u) *Fix state $z = (a^k, a^p, s, y^k, y^p, h)$ and assume that either the child is broke, $a^k = 0$, or the parent is broke, $a^p = 0$, or both. Furthermore, assume that $\mu^p(z) < 0$ and $\mu^k(z) < 0$. Define the* lower indifference threshold *as*

$$Q^*_l(z) = \begin{cases} \min\{g^p_{stat,f.b.}(z), g^p_{s.b.}(z)\} & \textit{if } a^k = 0, a^p = 0, \\ g^p_{s.b.}(z) & \textit{if } a^k = 0, a^p > 0, \\ -\infty & \textit{if } a^k > 0, a^p = 0, \end{cases} \tag{30}$$

and define the upper indifference threshold *as*

$$Q_u^*(z) = \begin{cases} -\min\{g^k_{stat,f.b.}(z), g^k_{s.b.}(z)\} & \textit{if } a^p = 0, a^k = 0, \\ -g^k_{s.b.}(z) & \textit{if } a^p = 0, a^k > 0 \\ \infty & \textit{if } a^p > 0,\ a^k = 0, \end{cases} \tag{31}$$

where $\{g^i_{s.b.}, g^i_{stat,f.b.}\}_{i\in\{k,p\}}$ *are defined by Equations (22) and (25). Then:*

1. *Both agents are indifferent among all bargaining transfers exceeding these thresholds, i.e.*

$$V^{i,2}(z; y^k + Q, y^p - Q,) = V^{i,2}(z; y^k + Q_l^*, y^p - Q_l^*) \qquad \forall Q \in (-\infty, Q_l^*],\ i = k, p;$$
$$V^{i,2}(z; y^k + Q, y^p - Q) = V^{i,2}(z; y^k + Q_u^*, y^p - Q_u^*) \qquad \forall Q \in [Q_l^*, \infty),\ i = k, p;$$

   where $V^{i,2}(z; \tilde{y})$ *is agent* i*'s value function in the gift-giving stage for state* z *and post-bargaining flow income vector* $\tilde{y}$*.*

2. $Q_l^*(z) \leq Q_u^*(z)$.

3. *The parent's surplus is strictly decreasing and the child's surplus is strictly increasing in* Q *on the interval* $[Q_l^*(z), Q_u^*(z)]$.

Proof: We will distinguish three cases by which players are broke:

1. **Only the child is broke (**$a^k = 0$**,** $a^p > 0$**):**

   (a) *Lower indifference bound*: It is clear from the definition of $g^p_{s.b.}$ that any transfer Q satisfying $Q < g^p_{s.b.}$ would be topped up to $g^p_{s.b.}$ by the parent in the gift-giving stage, i.e., the parent would choose $g^p = g^p_{s.b.} - Q$, which implements her preferred allocation among all feasible allocations over a short interval $\mathrm{d}t$. This shows that both agents are indifferent among the transfer Q and $Q_l^* = g^p_{s.b.}$ since they induce the same allocation.

   (b) *Upper indifference bound*: Since $a^p > 0$ and $\mu^p < 0$, there will never be gifts from child to parent in the gift-giving stage. Since $\mu^k < 0$, the child's surplus is strictly increasing in Q for all Q and thus $Q_u^* = \infty$, as claimed in Point 1 of the Proposition.

   We have thus shown Point 1 of the proposition for the case in which only the child is broke. Point 2 also obviously holds. We now turn to Point 3. Denote by Q_{thr} the threshold transfer at which the child starts to save the additional transfer unit. We have $Q_{thr} \geq Q_l^*$ by construction of Q_l^* (the parent never gives gifts that flow into the child's savings since $\mu^p < 0$). Now, the child's surplus is strictly increasing for $Q \in (Q_l^*, Q_{thr})$ since $u^k_c(y^k + Q) \geq V^k_{a_k} >$

$V^k_{a^k}$, where the first inequality follows from the child's optimal consumption choice and the second follows from $\mu^k < 0$. For $Q \in [Q_{thr}, Q^*_u)$, the child's surplus is also strictly decreasing since $V^k_{a_k} > V^p_{a^p}$ by $\mu^k < 0$. Similarly, the parent's surplus is strictly decreasing for $Q \in (Q^*_l, Q_{thr})$ since $\alpha^p u^k_c(y^k + Q) < \alpha^p u^k_c(y^k + Q^*_l) = V^p_{a^p}$, which follows from the optimal choice of gifts by the parent and decreasingness of marginal utility. Finally, for $Q \in [Q_{thr}, Q^*_u)$, the parent's surplus is also decreasing, since $V^p_{a^k} < V^p_{a^p}$ by $\mu^p < 0$. This completes the proof of Point 3 of the Proposition for Case 1 (only child broke).

2. **Only the parent is broke (**$a^k > 0$**,** $a^p = 0$**):**

   This case is analogous to the Case 1 in which only the child is broke. However, since Q is a net transfer from parent to child, we have to switch the signs for the net transfers Q, and also the role of the two agents in the upper and lower bounds is reversed.

3. **Both agents are broke,** $a^k = a^p = 0$**.**

   The indifference bounds Q^*_l and Q^*_u in Point 1 of the proposition follow immediately from Lemma 1. As for the ordering of Q^*_l and Q^*_u, note first that imperfect altruism ($\alpha^p \alpha^k \leq 1$) implies that $g^p_{stat,f.b.} \leq -g^k_{stat,f.b.}$, i.e., the child would always make the parent give a larger net transfer than the parent herself would. Also, by Lemma 1, we have $Q^*_l = \min\{g^p_{stat,f.b.}, g^p_{s.b.}\}$ and $Q^*_u = -\min\{g^k_{stat,f.b.}, g^k_{s.b.}\}$. These together imply the ordering $Q^*_l \leq g^p_{stat,f.b.} \leq -g^k_{stat,f.b.} \leq Q^*_u$, which finishes the proof of Point 2 in the Proposition. Finally, Point 3 also holds obviously in this final case by an argument analogous to the case in which only the child is broke. ■

With these indifference bounds for the constrained case in place, we can now widen the scope of the analysis. We will now also include the case in which both agents have wealth. Here, especially the case in which one of the diagonal derivatives is positive, i.e., $\mu^p \geq 0$ or $\mu^k \geq 0$, is of interest. Furthermore, recall that the indifference bounds $\{Q^*_l, Q^*_u\}$ were defined on the entire real line, while in practice we impose exogenous bounds $\{\bar{Q}_l, \bar{Q}_u\}$ on them that are a function of the inside option. We will now bring all elements together by defining the set $[Q_{lb}(z, b), Q_{ub}(z, b)]$ of bargaining transfers that have to be considered at state z for inside option $b \in \mathcal{I}(z)$ in the analysis:

$$Q_{lb}(z,b) = \begin{cases} \bar{Q}_l(z,b) & \text{if } a_p > 0 \text{ and } \mu^p(z) < 0, \\ \bar{Q}_u(z,b) & \text{if } a_p > 0 \text{ and } \mu^p(z) \geq 0, , \\ \min\left\{\bar{Q}_u(z), \max\{\bar{Q}_l(z,b), Q_l^*(z)\}\right\} & \text{otherwise,} \end{cases} \tag{32}$$

$$Q_{ub}(z,b) = \begin{cases} \bar{Q}_u(z,b) & \text{if } a_k > 0 \text{ and } \mu^k(z) < 0, \\ \bar{Q}_l(z,b) & \text{if } a_k > 0 \text{ and } \mu^k(z) \geq 0, \\ \min\left\{\bar{Q}_u(z), \max\{\bar{Q}_l(z,b), Q_u^*(z)\}\right\} & \text{otherwise.} \end{cases} \tag{33}$$

Some notes are in order on these definitions. If, for example, we are on the interior of the state space ($a^p > 0$, $a^k > 0$) and each player prefers to hold on to their wealth ($\mu^p < 0$ and $\mu^k < 0$), then we have consider the entire set of feasible transfers, $[\bar{Q}_l, \bar{Q}_u]$. If, however, the parent has a non-negative diagonal derivative ($\mu^p \geq 0$) but the situation is otherwise unchanged, then the interval $[Q_{lb}, Q_{ub}]$ collapses to the point $\bar{Q}_u$. In this case, the parent wants to transfer wealth to the child and the child is fine with this; thus we only consider the highest possible transfer from the feasible since this is the best outcome for each of the players and thus the only candidate for a bargaining solution. Similarly, interests are aligned if the child wants to transfer wealth to the parent and we only consider the transfer $\bar{Q}_l$.[78] Finally, when an agent is broke, we use the indifference bounds established in Lemma 2, since we need not consider transfers that are returned by one of the agents in the gift-giving stage. For example, when both agents are broke, we consider all feasible transfers from the range $[\bar{Q}_l, \bar{Q}_u]$ that do not lie beyond the bliss points Q_l^* and Q_u^*.

By construction, on the interval $Q \in [Q_{lb}, Q_{ub}]$ the child's surplus is strictly increasing and the parent's surplus is strictly decreasing.[79] This allows us to define the *reservation transfer*, i.e., the lowest transfer for which an agent is willing to consider the inside option b over the outside option

[78] There is a pathological case in which *both* players want to transfer wealth to the other ($\mu^p \geq 0$, $\mu^k \geq 0$). In this case, we assign a net transfer Q in an ad-hoc fashion as it is described for the case of gift-giving in Section J.1.

[79] We have already shown this for the case in which one of the agents is broke, see Lemma 2. For the case in which both players have positive wealth, both players' surplus is clearly monotone when diagonal derivatives are negative; in the other cases the interval collapses to a point.

in state z, as

$$\underline{Q}^k(z,b) = \begin{cases} \infty & \text{if } S^k(z,b,Q_{ub}(z,b)) \le 0 \\ Q_{lb}(z,b) & \text{if } S^k(z,b,Q_{lb}(z,b)) \ge 0, \\ \arg\min_{Q\in(Q_{lb}(z,b),Q_{ub}(z,b))} |S^k(z,b,Q)| & \text{otherwise,} \end{cases} \tag{34}$$

$$\underline{Q}^p(z,b) = \begin{cases} -\infty & \text{if } S^p(z,b,Q_{lb}(z,b)) \le 0 \\ Q_{ub}(z,b) & \text{if } S^p(z,b,Q_{ub}(z,b)) \ge 0, \\ \arg\min_{Q\in(Q_{lb}(z,b),Q_{ub}(z,b))} |S^p(z,b,Q)| & \text{otherwise,} \end{cases} \tag{35}$$

where $S^u(z,b,Q)$ denotes agent u's surplus of the inside option b over the outside option under transfer Q. We now go over the different cases in this definition; we do so for both Eq. (34) and (35) jointly. In the first case, the agent prefers the outside option even under the most favorable Q that we need to consider, thus a (finite) reservation transfer does not exist and there will be no bargaining solution. The second case is the one in which the agent already prefers the inside option under the least favorable Q from the set that we have to consider. In all other cases, it must be possible to find a reservation transfer between the worst- and best-possible transfer that makes the agent indifferent between the two options and the surplus zero. In this case, we find $\underline{Q}^w$ numerically for the weak party w by a root-finding routine.

Finally, we define $\bar{S}^u$ as the highest surplus that agent u can obtain from the set of transfers Q that induce the other agent to prefer the inside option b over the outside option:

$$\bar{S}^p(z,b) = \begin{cases} -\infty & \text{if } S^k(z,b,Q_{ub}(z,b)) < 0 \text{ or } S^p(z,b,Q_{lb}(z,b)) < 0 \\ S^p(z,b,\underline{Q}^k(z,b)) & \text{otherwise,} \end{cases} \tag{36}$$

$$\bar{S}^k(z,b) = \begin{cases} -\infty & \text{if } S^k(z,b,Q_{ub}(z,b)) < 0 \text{ or } S^p(z,Q_{lb}(z,b)) < 0 \\ S^k(z,b,\underline{Q}^p(z,b)) & \text{otherwise.} \end{cases} \tag{37}$$

Here, we have assigned $-\infty$ for the cases in which the bliss point is undesirable for one of the agents since no bargain is possible then. Note that for the special case in which both players have positive wealth and one diagonal derivative is positive, the bounds $Q_{lb} = Q_{ub}$ coincide and $\bar{S}^k$ and $\bar{S}^p$ are positive if and only if both players prefer the inside option under the prescribed transfer.

The following proposition summarizes the solution; the proof then goes over all cases again and gives our solution algorithm:

Proposition 3 (Bargaining solution) *Let s index the party with bargaining power and let w index the party without. Then, if $\bar{S}^s(z,b) \ge 0$ for at least one inside option $b \in \mathcal{I}(z)$, the inside option $b^*(z) = \arg\max_{b\in\mathcal{I}(z)} \bar{S}^s(z,b)$ is played in equilibrium and the equilibrium transfer is*

$\underline{Q}^w(z, b^*(z))$. *Otherwise, the outside option is played.*

Proof and solution algorithm: First, we note that by Proposition 2, we can drop the inside option *IC+sell* for disabled owners. We now go over the list of possible cases for a given inside option b and show how we resolve them.

1. $a^p > 0$ and $a^k > 0$ (both agents have wealth):

   (a) $\mu^p(z) < 0$ and $\mu^k(z) < 0$ (both prefer own wealth; the most the common case): By setting agents' surplus under the inside option b to zero, we can calculate a candidate for the weak party's reservation transfers (this is only a candidate, since it still neglects the exogenous bounds for transfers):

   $$\tilde{Q}^w(z, b) = \frac{V^{w,b,0}(z) - V^{w,out}(z)}{\mu^w(z)\Delta t} \qquad \text{if } a^k > 0, a^p > 0, \mu^w(z) < 0,$$

   where $V^{w,b,0}$ is player w's value under inside option b and a zero transfer (i.e., $Q = 0$) and $V^{w,out}$ is w's value under the outside option. If $w = k$ and $\tilde{Q}^k(z, b) > \bar{Q}_u$ or $w = p$ and $\tilde{Q}^p(z, b) < \bar{Q}_l$, then the outside option is preferred to b since no admissible transfer gives positive surplus for the weak party. Otherwise, we can find the reservation transfer as

   $$\underline{Q}^k(z, b) = \max\{\tilde{Q}^k(z, b), \bar{Q}_l(z, b)\},$$
   $$\underline{Q}^p(z, b) = \min\{\tilde{Q}^p(z, b), \bar{Q}_u(z, b)\},$$

   where the max-min operators take care of the case in which the weak party already prefers the inside option under the least favorable transfer. The inside option is then a candidate (depending on potential other inside options) if the strong party's surplus given this reservation transfer is positive.

   (b) Otherwise ($\mu^p(z) \geq 0$ or $\mu^k(z) \geq 0$): If the parent prefers the child to have wealth, the candidate set collapses to $[Q_{lb}(z, b), Q_{ub}(z, b)] = [\bar{Q}_u(z, b), \bar{Q}_u(z, b)]$, see Eq. (32) and (33), and the inside option is an equilibrium candidate if and only if both agents prefer the inside option and this transfer to the outside option. If the child prefers the parent to have wealth, the candidate set collapses to $\bar{Q}_l(z, b)$ and bargaining outcome is obtained in the same fashion. In the pathological case in which both $\mu^p \geq \mu^k$ we obtain a candidate transfer taking into account the relative strength of agents' transfer motives in the same way we treat altruistic transfers; see the Computational Appendix J.1.

Clearly, under the inside option both agents' gifts are zero (since we constructed the bargaining transfer to make gifts zero) and consumption is equal to the unconstrained levels, c^p_{unc} and c^k_{unc} (since case both agents have positive wealth in this case).

2. $a^p = 0$ or $a^k = 0$ or both (at least one agent broke): The first step is to obtain the indifference thresholds Q^*_l and Q^*_u from Lemma 2. Then, there are two cases to consider: (a) the intervals (Q^*_l, Q^*_u) and $(\bar{Q}_l, \bar{Q}_u)$ do not overlap or (b) the intervals overlap. We now drop the dependence of the different variables on (z, b) for better readability.

   (a) The intervals (Q^*_l, Q^*_u) and $(\bar{Q}_l, \bar{Q}_u)$ do not overlap. This case can again be sub-divided in:

      i. $Q^*_l \geq \bar{Q}_u$: The parent undoes any admissible Q and tops them up with gifts in the gift-giving stage.[80] We only have to evaluate the transfer $Q = \bar{Q}_u$, since all other transfers lead to the same allocation. A bargaining solution with transfer $\bar{Q}_u$ is obtained iff both players prefer this outcome to the outside option. The parent then gives a positive gift in the gift-giving stage.

      ii. $Q^*_u \leq \bar{Q}_l$: The child undoes any admissible Q and tops it up with gifts in the gift-giving stage.[81] We only have to evaluate the transfer $Q = \bar{Q}_l$. A bargaining solution with transfer $\bar{Q}_l$ is obtained iff both players prefer this outcome to the outside option. The child then gives a positive gift in the gift-giving stage.

   (b) The intervals (Q^*_l, Q^*_u) and $(\bar{Q}_l, \bar{Q}_u)$ overlap. In this case we have to look for the equilibrium transfer on the overlap $[Q_{lb}, Q_{ub}]$, see Eq. (32) and (33). The cases to consider are:

      i. Bliss points undesirable: $S^p(Q_{lb}) < 0$ or $S^k(Q_{ub}) < 0$. If at least one agent cannot be made better of (even under the most favorable transfer for them), then we assign $\bar{S}^{p,i} = -\infty$ since the outside option is preferred, see Eq. (36) and (37). The outside option is played.

      ii. Otherwise (bliss points desirable), we have to find the weak party's reservation transfer. There are two cases to consider:

         A. If the weak party already accepts the least generous offer, then this least generous offer is the candidate transfer for a bargaining solution. (i) When the child is the weak party, this requires $S^k(Q_{lb}) \geq 0$ and the candidate is $Q^* = Q_{lb}$. (ii) When the parent is the weak party, this requires $S^p(Q_{ub}) \geq 0$ and the candidate is $Q^* = Q_{ub}$.

[80] This case can occur for for healthy, house-owning parents ($\bar{Q}_u = 0$) who want to give gifts to their children.

[81] This case can occur for disabled renting parents ($\bar{Q}_l = 0$) when a rich child wants to give altruistic transfer to them under the inside option IC ($g^k_{s.b.} \geq 0$).

B. Otherwise: We find the weak party's reservation transfer as the $Q^* \in (Q_{lb}, Q_{ub})$ that solves $S^w(Q^*) = 0$ by a root-finding algorithm.[82]

Then, for both A. and B., obtain the strong party's surplus under the reservation transfer, i.e., assign $\bar{S}^s = S^s(\underline{Q}^*)$.The inside option with transfer Q^* is played iff $\bar{S}^s \geq 0$.

Checking the formulae (34)-(37) for all cases then implies the statements in the proposition. Obviously, the party s chooses the inside option $b^*(z)$ defined in the proposition if there are multiple options with positive surplus since it maximizes party s's surplus.■

C.4 Dynasty wealth equivalent variation

In this appendix, we define and discuss a measure that tells us how much a dynasty values the option of owning a home at age 65.

Why calculate WEV for a dynasty? First, the reader may ask: Why not look only at the gains that the parent derives from owning? We claim that doing this would understate the true willingness to pay of the dynasty if the *child* actually derives substantial benefits from the parent's homeownership. To see this, consider an extreme situation in which the child extracts *all* surplus from owning over renting, and the child is willing to pay up to, say, $20,000 for the parent to own. Since the parent is indifferent, we might conclude that the willingness to pay for housing is zero and that ownership is fragile in the sense that the parent/dynasty would sell with even the slightest of changes in the environment in favor of renting. But what would actually occur in our model if renting became slightly more attractive for the parent? The child would simply pass over some of her surplus (say, $1,000) to induce the parent to keep the home. This process would continue, and the dynasty would continue to own the home, until changes in the environment exhausted the child's surplus. Thus, we should conclude in this situation that the decision unit's (i.e., the dynasty's) willingness to pay for housing equals the child's willingness to pay.

The larger point of this discussion is that, because ownership decisions are the outcomes of intra-family bargaining, considering the surplus of only one of the parties provides an incomplete picture of the family's incentives for homeownership. In order to fully grasp why families acquire housing assets and why they *retain* those assets in old age, we must account for the surplus accruing to both parents *and* their children.

[82] Note that on the interval (Q_{lb}, Q_{ub}), by construction there are no gifts in the gift-giving stage and we can restrict ourselves to computing consumption according to a simple rule: Broke agents consume all transfers until they reach their unconstrained consumption level, c^u_{unc}; agents with wealth always consume c^u_{unc}. The surplus can then be evaluated at a low computational cost by varying the flow utility term and the savings terms in the HJB (savings terms are terms in $V^u_{a^u}$ and $V^u_{a^{-u}}$)).

Definition. We now introduce a concept that takes into account the gains of *both* agents in a systematic way. Consider a fictitious planner who wants to determine the minimal amount of transfers he has to make to parent and child in order to compensate them for the parent having to rent forever. Let $V^i_{rent}(a^k, a^p)$ denote the value of agent $i \in \{k, p\}$ when renting forever in a dynasty with given net worth vector (a^p, a^k) when the parent is age 65. (We fix the good health state and households' productivities here.) Similarly, let $V^i_{own}(a^k, a^p)$ be the value that is attained under the optimal housing decision. Note that by optimality, $V^i_{rent} \leq V^i_{own}$, with equality for those who decide to rent. Our fictitious planner's problem is now to choose non-negative compensation payments to solve:

$$WEV_{dyn}(a^k, a^p) \equiv \min_{\Delta a_p \geq 0, \Delta a_p \geq 0} \Big\{ \Delta a_k + \Delta a_p \Big\} \tag{38}$$

$$\text{s.t.} \qquad V^p_{rent}(a^k + \Delta a_k, a^p + \Delta a_p) \geq V^p_{own}(a^k, a^p), \tag{39}$$

$$V^k_{rent}(a^k + \Delta a_k, a^p + \Delta a_p) \geq V^k_{own}(a^k, a^p). \tag{40}$$

In words, the dynasty's wealth equivalent variation, WEV_{dyn}, is defined as the minimal sum of non-negative transfers that the planner has to make to both agents to forgo the parent's homeowning option. To make this operational, take first-order Taylor expansions of the constraints around $(\Delta a^p, \Delta a^k) = (0, 0)$ to obtain the linear programming problem

$$WEV_{dyn} \simeq \min_{\Delta a_p \geq 0, \Delta a_p \geq 0} \Big\{ \Delta a_k + \Delta a_p \Big\} \tag{41}$$

$$\text{s.t. } V^p_{a^k} \Delta a_k + V^p_{a^p} \Delta a_p \geq \Delta V^p, \tag{42}$$

$$V^k_{a^k} \Delta a_k + V^k_{a^p} \Delta a_p \geq \Delta V^k. \tag{43}$$

Here, we have suppressed the dependence of WEV_{dyn} and the partial derivatives $V^i_{a^j}$ on the state (a^k, a^p) for better readability. Also, we have defined the value differential between housing and renting for agent $i \in \{k, p\}$ as

$$\Delta V^i \equiv V^i_{own}(a^p, a^k) - V^i_{rent}(a^p, a^k). \tag{44}$$

Private WEVs. We can also define a more naive notion of wealth equivalent variation that measures how much wealth *one* agent has to be given in order to be as well off under renting as with housing while keeping the other agent's wealth constant. We call this measure the *private*

WEV and define it for agent $i \in \{p, k\}$ as

$$WEV_i \equiv \min \Delta a^i \tag{45}$$

$$\text{s.t. } V^i_{rent}(a^i + \Delta a^i, a^{-i}) \geq V^i_{own}(a^i, a^{-i}), \tag{46}$$

where we denote by $-i$ the other agent. We will discuss below how WEV_{dyn} relates to the private WEV_p and WEV_k. A first-order Taylor approximation of the constraint gives us

$$WEV_i \simeq \Delta V^i / V^i_{a^i}.$$

Interior solution. Figure C.1 depicts the regular case in which both agents benefit from the existence of housing and in which the non-negativity constraints in the problem 41 are not binding. The two axes are the wealth increments Δa^i to both agents, i.e., the planner's compensation payments. The point (0,0) is the situation in which the parent is forced to rent at given net worth (a^p, a^k). The dashed and dash-dotted line crossing through (0,0) are iso-value lines (under a linear approximation of the value function) for parent and child. The solid line with slope -1 that goes through the origin is a line on which dynasty wealth, $a^p + a^k$, is held constant. Note that in our altruism setting with the possibility of large immediate transfers, we have $V^p_{a^p} \geq V^p_{a^k}$, i.e., the parent prefers additional wealth in her pocket to additional wealth to the child. If this was not the case, the parent would have transferred some of her wealth to the child. This implies that the parent's iso-value line has a steeper slope than the iso-wealth line, which in turn is steeper than the child's iso-value line (by an analogous argument).

Now, consider the second pair of iso-value lines that lie north-east of the origin and which depict the locus of compensation payments under which each agent would obtain the same value under renting as when owning a house is possible. If $\Delta V^i > 0$ for both i, which will usually be the case, these lines are parallel shifts of the iso-value lines through the origin under a first-order approximation of value functions. From these higher iso-value lines, we can already read off agents' private WEVs. For the parent, increase Δa^p by going east from the origin until reaching the parent's indifference to housing. (Recall that, when computing each agent's private WEV, the transfer to the other agent is zero.) For the child, do the analog going north from the origin. However, we note here that just compensating one agent is not enough: If a planner gave the parent her WEV^p, then the child would still have a positive surplus from owning. This surplus could be shared with the parent, and thus the parent would not want to give up the chance of owning a house after talking about the situation with the child and receiving part of the remaining surplus.

The only approach that leaves no surplus on the table is one in which *both* agents weakly prefer renting to owning under the compensation, meaning that the solution for WEV_{dyn} in the problem 41 must lie in the grey dotted area in Fig. C.1. To minimize the sum of compensation

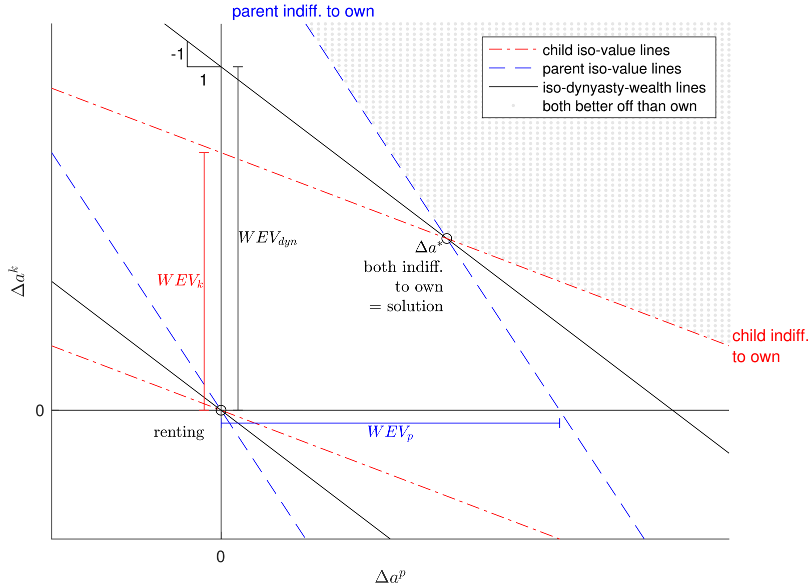


Figure C.1: WEV: regular case

transfer, the solution must actually lie on the point of this set on the lowest iso-dynasty wealth line. For the case depicted in the figure, this is obviously the case at Δa^*, which we define as the pair of transfers under which both agents are exactly indifferent to owning; solving the two constraints in the problem 41 with equality gives us

$$\Delta a^* = \begin{pmatrix} V^k_{a^k} & V^k_{a^p} \\ V^p_{a^p} & V^p_{a^p} \end{pmatrix}^{-1} \begin{pmatrix} \Delta V^k \\ \Delta V^p \end{pmatrix}. \tag{47}$$

Fig. C.1 now tells us that if $\Delta a^* \geq 0$, i.e., if both components are non-negative, then Δa^* must be the solution for the optimal compensating transfer. This is because the slope of the parent's iso-value line is steeper and the slope of the child's iso-value line is flatter than the iso-dynasty-wealth line, as argued above. Given this solution, we can then read off the corresponding solution for $WEV^{dyn} = \Delta a^{p*} + \Delta a^{k*}$ by following the iso-dynasty-wealth line from the point Δa^* north-west until it cuts the y-axis. Geometrically, it is clear that, in this case, we must have $WEV_{dyn} > WEV_p$ and $WEV_{dyn} > WEV_k$, i.e., the dynasty WEV must exceed the private ones. This is intuitive since both agents benefit from the existence of housing. Also, we must have $WEV_{dyn} < WEV_p + WEV_k$.

Corner solution. Another relevant situation is one in which one of the components of Δa^* is negative. This happens when one of the households gains little from housing while the other gains a lot.[83] Fig. C.2 depicts a situation in which the gains for the child are small compared to the gains

[83]We will maintain the assumptions that $\Delta V^i \geq 0$ and that $V^i_i \geq V^i_{-i} \geq 0$, which are usually satisfied.

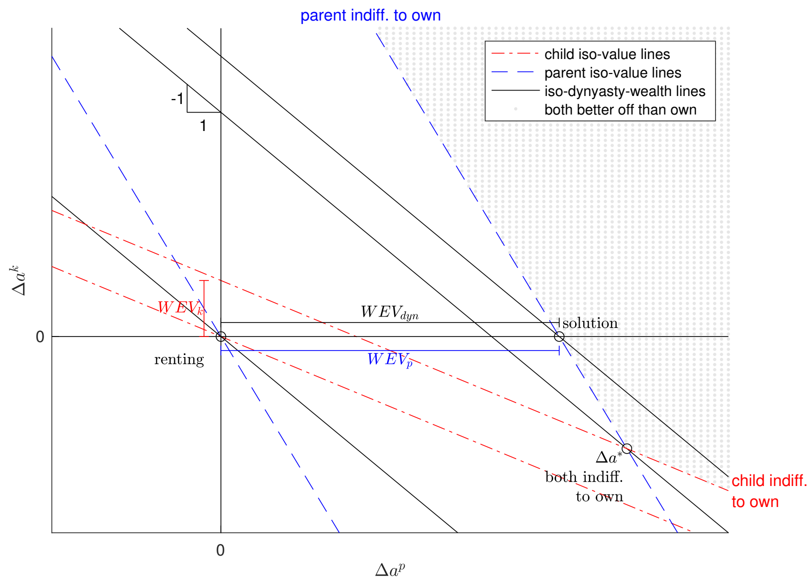


Figure C.2: WEV: corner solution

of the parent, which in the figure is apparent in the small distance between the child's iso-value lines, and the resulting low WEV_k, and the large distance between the parent's iso-value lines, and the resulting high WEV_p.

Geometrically, it is obvious that the solution to the problem 41 now occurs at the point where the parent's upper iso-value line cuts the horizontal axis: This is the lowest iso-dynasty-wealth line in the north-east quadrant that is part of the set in which both households are better-off. This is a situation in which the fictitious planner would increase transfers to the parent, going east from the origin, until reaching the point at which the parent would accept renting forever. It turns out that at the solution, we have $WEV_{dyn} = WEV_p > WEV_k$. Also, the child strictly prefers that allocation to the world with housing. This can occur when the child reaps few benefits from the parent' homeownership but values the parent's financial wealth substantially.

But why exclude the vector Δa^* that lies in the south-east quadrant? It would require the planner to to forcefully take away wealth from the child and essentially re-distribute wealth within the dynasty, both of which we deem unappealing for a concept of wealth equivalent variation. Also, requiring non-negativity of the compensation transfers has the attractive property that $WEV_{dyn} \geq WEV_p$, which is a natural requirement. Note that this inequality would be violated if we allowed the negative transfer to the child and chose Δa^* as the solution in Fig. C.2.

Properties of WEV_{dyn}. Summarizing, inspection of Figs. C.1 and C.2 tells us that dynasty wealth equivalent variation has the following appealing properties with respect to the private WEVs:

1. $WEV_{dyn} \geq \max\{WEV_p, WEV_k\}$,
2. $WEV_{dyn} \leq WEV_p + WEV_k$.

Technically, recall that we invoked the regularity assumptions $V^i_{a^i} \geq V^i_{a^{-i}} \geq 0$ and $\Delta V^i \geq 0$ for $i \in \{p, k\}$ to arrive at these conclusions.[84] Finally, note that there is a third case in which Δa^* falls into the north-west quadrant, which is analogous to the case depicted in Fig. C.2 and in which we have $WEV_{dyn} = WEV_k > WEV_p$.

[84]The assumption $\Delta V^p \geq 0$ is ensured since renting is an option the parent has at her disposal also when owning. If $\Delta V^k < 0$ (but the regularity assumptions on the derivatives V^i_j hold), then it is obvious that the solution is as in Fig. C.2 and thus $WEV_{dyn} = WEV_p$.

D Earnings process and fit

The continuous-time hazard matrix (i.e., rates) is given by $\Lambda_{\epsilon\epsilon'}$ and the annualized continuous-time transition matrix (i.e., probabilities) by $\tilde{\Lambda}_{\epsilon\epsilon'}$:

$$\Lambda_{\epsilon\epsilon'} = \begin{bmatrix} -0.0308 & 0.0308 & 0 & 0 \\ 0.0256 & -0.0513 & 0.0256 & 0 \\ 0 & 0.0308 & -0.0410 & 0.0103 \\ 0 & 0.0308 & 0 & -0.0308 \end{bmatrix}, \quad \tilde{\Lambda}_{\epsilon\epsilon'} = \begin{bmatrix} 0.9701 & 0.0295 & 0.0004 & 0.0000 \\ 0.0246 & 0.9508 & 0.0245 & 0.0001 \\ 0.0004 & 0.0295 & 0.9602 & 0.0099 \\ 0.0004 & 0.0295 & 0.0004 & 0.9697 \end{bmatrix}$$

The grid for efficiency units is given by:

$$\mathcal{E} = \begin{bmatrix} -0.8195 & -0.0729 & 0.6737 & 1.6070 \end{bmatrix},$$

where the fourth level corresponds to the high earning state which an agent can only reach from the third productivity state and if left, the agent transits to the second productivity state. The ergodic distribution of efficiency units is given by

$$\bar{\lambda} = \begin{bmatrix} 0.3125 & 0.3750 & 0.2344 & 0.0781 \end{bmatrix}$$

We calculate household efficiency units as a function of age and productivity in the following way:

$$1.5 \times \exp(9.84126 + .0646223 * (\text{age} - 20) - .0010749 * (\text{age} - 20).^2 + \epsilon)/1000.$$

The coefficients are obtained from a regression using the 2010 census of individual ($\log$) earnings and is pooled over males and females. The factor 1.5 converts earnings from the individual to the household level reflecting the fact that not all couples are full-time employed, and the division by 1000 is a normalization.

The fit of the before-tax household earnings process is displayed in Table D.1.

Table D.1: Earnings process fit

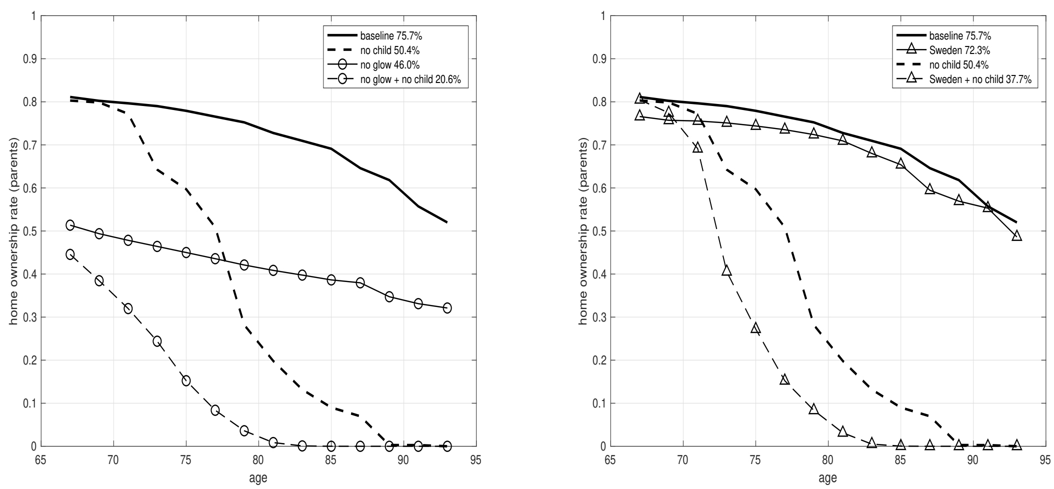
Source	Gini	Bottom Q10	Bottom Q20	Bottom Q40	Top Q40	Top Q20	Top Q10
Data	37.4%	1.6%	5.3%	16.2%	67.6%	44.5%	28.5%
Model	41.2%	2.5%	6.3%	15.4%	69.3%	48.0%	31.1%

Household earnings data based on OECD.

E Counterfactual wealth and bequest distributions

When zooming in on ownership rates by age in Figure E.1, we see that ownership rates are about the same for parents and childless households from ages 65 to 70 but decrease much faster in the *no-child* economy. The difference is the result of increasing mortality risk with age, which makes holding on to illiquid ownership increasingly costly for the childless, who liquidate in order to access their savings. (Life expectancy at age 65 is about 83.5.)

Figure E.1: Counterfactuals: homeownership rate by age



Cross-sectional home-ownership rates by age in simulated panel from baseline model and selected counterfactual scenarios (described in text). Legend shows age 65+ homeownership rate.

Here we provide the counterfactual initial retirement wealth distributions to complement Section 7.3. For convenience we also replicate the bequests distribution. In contrast to Table 13, we provide two additional scenarios not discussed in the main text.

Table E.1: Wealth distributions ages 65 to 69

Scenario	p25	p50	p75	p90	p95
1. baseline	96	206	535	1094	2004
2. no child	81	204	508	968	1726
3. Sweden	57	193	493	1034	1907
4. Swd.+no child	81	196	460	896	1595
5. renting only	43	187	536	1108	1989
6. no child+rent.	32	162	483	960	1724
7. Swd.+rent.	25	147	461	1005	1864
8. Swd.+no ch.+rent.	22	138	413	862	1568
9. no glow	48	231	571	1128	2017
10. Swd.+no glow	28	188	499	1054	1897
Extra scenarios					
11. no glow+no child	33	183	517	978	1732
12. Swd.+no glow+no child	23	152	454	910	1589

Percentiles of the wealth distributions are in 1000s of 2010-dollars. Counterfactual scenarios are described in the main text. Extra scenarios are the remaining combinations not discussed in the main text.

Table E.2: Bequest distributions

Scenario	extensive	p25	p50	p75	p90	p95
1. baseline	75%	30	139	259	495	817
2. no child	41%	0	0	128	342	561
3. Sweden	76%	45	155	268	468	800
4. Swd.+no child	31%	0	0	67	249	440
5. renting only	39%	0	0	134	415	715
6. no child+rent.	30%	0	0	67	293	510
7. Swd.+rent.	30%	0	0	65	324	607
8. Swd.+no ch.+rent.	23%	0	0	4	193	377
9. no glow	57%	0	120	331	561	923
10. Swd.+no glow	47%	0	0	358	539	913
Extra scenarios						
11. no glow+no child	31%	0	0	80	316	534
12. Swd.+no glow+no child	24%	0	0	18	217	412

Percentiles of the bequest distributions are in 1000s of 2010-dollars. Counterfactual scenarios are described in the main text. Extra scenarios are the remaining combinations not discussed in the main text.

F Robustness

HACC We provide a robustness experiment to study how strongly the overstated housing bequest distribution matters for the quantification of HACC as presented in Sec. 7.2. To do so, we choose a higher expenditure share on non-housing consumption $\xi = 0.90$ (up from $\xi = 0.81$ in the baseline calibration), but otherwise leave all other parameters unchanged from the baseline calibration, to obtain a housing bequest distribution in line with our data, see Table F.1.

Table F.1: Bequest distribution by asset class ($\xi = 0.90$)

Data	non-negligible	p25	p50	p75	p90	p95
Housing	**45%**	**0**	**0**	**104**	**230**	**365**
Non-Housing	41%	0	5	87	352	643
Of which:						
Liquid non-housing	37%	0	2	58	239	493
Illiquid non-housing	14%	0	0	5	24	141
Illiquid	48%	0	9	136	300	521
Liquid	37%	0	2	58	239	493
Model						
Housing	**50%**	**0**	**0**	**112**	**179**	**337**
Financial	35%	0	0	69	242	454

Percentiles of the bequest distributions. Data: HRS core interviews 1998-2010. Wealth measures are taken from the final core interviews of a sample of single decedents with children. Housing wealth is defined as the combined value of the primary and secondary residences, not net of mortgages. Non-housing wealth is defined as net worth excluding housing wealth. Illiquid wealth consists of housing wealth plus vehicles, businesses, and the net value of other real estate. The remaining components of net worth are considered liquid. "non-negligible" means $> 15K$. None of the numbers targeted by calibration.

The net worth distribution at the start of retirement remains in line with the data while housing wealth of course decreases, see Table F.2; the homeownership rate decreases only slightly from 75.7% to 73.4% (not shown). Owners' net worth at the start of retirement also remains closely in line with the data, see Table F.3.

We then calculate HACC's importance along the extensive and intensive margins. HACC's contribution to the homeownership rate – the difference between the ownership rate in the modified baseline and no child scenario – decreases from 33% to 32%. When doing the same calculation when also shutting-off the utility benefit of owning, $\omega = 1$, we find that the contribution to the extensive margin decreases from 34% to 26%. Table F.4 shows the quantification of HACC on the intensive margin under this modified parameterization. A parent's willingness to pay for a house, as measured by the difference in mean WEV values, decreases from $\$16,000$ in the baseline calibration to $\$12,000$. When also setting $\omega = 1$, the difference in mean WEV values is $\$8,000$, in contrast to $\$12,000$ from before. However, it is perhaps unsurprising that we see such a decrease since less housing wealth is held in this economy. Our preferred intensive margin measure of

Table F.2: Net worth distribution at the start of retirement ($\xi = 0.90$)

(a) Data	p10	p25	p50	p75	p90	p95
Housing	**0**	**46**	**134**	**261**	**501**	**727**
Non-housing	-40	0	43	274	808	1,355
Net worth	2	54	206	553	1,229	1,966

(b) Model	p10	p25	p50	p75	p90	p95
Housing	**0**	**50**	**79**	**139**	**226**	**392**
Non-housing	0	15	110	379	825	1,549
Net worth	0	60	189	518	1,053	1,943

(c) % of wealth in housing	p10	p25	p50	p75	p90	p95
Data	21	38	65	99	100	100
Model	21	25	33	53	85	100

Data: Health and Retirement Study. Core interviews 1998-2010. Model: Artificial panel. Panel (a): Parent households whose eldest member is ages 65-69. Panel (c): Home-owning, parent households whose eldest member is ages 65-69. The % of wealth in housing is the ratio of housing wealth to net worth. Housing wealth is defined as the combined value of the primary and secondary residences, not net of mortgages. While this ratio can exceed 100% in the data in cases where households have negative non-housing assets, we top-code the ratio at 100% for comparison to the model, where borrowing is not possible. Households with net worth less than or equal to zero (about 1% of owning households) are assigned ratios of 100%. Amounts in Panels (a) and (b) are 1000s of year-2010 dollars.

Table F.3: Net worth distributions by homeownership at the start of retirement ($\xi = 0.90$)

(a) Data	p10	p25	p50	p75	p90	p95
Owners	47	113	291	684	1,394	2,183
Renters	-1	0	3	25	156	314

(b) Model	p10	p25	p50	p75	p90	p95
Owners	73	135	316	608	1,390	2,165
Renters	0	0	0	15	40	47

Panel (a): HRS core interviews 1998-2010. Parent households whose eldest member is ages 65-69. Panel (b) Artificial panel generated from the model. Amounts are 1000s of year-2010 dollars.

HACC – WEV as a percentage of the house value – actually increases from 10% to 15%, and when doing the same calculations when shutting-off the utility benefit of owning we find that the measure remains unchanged at 5%.

Bargaining power Here we show that the main features of our model are robust to our assumptions on bargaining power. Table F.5 compares key model moments in the baseline model to two extreme alternatives: One in which the parent has bargaining power in all scenarios[85] (*parent power*) and one in which the child has the power in all scenarios (*child power*).

[85] i.e., under all scenarios in the set $\mathcal{I}(z)$

Table F.4: Value of housing technology, measured by dynasty wealth equivalent variation (WEV) at age 65 ($\xi = 0.90$)

raw values ($000)	mean	p25	p50	p75	p90
baseline ($\xi = 0.90$)	34	19	30	62	87
no child ($\xi = 0.90$)	22	2	16	51	97
no glow ($\xi = 0.90$)	13	0	13	27	33
no child + no glow ($\xi = 0.90$)	5	0	3	13	29

% of home value	mean	p25	p50	p75	p90
baseline ($\xi = 0.90$)	33%	32%	41%	44%	49%
no child ($\xi = 0.90$)	17%	4%	20%	34%	42%
no glow ($\xi = 0.90$)	8%	0	11%	12%	16%
no child + no glow ($\xi = 0.90$)	3%	0	2%	7%	11%

WEV is defined by WEV_{dyn} in Appendix C.4. The upper panel shows the distribution of WEV, expressed in thousands of dollars. The lower panel shows the distribution of WEV as a percentage of the value of the purchased home. Renters enter the calculations in both panels as zeros.

The first take-away from the table is that none of the variables is dramatically affected in either of the two scenarios. This shows that the most important feature of our model is *if* the two parties can find mutually-beneficial arrangements (which, for a fixed state, is the same under all protocols), but that it is only secondary *how* the surplus is allocated. The surplus allocation affects mainly how fast disabled parents spend down their wealth, which has dynamic second-round effects that we come to now.

We first discuss the results of the scenario *child power*. This scenario yields a change with respect to the baseline in IC by 5 percentage points, which is driven mainly by renters' behavior. The care burden is taken up by Medicaid, which increases by about the same amount. Parents (especially renting ones) move faster from IC into Medicaid since they spend down their *commitment capital* (wealth) down faster when the child can extract the maximal transfer. The fraction of renters who receive IC is substantially smaller. FHC and private-payer nursing home are practically unaffected. Initial retirement wealth and bequests remain largely unchanged as is the homeownership rate.

In the scenario *parent power*, initial retirement wealth and bequests are somewhat lower as is the homeownership rate. The IC fraction decreases by about 2.5 percentage points and the FHC fraction by 1.9 percentage points which are picked up by NH and Medicaid. Among those who require LTC, there are fewer homeowners and among those a slightly smaller fraction receives IC.

Table F.5: Counterfactual exercises for bargaining power

Wealth: Ages 65-70	p10	p25	p50	p75	p90	p95
baseline	0	96	206	535	1094	2004
parent power	0	93	191	504	1047	1931
child power	0	94	210	547	1105	2012

Bequests	extensive (%)	p25	p50	p75	p90	p95
baseline	75	30	139	259	495	817
parent power	73	0	133	242	469	798
child power	72	0	139	264	494	812

LTC provision (%)	IC	FHC	NH	MA
baseline	48.8	9.6	13.9	27.7
parent power	46.4	7.7	15.4	30.5
child power	43.3	9.7	13.7	33.3

LTC housing (%)	owner in LTC	renter in LTC	owner get IC	renter get IC
baseline	32.8	67.2	70.2	38.4
parent power	25.5	74.5	67.6	39.2
child power	36.4	63.6	73.1	26.3

Calibration moments	homeownership rate	mean IVT by healthy parents
baseline	74.9	3,360
parent power	72.8	3,162
child power	74.3	3,502

Counterfactual experiments for bargaining power. Percentiles of the wealth and bequest distributions are in 000s of 2010-dollars. *Extensive* is $>$ 15K. *parent power:* parent generation makes take-it-or-leave-it offers in all scenarios. *child power:* child generation makes take-it-or-leave-it offers in all scenarios. *IC*: informal care, *FHC*: formal home care, *NH*: nursing home, *MA*: Medicaid.

G Definitions of key variables

G.1 Wealth

Our measures of wealth are taken from the RAND Longitudinal Files. For net worth, we use RAND's `HwATOTB`. We compute the value of housing wealth, corresponding to h in the model, as the sum of the values of the primary residence (`HwAHOUS`) and the secondary residence (`HwAHOUB`); these values are not net of mortgages. Non-housing wealth, corresponding to a in the model, is defined to be net worth minus housing wealth. Within non-housing wealth, we at times distinguish between liquid and illiquid components. Illiquid non-housing wealth includes other real estate, vehicles, businesses. Liquid non-housing wealth is defined to include IRA and Keogh accounts; the net value of stocks, mutual funds, and investment trusts; the value of checking, savings, or money market accounts; the value of CD, government savings bonds, and T-bills; the net value of bonds and bond funds; and the net value of all other savings; less the value of other debt.

G.2 Estate values

We obtain estate values from the HRS exit interviews. As is typical in surveys where dollar amounts are concerned, there are numerous cases in our data where the precise dollar value of the decedent's estate is unknown. In this section, we describe the procedure we use to impute estate values for these cases. We first document the extent and varieties of missing data in our sample. We then describe the imputation procedure in detail. Finally, we discuss how we deal with an added complication in our imputation procedure which concerns whether the reported estate value includes (and whether it should include) the primary residence or not.

G.2.1 Missing estate values

Table G.2 reports the types and frequencies of estate value reports in our final sample of single decedents. *No asset* means the decedent left no bequest, which is the case for 1,168 decedents in our sample (38.68%). *Continuous report* refers to cases in which the proxy respondent reported the dollar amount of the estate. This applies to 1,836 individuals, accounting for 36.29% of the sample or just under 60% of those known to have left a bequest. When a proxy was unable or unwilling to report a precise dollar value for the estate, the HRS survey attempted to elicit bounds on the estate value using an HRS innovation known as "unfolding brackets." In this procedure, the interviewer cycles through a sequence of pre-defined "breakpoints" (i.e., the endpoint of the bracket intervals) and asks the respondent whether the estate value was greater than, less than, or about equal to each breakpoint. If the process reaches completion, the result is a *complete bracket*. If at any point in the procedure the respondent refuses to answer or does not know the value of the estate in relation to a particular breakpoint, the procedure ends, resulting in an *incomplete bracket*. If the upper bound on the estate cannot be established or is reported to be greater than the maximum breakpoint ($2 million), we refer to this case as having an *open top bracket*. In our sample, 305 individuals (16.72% of the sample) have some bound information. *No bracket information* refers to cases where neither an upper nor lower bracket was obtained, which applies to 235 individuals (7.78% of the sample). Finally, *don't know ownership* means the proxy was not sure whether the decedent left a bequest. Fortunately this applies to only 16 individuals (.53% of the sample). Taken together, approximately 25% of our sample has incomplete estate value data.

G.2.2 Main imputation procedure

The main imputation sequence has three main steps. It closely follows the procedure used by the RAND Corporation to impute missing income and wealth data in the HRS (Hurd et al., 2016). We first impute estate ownership for those for whom this information is missing. We then impute complete brackets for those with missing or incomplete bracket information. Finally, we impute continuous dollar amounts.

In each step of the imputation, we use the same set of covariates. These include the inverse hyperbolic sine of net worth; age at death and age squared; indicators for whether the respondent was female, non-white, covered by Medicaid, owned a home, intended to leave a bequest greater than $10,000 or $100,000, and for different levels of educational attainment; plus indicators for each interview wave. Data on wealth and bequest intentions are taken from the most recent non-missing core data. Homeownership is from the preloaded information for the exit interview. Medicaid coverage is from the exit interview, if available, or the most recent non-missing core data.

To impute estate ownership, we begin by estimating a logit model in which the dependent variable is equal to 1 if the decedent left a bequest. We estimate our model of ownership over all decedents for whom this information was non-missing, including those with missing estate values and bracket information. We then predict the probability of ownership for those with missing values, take a random draw from a uniform [0,1] distribution, and impute ownership (non-ownership) if the draw is less than or equal to (greater than) the predicted probability of ownership. The estimates for the logit model appear in column (1) of Table G.1.

In order to impute complete brackets for those with missing or incomplete bracket information, we estimate an ordered logit model. The data for the model include all individuals with reported complete brackets as well as individuals with estate values reported as dollar amounts, which we bin into the HRS (mutually exclusive and exhaustive) estate value brackets. The estimates for the ordered logit model appear in column (2) of Table G.1. From the estimates, we obtain predicted probabilities of appearing in each bracketed interval. Taking a random draw x from a uniform [0,1] distribution, we assign bracket j if $\sum_{i<j} p_i < x \leq \sum_{i \leq j} p_i$, where p_i is the estimated probability of appearing in bracket i, ordered from lowest to highest. For individuals with incomplete bracket information, we adjust the fitted probabilities to be consistent with the available information.

The final step of the main imputation procedure is a nearest neighbor matching assignment of continuous estate values. The data for this step include all individuals who left bequests and whose proxies reported non-missing dollar amounts. The procedure differs depending on whether the observation to be imputed is in the highest bracket (values greater than $2 million) or not. For those not in the highest bracket, we first obtain fitted values from a regression of the inverse hyperbolic sine of the estate value on the covariates listed above. The estimates from the regression appear in column (3) of Table G.1. Second, we locate the nearest neighbor, which is the decedent within the same bracket with a non-missing estate value whose fitted value is closest to the fitted value of the recipient. Finally, we assign the nearest neighbor's estate value to the recipient. Ties are broken at random. For individuals in the highest bracket, we use a pure hot-deck procedure, randomly assigning a nearest neighbor without covariates. Since we ultimately drop all decedents in this highest category for most of our analyses, this choice is immaterial.

G.2.3 Adding home values to estates

Apart from the main routine described above, our estate value imputation procedure involves one additional step. After supplying information on the estate value, the proxy respondent is asked whether the supplied value (or brackets) include the value of the primary residence. This question is only asked if the preloaded information indicated that the decedent previously owned a home. We have identified several cases (39 in our final sample of single decedents) in which, although the proxy did not include the value of the home in the estate, the home had been inherited or given away before death and was not previously reported as an inter-vivos transfer. In such instances, we believe the home value *should* have been included in the estate.

To correct for these omissions, we took the value of the primary residence from the most recent non-missing core interview data and added it to the estate value. (Although data on home values are recorded in the exit interview, the core interview housing value data have been more carefully vetted by RAND.) For individuals with continuously reported estate values, we added home values *before* the main imputation procedure. For other individuals, we added home values *after* the procedure. Doing otherwise (e.g., adding the home value to the endpoints of a bracket) would have required that we modify our imputation procedure.[86] Given that relatively few observations were affected, we did not see much value in deviating from RAND's well-established procedure.

[86]The reason is that our complete bracket categories are mutually exclusive. If the categories overlapped, we could not longer model the probability of appearing in each bracket using an ordered logit model.

G.2.4 Sensitivity of the imputation routine

Following extensive experimentation with our imputation routine, we have found that the final distribution of estates values is not sensitive to any of the specifics of the procedure. The distribution of estate values depends little on the particular covariates included in the imputation procedure, and in fact, implementing the procedure without covariates yields a very similar distribution. Furthermore, we obtain a similar distribution regardless of whether or not we add home values in cases where proxy respondents did not include these values in the reported estate value.

G.3 Bequests and inter-vivos transfers of housing assets

We code a decedent as having left a housing bequest if the decedent died owning a home. We also define a broader measure of housing bequests that includes houses that were transferred prior to death. By this measure, an individual is coded as having given a home as a bequest if any of the following are true: the decedent (i) died owning home, (ii) disposed of a home prior to death by giving the home away, (iii) ever reported living in a home owned by her children which she had previously owned, (iv) ever gave a home deed to a child, or (v) ever gave a home to someone.

G.4 Bi-annual inter-vivos transfer flows

Our measure of inter-vivos transfers to and from children are taken from the RAND Family Files (`HwTCAMT` and `HwFCAMT`). The HRS records financial help totaling more than $500 to and from children (or grandchildren) that may include "giving money, helping pay bills, or covering specific types of costs such as those for medical care OR insurance, schooling, down payment for a home, rent, etc." and which may "be considered support, a gift or a loan." The definition excludes shared food and housing and the deeds to any houses. RAND imputes missing transfer values using a similar procedure to the one they use to impute missing values of income and wealth and which we have used to impute estate values (see Appendix G.2).

G.5 The ratio of inter-vivos transfers to bequests

To compute the ratio of inter-vivos transfers to bequests, we first separately calculate the weighted sums of inter-vivos transfers and bequests in our data. For inter-vivos transfers, we sum all transfers given by parent households in the 1998-2010 core interviews whose eldest member is 65 years of age or older and whose net worth is below the 95th percentile. For bequests, we sum all estate values for single decedent parents in the 2004-2012 exit interviews who are ages 65 and older and whose estate value is below the 95th percentile of net worth.[87] These sums are weighted using respondent-level weights corrected for nursing home residents, and we select one member per household in the case of couples.[88] Having calculated the weighted sum of inter-vivos transfers and the weighted sum of bequests within our sample, we complete the calculation by taking the ratio of the former to the latter.

The rationale for excluding the wealthiest households is twofold. First, as we demonstrate in Appendix I, estate values appear to follow a thick-tailed Pareto distribution, making any calculations involving means or ratios highly sensitive to outliers. Second, as noted in the main text, Bosworth & Smart (2009) find that net worth in the HRS is representative of the elderly population in the U.S. only up to about the 95th percentile.

The effect of this wealth restriction is apparent in Figure G.1, which summarizes the distributions of inter-vivos transfers and bequests using boxplots. The panels in the first row compare the distributions of inter-vivos transfer amounts with (Panel A) and without (Panel B) the wealthiest 5% of households included. Panels C and D repeat this exercise for bequest amounts. Note in particular the elimination of a $100 million bequest.

Table G.3 presents the ratio of inter-vivos transfers to bequests reported in the text (0.299) and shows the sensitivity of the ratio to the choice of wealth threshold. When no wealth restriction is imposed, the ratio reaches a low of 0.266. The introduction of even a very high wealth threshold ($10 million) causes the ratio to jump to 0.329 as a small number of outlier estate values are eliminated. Further tightening to wealth cap causes the ratio to first decline slightly (reaching a low between 0.29 and 0.30) before increasing again as the cap begins to eliminate a larger and larger number of estates.

G.6 Long-term care hours

For each individual who reports receiving long-term care, we compute the sum of reported weekly long-term care hours across all helpers to calculate total hours of care per week. We first top-code hours of care at the helper level from any particular non-institutional (non-nursing home) caregiver

[87] We calculate that the 95th percentile of net worth for the pooled sample of all households in the HRS core interviews 1998-2010 is 1,684,282 in 2010 dollars. We drop households whose net worth (core interviews) or estate (exit interviews) equals or exceeds this figure.

[88] Because the number of core interviews (seven) in our data set exceeds the number of exit interview (five), it is necessary to re-weight the observations if we are to make use of all of the available data. We achieve this by scaling up the weights on all of the decedents by a common factor. To calculate the scaling factor, we use the fact that there are four interview waves (2004-2010) in which we have both core and exit interviews. We calculate that the ratio of households in the core interviews to single decedents households in the exit interviews in 2004-2010 is 0.028. Without adjustment, the ratio of households in the 1998-2010 core interviews to single decedent households in the 2004-2012 exit interviews is 0.021. As expected, the latter figure is lower, putting too much weight on the households in the core interviews, and thus on the inter-vivos transfers. We therefore scale up the exit interview weights by $\approx 1.33 = \frac{0.028}{0.021}$.

at 16 hours per day for 7 days per week. Missing values for individual non-institutional helpers are not imputed and therefore enter the sums as zeros.

The HRS does not elicit hours of long-term care for institutional (nursing home) helpers. Total long-term care hours for individuals receiving nursing-home care are therefore not accurately measured in the survey. For these individuals, total hours are imputed using a nearest neighbor predictive mean match as a function of ADLs and IADLs and (for core interviews only) cognitive impairment and whether a proxy interview. A single nearest neighbor is selected with replacement from the sample of care recipients who receive no nursing-home care, and ties are broken randomly. The procedure is done separately for core and exit interviews. When finding neighbors, we exclude the 1998 core interview data, which do not record care hours from spouses/partners.

We categorize long-term care arrangements using the relationship between caregivers and care recipients in the helper files. Individuals who receive any nursing home care or who reportedly live in a nursing home are classified as in a nursing home. Individuals who do not receive nursing home care and who received more than 50% of their care hours from informal sources (family or other unpaid individuals) are classified as receiving informal care. The remaining individuals, who are not in nursing homes and who received less than 50% of their care from informal sources, are classified as formal home care recipients.[89]

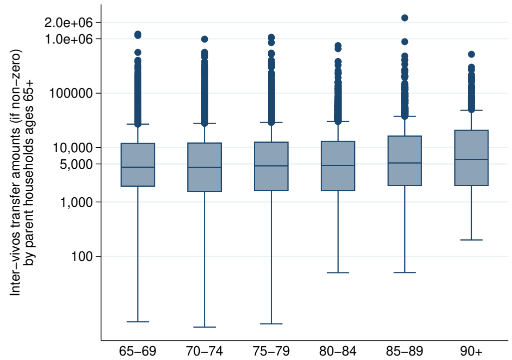
For our regression analyses, we construct summary measures of long-term care at the end of life that are comparable across individuals. Specifically, we calculate average weekly total long-term care hours and average weekly long-term care hours from children over the final six years of life for our sample of single decedents. These are weighted averages, with each interview weighted by the share of the six-year period occurring during the timeframe covered by that interview. Six years was chosen because less than 5% of our single decedent sample has fewer than six years worth of data. (For comparison, 30% have fewer than 8 years of data.) To reduce the influence of outliers in the (highly skewed) hours measures, we transform them using log(1 + hours).

G.7 Disability status

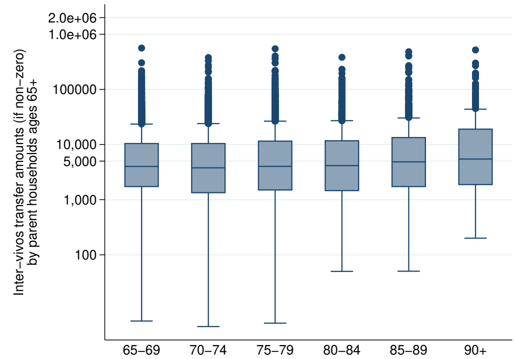
A household is classified as *disabled* (used interchangeably with *sick*) if its member is both (i) single and (ii) receives twenty-one or more total hours of long-term care per week. For community care recipients, reported hours are used to determine disability status while for nursing-home care recipients, imputed hours are used. If either of these criteria is not satisfied, a household is classified as *healthy*.

[89] We define the caregiver as a child if the helper's relationship to the care recipient is: child, child-in-law, stepchild, ambiguous child relationship, grandchild, spouses of children or grandchildren. Informal caregivers include child caregivers as well as helpers whose relationship to the care recipient is categorized as: (late) spouse/partner, parents, parents-in-law, other relatives, siblings, and other unpaid individuals. Formal home caregivers include helpers categorized as: professionals, organizations, and other paid individuals.

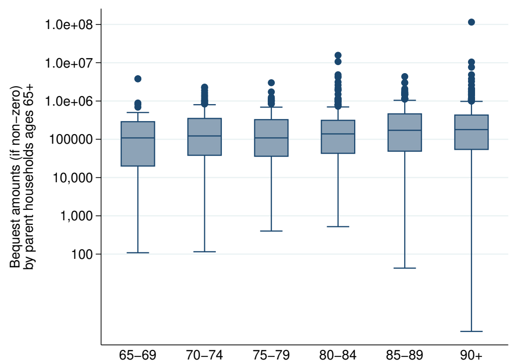
Figure G.1: Boxplots of the distributions of inter-vivos transfers and bequests



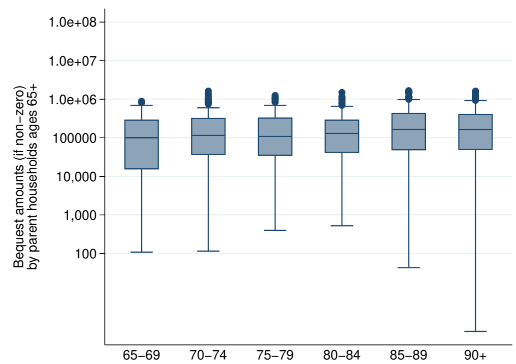
A. Inter-vivos transfers.



B. Inter-vivos transfers. Bottom 95%.



C. Bequests.



D. Bequests. Bottom 95%.

IVT: core interviews 1998-2010, parent households whose eldest member is aged 65+. Bequests: exit interviews 2004-2012, decedents ages 65+ with children who were single at the time of their death. In each of the two rows, the panel on the right (Panels B and D) impose an additional restriction on the sample: households whose net worth (core interviews) or estate value (exit interviews) equals or exceeds the 95th percentile of net worth among all households in the core interview data (1,684,282 in 2010 dollars) are dropped. The panels on the left (Panels A and C) do not impose this restriction. Note that the y-axes use log scales. The box edges are the 25th and 75th percentiles, and the midlines are the medians. The whisker edges are the upper and lower adjacent values, and the dots are outliers beyond the adjacent values.

Table G.1: Imputation models

	Any Estate	Bracket	ihs(Value)
ihs(Net Worth)	0.0839***	0.164***	0.208***
	(0.0102)	(0.0184)	(0.0221)
Female	0.269**	-0.0472	-0.119
	(0.111)	(0.110)	(0.187)
Educ: high school or GED	0.233**	0.227*	0.395*
	(0.115)	(0.129)	(0.218)
Educ: some college	0.248*	0.338**	0.549**
	(0.150)	(0.150)	(0.256)
Educ: college graduate	0.626***	0.914***	0.832***
	(0.209)	(0.178)	(0.293)
Age	0.0739	-0.0205	0.218*
	(0.0600)	(0.0734)	(0.128)
Age Squared	-0.000297	0.000324	-0.00113
	(0.000374)	(0.000452)	(0.000784)
Non-white	-0.459***	0.0291	0.239
	(0.116)	(0.157)	(0.267)
Owned Home 0/1	0.869***	0.752***	1.163***
	(0.122)	(0.120)	(0.200)
Medicaid Coverage	-0.892***	-1.076***	-1.654***
	(0.104)	(0.141)	(0.228)
Intended Bequest 10k+	0.00549***	0.00271*	0.00304
	(0.00142)	(0.00155)	(0.00267)
Intended Bequest 100k+	0.00914***	0.0167***	0.00920***
	(0.00194)	(0.00159)	(0.00254)
Observations	2,922	1,402	1,127
R^2			0.36
pseudo-R^2	0.30	0.18	

Coefficient estimates with standard errors in parentheses. Asterisks denote statistical significance at the 1% (***), 5% (**), and 10% (*) levels. Dependent variables are (from left to right): an indicator for whether any estate was bequeathed, a categorical variable for the bracket in which the value of the estate falls, and the inverse hyperbolic sine (ihs) of the estate value. Statistical models are (from left to right): logit, ordered logit, and linear regression. Net worth and bequest intentions are taken from the most recent available core interview data. Bequest intentions are indicators for whether the individual expected to leave a bequest above the named amount. Medicaid coverage is taken from the exit interview, if available, or the most recent core data otherwise. Age is age at death. Homeownership is from the preloaded information for the exit interview. All models also include a constant (not reported). Models are estimated for our sample of single decedents.

Table G.2: Types and frequencies of estate value reports

	N	Percent	Cum. Percent
No asset	1,180	36.57	36.57
Continuous report	1,202	37.25	73.81
Complete brackets, closed	302	9.36	83.17
Complete brackets, top bracket	1	0.03	83.20
Incomplete brackets, closed	46	1.43	84.63
Incomplete brackets, open top	224	6.94	91.57
No bracket information	253	7.84	99.41
Don't know ownership	19	0.59	100.00
Observations	3,227		

Counts and frequencies are for our sample of single decedents. No asset means the decedent left no bequest. Continuous report refers to cases in which the proxy respondent reported the dollar amount of the estate. Brackets refer to cases in which the dollar amount of the estate could not be ascertained, but upper and/or lower bounds on the value were reported. The procedure used to obtain these bounds involves the interviewer cycling through a sequence of pre-defined "breakpoints" and asking the respondent whether the estate value was greater than, less than, or about equal to each breakpoint. If the process reaches completion, the result is a complete bracket. If at any point in the procedure the respondent refuses to answer or does not know the value of the estate in relation to a particular breakpoint, the procedure ends, resulting in an incomplete bracket. If the upper bound on the estate cannot be established or is reported to be greater than the maximum breakpoint ($2 million), we refer to this case as having an open top bracket. No bracket information refers to cases where neither an upper nor lower bracket was obtained. Finally, don't know ownership means the proxy was not sure whether the decedent left a bequest.

Table G.3: Ratio of inter-vivos transfers to bequests, by wealth threshold.

Threshold value (2010 $)	IVT-bequest ratio	Description
1.0×10^5	0.312	
1.684×10^6	0.299	Result appearing in the main text
5.0×10^6	0.310	
1.0×10^7	0.329	
∞	0.266	No wealth threshold imposed

IVT: core interviews 1998-2010, parent households whose eldest member is aged 65+. Bequests: exit interviews 2004-2012, decedents ages 65+ with children who were single at the time of their death. Each row of the table corresponds to a different wealth threshold. When calculating the IVT-to-bequest ratio, we drop households whose current wealth (for inter-vivos transfers) or estate value (for bequests) equals or exceeds the threshold.

H Accounting for the wealth trajectories of liquidators

In this appendix, we investigate the large declines in housing liquidators' median net worth seen in Panel (b) of Figure 1. We document that a large share of these declines can be accounted for by i) observable factors, such as out-of-pocket medical expenditures, and ii) the effect of transitioning from homeownership to non-ownership—which, according to our theory, should generate faster rates of dis-saving among liquidators relative to owners. By contrast, the role of measurement error appears to be more minor. A variety of other factors that we do not directly examine (e.g., transaction costs of selling, pent-up demand) seem quite capable of explaining the residual, unexplained portion of the declines.

To provide a rough measure of the size of the phenomenon that we wish to explain, we pool all of the home liquidations from Figure 1 Panel (b) and calculate the difference between median pre-liquidation wealth among liquidators (139K) and their median post-liquidation wealth (23K). The difference (116K) is the figure for which we aim to account. As we proceed, we provide rough calculations of the share of this decline that can be accounted for by the explanatory factors we examine.

Long-term care and medical spending. Because many liquidations of housing assets coincide with entry into a nursing home (see Figure 3 in the text), it seems plausible that the large decreases in net worth exhibited by liquidators could potentially be explained by long-term care expenditures. We explore this hypothesis in Panels (a) and (b) of Figure H.1.

Panel (a) replicates Figure 1 Panel (b) in the text but, for each pair of interviews, separates the group of liquidators into those who entered a nursing home between interviews (25% of liquidators) and those who resided in the community at both interviews (66%).[90] The lines for owners are unchanged, and we omit the lines for renters to improve readability. The results indicate that median changes in wealth are generally similar for the two groups of liquidators with perhaps slightly steeper downward trajectories for nursing home entrants. Pooling the liquidators who entered nursing homes, the decline in median net worth is 123K (= 138K − 15K); the analogous figure for those remaining in the community is 111K (= 138K − 27K). Thus, we calculate that nursing home entries coinciding with home liquidation account for 12K (= 123K − 111K), or 10% $\left(= \frac{12K}{116K}\right)$, of the decline in median net worth for liquidators.

We look more directly at the role of out-of-pocket medical expenditures, inclusive of long-term care spending, in Panel (b) of Figure H.1. Again, the starting point is Figure 1 Panel (b) from the text. We retain the original lines for keepers and liquidators (again, renters have been omitted), and we add counterfactual lines for each group that remove the effect of out-of-pocket medical spend-

[90] We ignore the smaller numbers of liquidators who were NH residents in both periods or exited an NH between interviews.

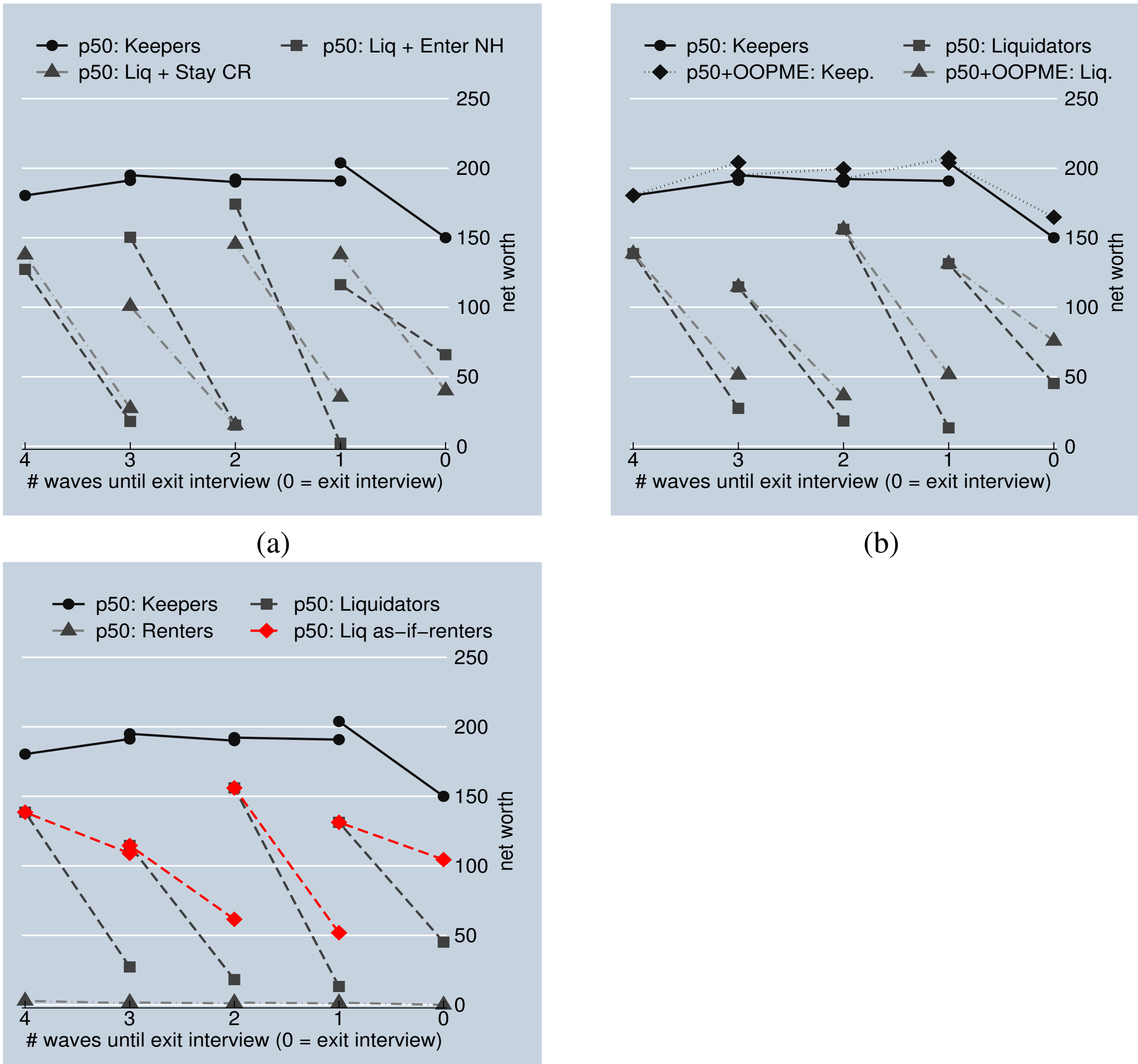
ing. Specifically, for each individual and each pair of interviews, we add the individual's observed out-of-pocket medical spending between interviews to their net worth at the second interview in the pair. If all changes in net worth were due to out-of-pocket medical expenditures, the counterfactual lines would be flat. The results indicate that out-of-pocket medical expenditures can account for a significant portion of the change in median net worth for home liquidators. We calculate that median post-liquidation net worth including medical expenditures is 55K (versus 23K without). Hence, a rough estimate is that out-of-pocket medical expenditure explains 32K (= 55K − 23K), or 28% $\left(=\frac{32K}{116K}\right)$, of the decline in liquidators' median net worth. We conclude that observable events, such as nursing home entry and medical spending, can explain somewhere on the order of one-third of the dis-savings of liquidators.

The effect of homeownership on savings. While the declines in median net worth for liquidators appear large relative to those for keepers, it bears emphasizing that these patterns are not actually inconsistent with our theory, which predicts that non-owners should dis-save more rapidly than owners. Because liquidators spend part of the period between interviews as owners and part as renters, the model predicts that they should dis-save at a rate between these groups. Thus, the keepers' net worth trajectories do not provide the right counterfactual against which to judge the reasonableness of the liquidators' trajectories.

We explore this channel in Figure H.1 Panel (c). Except for the red lines, this figure exactly reproduces Figure 1 Panel (b) from the text. The red lines provide a (crude) counterfactual. For each liquidator at each pair of interviews, we find a nearest-neighbor renter on the basis of net worth at the first interview in the pair and assign to the liquidator the observed change in net worth between interviews from the renter. The goal is to capture how each liquidator's net worth would have evolved if they had acted like an observably-similar renter. We thus refer to the counterfactual trajectories as *liquidators-as-if-renters*.

As anticipated, we see that the dis-savings of liquidators resemble much more closely the counterfactual dis-savings of liquidators-as-if-renters than the dis-savings of owners (or renters, whose savings at the median are too low to allow for much dis-savings). However, whereas the theory would predict, all else equal, that the observed trajectories for liquidators would be steeper than those for owners but less steep than those for (counterfactual) renters, we see the liquidators dis-saving somewhat faster than in the counterfactuals. Nevertheless, we conclude that a significant portion of the decline in liquidators' net worth can be plausibly explained by the link between ownership and savings—i.e., the fact that liquidators, as non-owners, should dis-save at a faster rate than owners. As a rough measure of magnitudes, we calculate that median post-liquidation net worth for the liquidators-as-if-renters is 83K (versus 23K for the true liquidators). Hence, we conclude that this factor may explain up to 60K (= 83K − 23K), or 52% $\left(=\frac{60}{116}\right)$, of the declines

Figure H.1: Wealth trajectories and housing



(a) (b) (c)

Notes: HRS core interviews 1998-2010 and exit interviews 2004-2012. Percentiles of wealth (e.g., p50 is the 50th percentile) are reported at 4, 3, 2, and 1 interview-waves prior to the exit interview and at the exit interview (= 0). The sample is a balanced panel of single decedents with four or more core interviews. In Figure 1 Panel (b) in the text, we divided this sample at each pair of interviews into three mutually exclusive groups: Keepers, who owned at both interviews; Liquidators, who owned at the first but not the second; and Renters, who owned at neither interview. The panels in this figure are variations on the original. Panel (a): Liquidators are divided into categories on the basis of nursing home utilization: Liquidators who enter a nursing home between interviews (*Enter NH*, 25% of liquidators); and Liquidators who remain community residents in both interviews (*Stay CR*, 66% of liquidators). We exclude the smaller groups of liquidators who lived in a nursing home in both periods or exited an NH between interviews. We also omit the lines for renters to improve readability. Panel (b): Plots the lines for Keepers and Liquidators, now regardless of nursing home utilization. For each household and each interview pair, we add the total out-of-pocket medical expenditure (OOPME) that accrued between interviews to net worth at the second interview in the pair. If all decreases in net worth were due to medical expenditures, the counterfactual trajectories would be flat. Panel (c): In addition to the original lines in Figure 1 Panel (b) in the text, we add counterfactual lines for liquidators that assign to each liquidator at each pair of interviews a counterfactual change in net worth from an observably similar renter (matched on the basis of net worth at the first interview in the pair). This counterfactual is meant to capture, albeit crudely, how net worth for the liquidator household would have evolved if the household acted "as-if" a renter. In all panels, amounts are 1000s of year-2010 dollars. Statistics are computed with respondent-level sample weights corrected for nursing home residents.

we observe—likely an upper bound as liquidators may not spend the whole period as renters.[91]

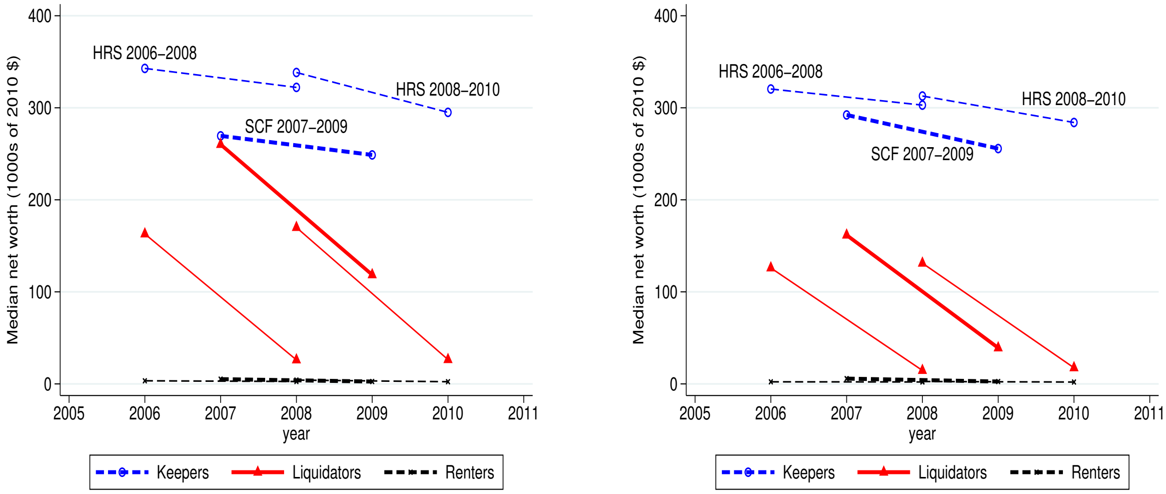
Measurement error. To examine the potential impact of measurement error, we compare the patterns in the HRS to those in the Survey of Consumer Finances (SCF), often considered the gold standard for measuring household wealth in the U.S. Figure H.2 compares the SCF 2007-2009 panel to the HRS interviews in 2006-2008 (waves 8-9) and 2008-2010 (waves 9-10). For each pair of interviews, we show the evolution of median net worth for the three groups in Figure 1 Panel (b) of the text: keepers, liquidators, and renters. Panels (a) and (b) restrict the samples to be ages 65+ and 50+, respectively. We loosen the age restriction in (b) to increase the sample size, for there are few liquidators in the SCF data.

The results from the SCF are strikingly similar to the HRS. The declines in median net worth for liquidators are nearly identical in absolute terms and, in Panel (b), in relative terms as well. The lines for owners and renters are also quite similar across the surveys. Given the reputation of the SCF, we find these results reassuring. While we cannot rule out that the HRS and SCF both suffer from measurement error to a similar degree, we regard it as equally plausible that measurement error is not a major driver of changes in median net worth for liquidators.

Other factors. The factors above appear to explain a majority of the observed decline in liquidator median net worth. Allowing for some overlap between the factors, a reasonable estimate could be that three-quarters of the decline are accounted for, leaving around one-quarter of the excess dis-savings of liquidators unexplained. There are a number of factors "outside the model" that could help account for this residual. One possibility is that liquidators receive less for their homes than they anticipate. This may occur, for instance, if the house has to be sold quickly following a sudden decline in health. Another is that moving and transactions costs eat up a significant portion of the proceeds from the home sale. Costs on the order of 10-20K (9-17% of the observed decline) do not seem unreasonable. A third possibility is that liquidators have higher consumption due to pent-up demand for big-ticket purchases, such as durables or "bucket-list" items, that were put off when most wealth was tied up in the home. For example, a consumer may finally make a reality of their dream to take an expensive trip to Australia that he or she could not afford before selling the house. Although we have not evaluated the separate contributions of these factors, we conjecture that together they may well account for the remaining unexplained part of liquidators' rapid dis-savings.

[91] We have also experimented with constructing these counterfactuals using a more rigorous approach. Specifically, we applied the quantile decomposition methods in Chernozhukov, Fernández-Val, and Melly (2013 ECMA) to construct the full counterfactual distributions of changes in net worth for renters if they shared the same distributions of other observable characteristics (e.g., lagged net worth, health, etc.) as liquidators. We obtain similar results with this approach. When we compare the counterfactual distributions to the liquidators' original distribution, we again see that the real liquidators behave similarly to, but still dis-save somewhat faster than, their counterfactual counterparts who "look like" liquidators but "behave like" renters.

Figure H.2: Wealth trajectories and housing in the HRS and SCF



(a) Ages 65+ (b) Ages 50+

Notes: HRS—Health and Retirement Study. Core interviews 2006-2010 (interview waves 8-10). Median net worth for households whose eldest member is ages 65+ (a) or 50+ (b). For couples, one household member is selected. Amounts are weighted with respondent-level sample weights corrected for nursing home residents. SCF—Survey of Consumer Finances (SCF) 2007-2009 panel. Median net worth for households whose reference person is ages 65+ (a) or 50+ (b). All amounts are in 1000s of 2010 dollars. For each pair of interviews, households are divided into groups based on homeownership at the first and second interviews in the pair. Keepers are households that own a home at both interviews. Liquidators owned in the first interview but not at the second interview. Renters did not own a home at either interview.

I The Pareto tail of the estate distribution

The right tail of the distribution of wealth in the United States is generally thought to be distributed according to a Pareto (power-law) distribution. A key feature of the Pareto distribution is that, depending on the fatness of the upper tail, some or even all of the moments of the distribution may not exist. Indeed, some estimates suggest that this is the case for the distribution of wealth in the U.S. For instance, estimates from Klass et al. (2006) imply that the mean and all higher moments of the distribution of wealth in the U.S. are infinite. In this section, we examine whether the same applies to the upper tail of the distribution of estate values.

I.1 Results

Visually, a Pareto tail manifests itself as a linear relationship between the natural log of a variable and the natural log of its anti- (or complementary) CDF. We present this evidence in Panel (a) of Figure I.1. The navy circles are the log of the empirical anti-CDF of estate values plotted against log estate value. For this figure, we use data on all non-missing estate values for our sample of single decedents who left bequests in the 2004-2012 exit interviews prior to our imputation of missing values. The linear pattern is clearly evident in the right tail of the distribution. Imposed on top of the navy circles, the dashed red line depicts the tail of a Pareto distribution that we fit to the data. Typically, a power law only applies above some threshold value of the variable in question. The threshold is captured by the dashed cyan line in the figure.

Following the procedure outlined in Clauset et al. (2009), which we describe just below, we estimate the threshold and the shape parameter, α, of the Pareto distribution. Our estimates indicate that the distribution of estate values follows a power law for estates above approximately $450,000. We find that the shape parameter α of the Pareto distribution is 2.45. This value implies that the mean of the distribution exists, but the variance and all higher moments do not.

I.2 Power-law distribution estimation

The density of the Pareto distribution is given by:

$$\text{Prob}\left(X = x\right) = \frac{\alpha}{x_{min}} \left(\frac{x}{x_{min}}\right)^{-\alpha}$$

where x_{min} is the threshold above which the power law applies and α is the shape parameter of the distribution. Per this parameterization, the m^{th} moment exists only if $m < \alpha - 1$. All moments with $m \geq \alpha - 1$ diverge. For example, when $\alpha < 2$, the mean and all higher-order moments are infinite. When $2 < \alpha < 3$, the mean exists, but higher order moments diverge. The anti- (or complementary) CDF given by:

$$\text{Prob}\,(X \geq x) \quad = \quad \int_x^{\infty} p\,(X)\,\mathrm{d}X = \left(\frac{x}{x_{min}}\right)^{-\alpha+1}$$

Taking logs reveals the linear relationship we see in Figure I.1 between the log anti-CDF and the log of the data:

$$\log\left(\text{Prob}\,(X \geq x)\right) = (-\alpha+1)\log\,(x) - (-\alpha+1)\log\,(x_{min})$$

We follow the approach in Clauset et al. (2009) to estimate the threshold and shape parameter of the Pareto (power-law) distribution. Given a value for x_{min}, we can estimate α by maximum likelihood. The ML estimator has the following analytical solution:

$$\hat{\alpha} = 1 + \left[\frac{1}{N}\sum_i \log\left(\frac{x}{x_{min}}\right)\right]^{-1}$$

with standard error:

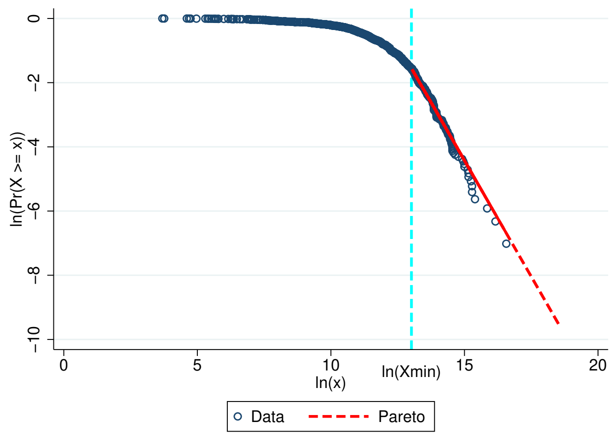
$$\frac{\hat{\alpha}-1}{\sqrt{N}}$$

We choose x_{min} to minimize the Kolmogorov-Smirnov distance D between the empirical CDF of the estate distribution and our estimated Pareto distribution:

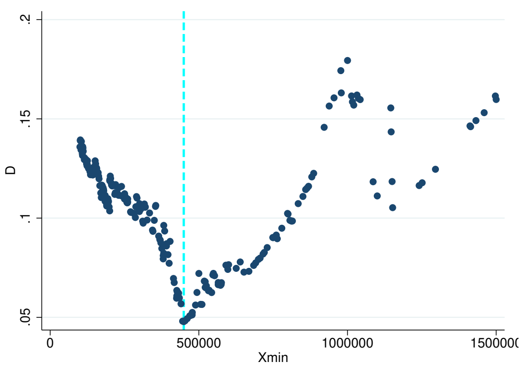
$$D = \max_{x \geq x_{min}} |S(x) - P(x)|$$

where $S(x)$ is the empirical CDF and $P(x)$ is a Pareto CDF with α equal to the ML estimator. Panel (b) of Figure I.1 shows how D varies with x_{min}. Panel (c) illustrates how the estimate of α is dependent on the choice of x_{min}. In both panels, the dashed cyan line indicates the location of our estimate $\widehat{x_{min}}$.

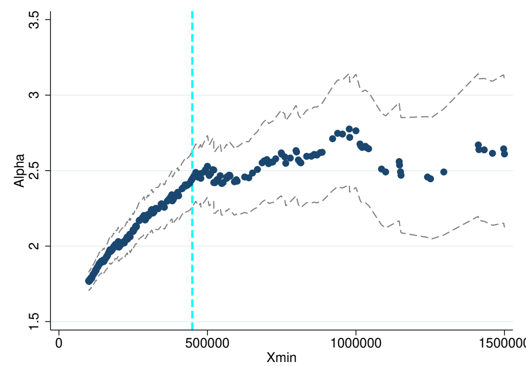
Figure I.1: The Pareto tail of the estate value distribution



(a) Pareto tail



(b) Kolmogorov-Smirnov distance



(c) ML estimates for $\widehat{\alpha}$

Panel (a): The navy circles represent data on reported estate values from the 2004-2012 exit interviews for our sample of decedents prior to imputation of missing values. The figure plots the log anti-CDF of the estate values (y-axis) against the log of the estate values (x-axis). The dashed cyan line is the threshold log estate value above which the power law appears to hold, in the sense that the data appear to be distributed according to a Pareto distribution. The dashed red line is the log anti-CDF of a Pareto distribution with $\alpha = 2.446384344956527$ and $x_{min} = 449184.5$. This line has been shifted down to align with the empirical log anti-CDF. Our estimate for α is obtained using the maximum likelihood estimator. Our estimate for x_{min} was computed as the minimizer of the Kolmogorov-Smirnov distance between the empirical and estimated CDFs: $D = \max_{x \geq x_{min}} |S(x) - P(x)|$ where $S(x)$ is the empirical CDF and $P(x)$ is a Pareto CDF with α equal to the ML estimator. Panel (b): This figure plots D against x_{min} for all possible values of x_{min} in our data. The dashed cyan line indicates where the minimum is located. Panel (c): This figure plots the ML estimates for α at each possible value of x_{min}.

J Computational appendix

We will discuss here the solution method concerning model ingredients that are novel. We refer the reader to Barczyk & Kredler (2014), Barczyk & Kredler (2018) and their appendices for elements that are already present in past papers. The online appendix to Barczyk & Kredler (2014) contains a description of the Markov-chain approximation methods.

J.1 Transfers within the state space

As shown in Theory Appendix C.3, the gift-giving decision within the state-space is of bang-bang type. To make this operational in our code, we have to tackle two issues. First, we impose bounds on the transfer flows (since we cannot deal with infinite flows or lump-sum transfers). Second, there is a discontinuity in transfer flows when the term $\mu^p = V^p_{a^k} - V^p_{a^p}$ switches signs; we smooth this discontinuity in our computations, which helps with stability of the algorithm. We do so in the same fashion for exchange-motivated transfers Q once μ^p or μ^k become positive, since these transfers have the flavor of gifts then (both agents agree that the maximal transfer possible should flow in this situation).

Bounds on transfers. To make transfer flows bounded, we assume that transfers cannot exceed a multiple of the recipient's income flow. Specifically, we impose the following lower and upper bounds on the net transfer flows (from parent to child):

$$\bar{T}_k(z) = -\bar{q} y^p_{net}(z), \qquad \bar{T}_p(z) = \bar{q} y^k_{net}(z), \tag{48}$$

where $\bar{q} > 0$ is a tuning parameter of the algorithm and where $y^k_{net}(z)$ is the child's net income (after taxes) in state z. As for the parent's net income, we include housing services, i.e., we let $y^p_{net}(z) = income + (r + \delta_h)h^p$, where $income$ is social-security income plus asset income, ra^p, net of taxes.

Transfer motives. We now show how we deal with the discontinuity of gifts when the "diagonal derivative" $\mu^p = V^p_{a^k} - V^p_{a^p}$ switches sign. The idea is to let gifts continuously increase to the upper bound once μ^p becomes positive. A problem that we encounter here is that the magnitude of the diagonal derivative depends on the agent's wealth: The marginal value of a dollar decreases when the agent becomes richer. To address this issue, we first construct a measure of the willingness to give that is independent of agents' wealth. To construct this measure (the *transfer motive*), we ask the following question: At which rate τ^i would a transfer have to be taxed (or subsidized) so that player i would be exactly indifferent between giving and not giving a marginal dollar to the other player? Specifically, player i's *transfer motive* τ^i in state z is defined implicitly from the equation

$$V^i_{a^{-i}}(z)[1-\tau^i(z)] = V^i_{a^i}(z),$$

where $-i$ indexes the other player. From this, we can back out the transfer motive in state z as

$$\tau^i(z) = 1 - \frac{V^i_{a^i}(z)}{V^i_{a^{-i}}(z)}. \tag{49}$$

Smoothing transfer policies. To make transfers continuous in the transfer motive, we apply a continuous function $\phi(\cdot)$ to the transfer motive that quickly increases from 0 to 1 once the transfer motive becomes positive. In practice, we choose the following piecewise-linear function $\phi : [0,\infty) \to [0,1]$:

$$\phi(\tau) = \min\left\{\frac{\tau}{\bar{\tau}}, 1\right\}, \tag{50}$$

where $\bar{\tau} > 0$ is a parameter. The function prescribes that once τ is above $\bar{\tau}$, we set gifts to upper bound. On the range $\tau \in [0,\bar{\tau}]$, we let gifts linearly increase from 0 to the upper bound.

Algorithm. We set gifts by the following algorithm in our computations for each z **within the state space**, i.e., for states z such that both $a^p > 0$ and $a^k > 0$:

1. If $\tau_p(z) \leq 0$ and $\tau_k(z) \leq 0$ (players want to hold on to their wealth), set $g^p(z) = g^k(z) = 0$ for gift-giving decisions and set the bounds for transfers in the bargaining stage to $[\bar{Q}_l(z), \bar{Q}_u(z)]$.
2. Otherwise (at least one of the players wants to move wealth), define a "net transfer motive" $\tau(z) \equiv \tau^p(z) - \tau^k(z)$ and distinguish the following two cases:[92]
   (a) $\tau(z) \geq 0$: Set $g^p(z) = \phi(\tau(z))\bar{Q}_u(z)$ and $g^k(z) = 0$ when calculating gifts under an outside option. Set the candidate transfer under to $Q^*(z) = \phi(\tau(z))\bar{Q}_u(z)$ when trying to find a bargaining solution for an inside option.
   (b) $\tau(z) < 0$: Set $g^p(z) = 0$ and $g^k(z) = -\phi(-\tau(z))\bar{Q}_l(z)$ when calculating gifts under an outside option. Set the candidate transfer to $Q^*(z) = -\phi(-\tau(z))\bar{Q}_l(z)$ when trying to find a bargaining solution for an inside option.

[92]Note here that this distinction also takes care of situations in which *both* players want to give gifts; our specification does so in a fashion that preserves continuity of gifts in the transfer motives. These counter-intuitive situations occur in our computations at the outer margins of the state space (when players are very asset-rich), where extrapolation together with changes in the discrete decisions can create turbulence in the value functions. It turns out that this algorithm deals successfully turbulences in these regions, which are visited only by a tiny fraction of agents in equilibrium, if at all.

Choice of tuning parameters. In practice, we set the tuning parameters for the algorithm to $\bar{q} = 2$ and $\bar{\tau} = 0.05$. This means that (i) players can receive maximally twice their income flow as a gift and (ii) this maximum is attained once the net transfer motive τ reaches 0.05.

J.2 Other computational issues

Grids. Due to the large dimensionality of the state space, we have to strike a balance between how fine we can choose the grid in the different dimensions. A novelty with respect to our previous work is that we use *non-linear* grids for a^p and a^k. This allows us to have a relatively fine grid at low assets (the first two grid points are 0 and 100K\$), while using a low number of grid points ($N_a = 21$). We set the top grid point at $\bar{a} = 4m\$$, the second-to-last grid point being $a = 3.65m\$$. Our choice for $\bar{a}$ is large enough to ensure that agents always dis-save when at this bound, thus the drift points inward, which is important for stability of the algorithm. In the simpler case with one player (counterfactual without children), we found that this non-linear grid led to policy functions that were very close to policies obtained with finer grids of both linear and non-linear type. There are three discrete health states ($N_s = 3$), the healthy state and the two disability states. For the two productivity grids, we choose grid size $N_\epsilon = 4$, see Appendix D for the details. For housing, the grid size is $N_h = 8$. There is one renting state and we use a log-grid for the seven house sizes, the smallest house being worth 50k\$ and the largest house 2m\$. We set the time increment in the algorithm to $\Delta t = 1/23 = 0.0435$ years. With this choice, the probabilities in the Markov-chain approximation method stay safely on the positive side. This leads to a time grid of $N_j = 30 \times 23 = 690$ points. In total, we thus have a grid with $N_s \times N_a^2 \times N_\epsilon^2 \times N_h \times N_j \simeq 117,000,000$ grid points. There is also a smaller grid with $N_a \times N_h \times N_j \simeq 116,000$ grid points on which we track children with dead parents.

Updating. The calculation of the model is feasible due to the continuous-time assumption. Continuous time has two key advantages. First, it allows us to derive tight characterizations of equilibrium policies in all stages of the game; these characterizations give us closed-form solutions for policies in the vast majority of cases and thus keep computational cost at a minimum. The second advantage is that when taking the time horizon to zero, interactions between shocks in different dimensions become second-order and can be neglected. In practice, this means that in our Markov-chain approximation it is sufficient to create a Markov chain on the discrete grid that changes in only one dimension at each Δt. When updating value functions at t, the expectation of the value at $t + \Delta t$ takes the form of a sum over a small number of grid points ($\simeq 13$). This linear mapping can be represented by a highly sparse matrix H. This matrix H is a sum of Kronecker products that collects the transition probabilities in the different dimensions. We exploit the tensor structure of the

Kronecker-matrix multiplications in the updating step to speed up the computation; the idea of the algorithm is to see value function vectors as a multi-dimensional array and to apply simple linear maps separately for each dimension whenever this is possible. We have made the code available on the Matlab File Exchange under the name "Fast Kronecker matrix multiplication".[93] We use the same routine when mapping forward the distribution over time and when calculating certain statistics on lifetime outcomes (e.g., the probabilities of ever ending up in NH or MA, expected bequests).

Smoothing. We found that solving the model was more challenging than in our previous work (by Barczyk & Kredler). The reason for this is the introduction of a permanent discrete choice: that of selling the house. What allowed us to make progress was to smooth value functions using various approaches. First, and most importantly, we give agents the opportunity to bargain on the house-selling decision; this prevents discontinuities in the child's value function when the parent abruptly changes the selling decision. Also, in order to prevent false selling decisions due to computational imprecisions, we set the bargaining weight of the strong party to 0.99 (instead of 1) inside the state space. We smooth out the bang-bang transfer decision as described in the previous section, Appendix J.1. We also smooth the Medicaid decision by introducing an i.i.d. preference shock to the utility of the Medicaid consumption floor, convexifying the MA uptake probability between the discrete values 0 and 1. Finally, we set the Brownian noise in the laws of motion for a^p and a^k to $\sigma_a = 0.05$.

Extrapolation. At the upper bound of the grids for a^p and a^k, we have to make choices for how to proceed with extrapolation. We ensure that we choose $\bar{a}$ high enough so that the asset drift is always negative at the top of the asset grid. However, there are still random movements due to shocks to assets that can make assets increase at this upper bound. We reflect back such paths at the boundary, which we found to be more stable than extrapolating value functions. When agents sell large houses, however, they can jump farther out of the state space. To calculate the values under selling, we extrapolate value functions along rays in the $a^k - a^p$-plane under the assumption that consumption functions are linear in (a^k, a^p), while fixing the other states.

House-buying decision. We compute the house-buying/renting decision at age 65 as follows. First, recall that the housing decision takes place *before* the parent learns about the productivity of the child and when all parents are still healthy. Thus, the parent's state consists of (a^p, ϵ^p) when making the decision, which substantially simplifies the problem. We first let everybody buy a house who has sufficient assets to do so. Those who prefer to rent will immediately sell it in the

[93]See https://es.mathworks.com/matlabcentral/fileexchange.

first time period, which is more parsimonious. We found that the following approach worked best: We find the best house-size policy in the class of affine functions of wealth (fixing each of the four productivity levels), interpolating the parent's after-purchase values by 2D spline interpolation.[94] We compared these affine policies to more flexible specifications and found very similar results. The affine specification has the advantage of providing more stable and reasonable results for house sizes at the lower and higher end of the spectrum.

Artificial panel. We draw an artificial panel with 250,000 model families that we follow from parent age 65 until the parent death. In line with the HRS practice, we "interview" families in intervals of two years (i.e., at age 67.0, 69.0 etc.) and again at their death (exit interview). Assets a^p and a^k are continuous variables that are updated using the (endogenous) drift and (exogenous) volatility of assets, drawing innovations of the Brownian increments from normal distributions. We use interpolation on the asset and housing grids to obtain family outcomes. We use nearest-neighbor interpolation, since some policies, such as caregiving choices and house-selling decisions, are discontinuous. Stock variables (financial wealth, housing wealth) are measured at the time of the interview. Flow variables (consumption, inter-vivos transfers, time in different forms of care) are integrated from the last interview until the current interview.

[94] Given the homogeneous (Cobb-Douglas) preferences, an affine policy in wealth is what we expect; there is a need for an intercept (in a addition to a slope parameter) since a substantial part of the parent's wealth comes from discounted pension payments, wealth-poor parents' lifetime wealth being a lot higher than their financial assets at age 65.

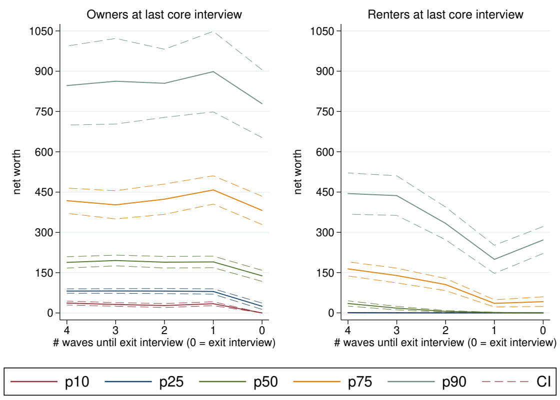
K Supplemental figures and tables

In this section, we present additional empirical results referenced in main text. A complete listing of the contents of the appendix appears below.

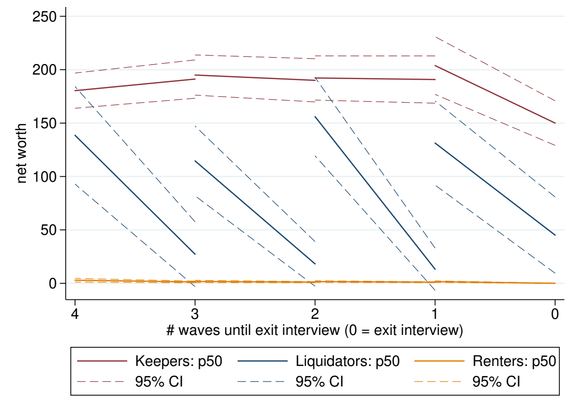
List of Figures

List of Tables

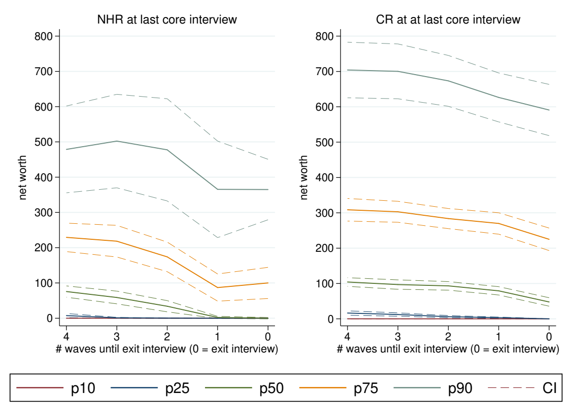
Figure K.1: Wealth trajectories (Figures 1, 2, and 4) with 95% confidence intervals



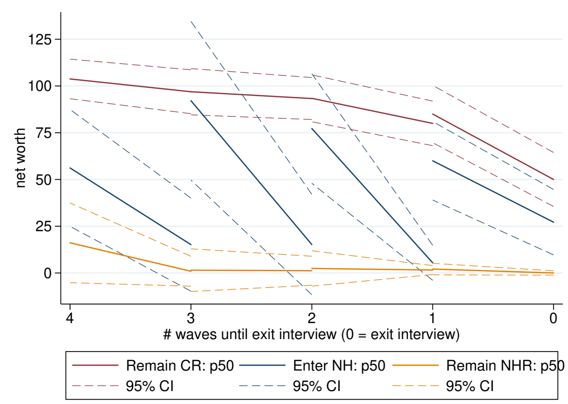
(a) Own or rent in last wave prior exit



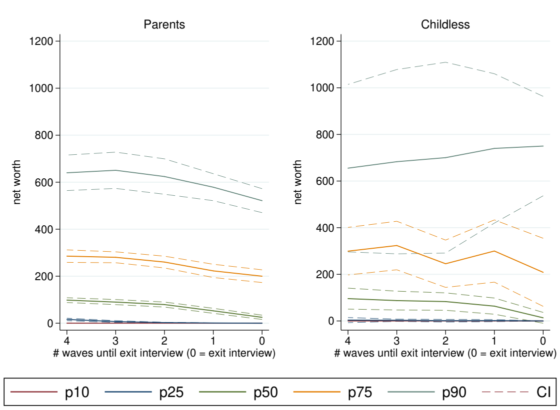
(b) Keepers vs. Liquidators vs. Renters



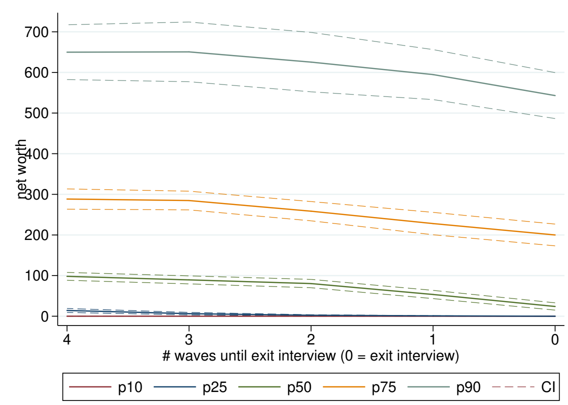
(c) Community or NH resident in last wave prior exit



(d) Remain CR vs. Enter NH vs. Remain NHR.



(e) With and without children



(f) All

This figure adds ninety-five percent confidence intervals for each of the wealth trajectories reported in figures in the text. Panels (a) and (b) correspond to Panels (a) and (b) of Figure 1. Panels (c) and (d) correspond to Panels (a) and (b) of Figure 2. Panels (e) and (f) correspond to Panels (a) and (b) of Figure 4. Consult those figures for additional notes. Some panels have been broken into separate plots for readability.

Table K.1: Children and nursing home utilization

	Dependent variables: nursing home utilization last 2 years					
	NH resident		NH stay		Log(Nights)	
	(1)	(2)	(3)	(4)	(5)	(6)
Children	-0.031***	0.010	-0.027**	0.0016	-0.21**	0.050
	(0.011)	(0.011)	(0.012)	(0.012)	(0.098)	(0.12)
Child LTC helper		-0.11***		-0.078***		-0.41***
		(0.011)		(0.012)		(0.090)
Observations	14,210	14,210	14,185	14,185	2,731	2,731
R^2	0.35	0.37	0.33	0.34	0.21	0.22
Mean of dep. var.	0.14	0.14	0.21	0.21	5.01	5.01

Coefficient estimates from linear regressions. Standard errors clustered at the household level in parentheses. Asterisks indicate statistical significance at the 1% (***), 5% (**), and 10% (*) levels. Sample includes single (uncoupled) individuals ages 65 and older with 2+ ADL limitations and/or cognitive impairment in the 1998-2010 HRS core interviews. Respondent-level sample weights are used. Children is an indicator equal to 1 if the respondent has any children. Child LTC helper is an indicator equal to 1 if any children (including their spouses, partners, and children) are caregivers for the respondent. Specifications also include as regressors: gender, race/ethnicity, age (quadratic), education, separate sets of indicators for each possible number of ADL (0-5) and IADL (0-5) limitations and for cognitive impairment and dementia, income and net worth quintiles, homeownership, Census division, and interview wave. For the complete set of coefficient estimates, see Table K.2 in the appendix.

Table K.2: Children and nursing home utilization (Table K.1): All coefficient estimates

Dependent variable:	Nursing home resident				Nursing home stay last two years				Log(Nights in nursing home)			
	(1)		(2)		(3)		(4)		(5)		(6)	
Children	-0.031***	(0.011)	0.010	(0.011)	-0.027**	(0.012)	0.0016	(0.012)	-0.21**	(0.098)	0.050	(0.12)
Child LTC helper			-0.11***	(0.011)			-0.078***	(0.012)			-0.41***	(0.090)
Female	-0.0026	(0.0077)	0.0033	(0.0077)	0.0045	(0.0087)	0.0086	(0.0088)	-0.020	(0.092)	-0.0075	(0.093)
Race: Black	-0.063***	(0.0079)	-0.062***	(0.0078)	-0.077***	(0.0088)	-0.077***	(0.0087)	-0.11	(0.11)	-0.15	(0.11)
Race: other	-0.036**	(0.015)	-0.035**	(0.014)	-0.057***	(0.016)	-0.057***	(0.016)	-0.35	(0.24)	-0.34	(0.23)
Hispanic	-0.077***	(0.011)	-0.076***	(0.011)	-0.10***	(0.014)	-0.10***	(0.013)	-0.18	(0.17)	-0.19	(0.17)
Educ: High school or GED	0.035***	(0.0081)	0.034***	(0.0080)	0.028***	(0.0091)	0.027***	(0.0090)	0.15*	(0.089)	0.14	(0.089)
Educ: Some college	0.038***	(0.012)	0.034***	(0.011)	0.047***	(0.013)	0.044***	(0.013)	0.20**	(0.10)	0.17*	(0.10)
Educ: College and above	0.061***	(0.015)	0.059***	(0.015)	0.065***	(0.018)	0.063***	(0.018)	0.28**	(0.14)	0.27*	(0.14)
1 ADL	0.020**	(0.0082)	0.029***	(0.0083)	0.043***	(0.010)	0.049***	(0.011)	0.20	(0.14)	0.22	(0.14)
2 ADLs	0.084***	(0.012)	0.093***	(0.012)	0.12***	(0.014)	0.13***	(0.014)	0.13	(0.14)	0.16	(0.14)
3 ADLs	0.097***	(0.014)	0.10***	(0.014)	0.15***	(0.017)	0.16***	(0.017)	0.18	(0.15)	0.20	(0.15)
4 ADLs	0.21***	(0.018)	0.21***	(0.018)	0.24***	(0.020)	0.25***	(0.020)	0.53***	(0.13)	0.54***	(0.13)
5 ADLs	0.27***	(0.022)	0.27***	(0.021)	0.32***	(0.022)	0.32***	(0.022)	0.61***	(0.13)	0.62***	(0.13)
1 IADL	0.0029	(0.0066)	0.056***	(0.0090)	0.032***	(0.0091)	0.070***	(0.011)	0.067	(0.15)	0.24	(0.15)
2 IADLs	0.022*	(0.011)	0.083***	(0.013)	0.065***	(0.014)	0.11***	(0.016)	0.42***	(0.14)	0.59***	(0.14)
3 IADLs	0.069***	(0.016)	0.14***	(0.018)	0.13***	(0.019)	0.18***	(0.021)	0.17	(0.16)	0.40**	(0.17)
4 IADLs	0.17***	(0.019)	0.25***	(0.021)	0.23***	(0.021)	0.28***	(0.023)	0.33**	(0.15)	0.59***	(0.17)
5 IADLs	0.25***	(0.020)	0.32***	(0.021)	0.27***	(0.021)	0.33***	(0.023)	0.38**	(0.16)	0.63***	(0.17)
Cog. Function: Impaired	0.098***	(0.013)	0.099***	(0.013)	0.090***	(0.016)	0.091***	(0.016)	0.21	(0.14)	0.20	(0.14)
Cog. Function: Demented	0.18***	(0.015)	0.18***	(0.015)	0.15***	(0.018)	0.15***	(0.018)	0.79***	(0.15)	0.79***	(0.15)
Age	-0.0079	(0.0076)	-0.0058	(0.0075)	-0.00060	(0.0081)	0.00090	(0.0081)	-0.078	(0.075)	-0.070	(0.074)
Age squared	0.000058	(0.000048)	0.000047	(0.000048)	0.000019	(0.000051)	0.000011	(0.000051)	0.00051	(0.00045)	0.00046	(0.00044)
Net Worth Quintile: 2	-0.016*	(0.0092)	-0.014	(0.0091)	0.0081	(0.011)	0.0098	(0.011)	-0.37***	(0.10)	-0.35***	(0.099)
Net Worth Quintile: 3	-0.022**	(0.011)	-0.020*	(0.011)	-0.00068	(0.013)	0.0012	(0.013)	-0.30**	(0.13)	-0.27**	(0.13)
Net Worth Quintile: 4	-0.034**	(0.014)	-0.031**	(0.014)	0.0090	(0.016)	0.011	(0.016)	-0.41***	(0.16)	-0.39**	(0.15)
Net Worth Quintile: 5	-0.035**	(0.015)	-0.036**	(0.015)	-0.0045	(0.019)	-0.0052	(0.019)	-0.33*	(0.18)	-0.33*	(0.18)
Income Quintile: 2	0.0049	(0.0076)	0.0065	(0.0075)	0.0030	(0.0089)	0.0041	(0.0088)	-0.021	(0.082)	-0.0069	(0.082)
Income Quintile: 3	0.022*	(0.012)	0.024**	(0.012)	0.012	(0.014)	0.013	(0.014)	0.28**	(0.13)	0.30**	(0.12)
Income Quintile: 4	-0.0036	(0.016)	-0.0029	(0.016)	-0.011	(0.021)	-0.011	(0.021)	-0.024	(0.22)	-0.028	(0.22)
Income Quintile: 5	0.034	(0.023)	0.033	(0.023)	0.029	(0.027)	0.028	(0.027)	0.19	(0.32)	0.20	(0.32)
Homeowner	-0.082***	(0.0087)	-0.081***	(0.0087)	-0.10***	(0.010)	-0.10***	(0.010)	-0.56***	(0.099)	-0.55***	(0.098)
Census Div: Mid Atlantic	-0.016	(0.019)	-0.017	(0.018)	-0.037*	(0.021)	-0.038*	(0.021)	0.079	(0.18)	0.057	(0.17)
Census Div: EN Central	0.022	(0.018)	0.022	(0.018)	0.0039	(0.020)	0.0037	(0.020)	0.13	(0.17)	0.15	(0.17)
Census Div: WN Central	0.036*	(0.021)	0.035*	(0.021)	0.021	(0.023)	0.020	(0.023)	0.25	(0.18)	0.26	(0.18)
Census Div: S Atlantic	0.0071	(0.017)	0.0065	(0.017)	-0.027	(0.019)	-0.027	(0.019)	0.16	(0.16)	0.16	(0.16)
Census Div: ES Central	-0.0039	(0.021)	-0.00095	(0.020)	-0.030	(0.023)	-0.028	(0.022)	-0.090	(0.22)	-0.070	(0.22)
Census Div: WS Central	-0.0089	(0.018)	-0.0100	(0.018)	-0.041**	(0.020)	-0.042**	(0.020)	0.050	(0.19)	0.041	(0.19)
Census Div: Mountain	0.017	(0.023)	0.011	(0.023)	0.021	(0.026)	0.017	(0.026)	-0.0099	(0.22)	-0.011	(0.22)
Census Div: Pacific	-0.0018	(0.019)	-0.0026	(0.018)	-0.013	(0.021)	-0.013	(0.021)	-0.041	(0.18)	-0.046	(0.18)
Census Div: not U.S.	-0.0061	(0.045)	-0.0024	(0.040)	-0.041	(0.073)	-0.039	(0.070)	0.023	(0.25)	-0.098	(0.25)
Observations	14,210		14,210		14,185		14,185		2,731		2,731	
R^2	0.35		0.37		0.33		0.34		0.21		0.22	
Mean of dep. var.	0.14		0.14		0.21		0.21		5.01		5.01	

Table reports the (nearly) complete set of coefficient estimates for the models estimated in Table K.1. See that table for additional notes. All models also include a constant and indicators for each interview wave, which have been omitted for space.

Table K.3: Children and nursing home utilization (Table K.1): Additional results

A. Dependent variable: Nursing home resident

Dependent variable:	Nursing home resident					Child LTC helper
	(WLS)	(WLS)	(WLS)	(WLS)	(IV)	(WLS)
Children	-0.031***	0.010	-0.0073	0.0069	0.087***	0.21***
	0.011	0.011	0.014	0.013	0.021	0.017
Child LTC helper		-0.11***			-0.31***	
		0.011			0.047	
Daughters			-0.029***			0.060***
			0.0098			0.011
Child within 10 miles				-0.051***		0.16***
				0.0076		0.0096
Observations	14,210	14,210	14,172	13,979	13,979	13,979
Mean of dep. var.	0.14	0.14	0.14	0.14	0.14	0.35
Over-ID: p-value					0.52	
Exogeneity: p-value					0.00	
F-stat.						166.31

B. Dependent variable: Nursing home stay in the last two years

Dependent variable:	Nursing home stay last two years					Child LTC helper
	(WLS)	(WLS)	(WLS)	(WLS)	(IV)	(WLS)
Children	-0.027**	0.0016	-0.0027	0.0090	0.089***	0.21***
	0.012	0.012	0.015	0.014	0.024	0.017
Child LTC helper		-0.078***			-0.31***	
		0.012			0.055	
Daughters			-0.031***			0.060***
			0.010			0.011
Child within 10 miles				-0.049***		0.16***
				0.0089		0.0097
Observations	14,185	14,185	14,147	13,954	13,954	13,954
Mean of dep. var.	0.21	0.21	0.21	0.21	0.21	0.35
Over-ID: p-value					0.40	
Exogeneity: p-value					0.00	
F-stat.						164.55

C. Dependent variable: Log(Nights in nursing home in the last two years)

Dependent variable:	Log(Nights in nursing home)					Child LTC helper
	(WLS)	(WLS)	(WLS)	(WLS)	(IV)	(WLS)
Children	-0.21**	0.050	-0.059	0.025	0.85	0.42***
	0.098	0.12	0.12	0.11	0.65	0.036
Child LTC helper		-0.41***			-1.71	
		0.090			1.32	
Daughters			-0.19**			0.084***
			0.095			0.028
Child within 10 miles				-0.33***		0.19***
				0.081		0.023
Observations	2,731	2,731	2,715	2,683	2,683	2,683
Mean of dep. var.	5.01	5.01	5.01	5.01	5.01	0.56
Over-ID: p-value					1.00	
Exogeneity: p-value					0.40	
F-stat.						37.96

Coefficient estimates with standard errors clustered at the household level in parentheses. WLS is weighted least squares. IV is instrumental variables. All regressions are weighted with sample weights. Asterisks denote statistical significance at the 1% (***), 5% (**), and 10% (*) levels. Sample includes single (uncoupled) individuals ages 65 and older with 2+ ADL limitations and/or cognitive impairment in the 1998-2010 HRS core interviews. Children is an indicator equal to 1 if the respondent has any children. Child LTC helper is an indicator equal to 1 if any children (including their spouses, partners, and children) are caregivers for the respondent. Daughters and Child within 10 miles are indicators for having any daughters and for having any child living within 10 miles, respectively. In the IV regressions, Child LTC helper is the endogenous regressor, and Daughters and Child within 10 miles are used as instruments. The final column provides the first-stage. Over-ID is a test of over-identifying restrictions. Exogeneity is a test of the null hypothesis that the endogenous regressor is exogenous. Specifications also include as regressors: gender, race/ethnicity, age (quadratic), separate sets of indicators for each possible number of ADL (0-5) and IADL (0-5) limitations and for cognitive impairment and dementia, income and net worth quintiles, homeownership, Census division, and interview wave.

Table K.4: Annualized wealth changes and homeownership

Median regressions by Lagged wealth quintile:	Dependent variable: Annualized change in wealth ($ 1000s). Top		4th		3rd		2nd	
Own home (prev. interview)	50.0***	(12.4)	24.4***	(2.8)	10.0***	(1.1)	0.3	(0.4)
Age	-0.3	(0.4)	0.3**	(0.1)	0.1*	(0.1)	0.0	(0.0)
Female	-2.4	(5.9)	1.6	(3.5)	0.5	(1.0)	0.0	(0.2)
Race: Black	-19.2	(55.9)	-15.2***	(3.2)	-5.2***	(1.2)	0.0	(0.2)
Race: other	65.6	(50.5)	-5.5	(8.6)	-5.4	(4.1)	0.3	(0.3)
Hispanic	4.4	(17.1)	4.0	(5.3)	2.1	(3.3)	0.1	(0.2)
Educ: high school or GED	21.0**	(8.7)	6.2**	(2.5)	0.4	(1.0)	0.3**	(0.1)
Educ: some college	7.9	(9.5)	3.7	(2.9)	-0.6	(1.4)	0.4	(0.3)
Educ: college graduate	23.8**	(11.3)	22.9***	(4.9)	7.9*	(4.2)	0.9*	(0.4)
Number of children	-4.2**	(2.1)	-1.8***	(0.6)	-0.1	(0.2)	-0.0	(0.0)
1 ADL limitation	1.9	(8.0)	-5.3**	(2.5)	-0.0	(1.5)	-0.0	(0.2)
2 ADL limitations	0.6	(10.8)	-5.4	(4.6)	-0.2	(1.8)	0.0	(0.2)
3 ADL limitations	-25.0	(19.9)	-2.3	(4.1)	-0.5	(2.3)	-0.1	(0.2)
4 ADL limitations	1.6	(22.0)	-8.0	(5.3)	1.7	(2.1)	0.4	(0.3)
5 ADL limitations	-4.4	(16.3)	-5.7	(4.8)	-3.2	(2.7)	0.1	(0.3)
1 IADL limitation	-6.7	(7.7)	-3.2	(2.5)	-2.5**	(1.2)	0.2	(0.2)
2 IADL limitations	-25.9**	(10.8)	-2.5	(3.3)	-3.7*	(2.0)	-0.4*	(0.2)
3 IADL limitations	-25.2*	(13.5)	-10.0	(6.2)	-5.1**	(2.3)	-0.4**	(0.2)
4 IADL limitations	6.4	(30.7)	-1.1	(4.9)	-6.2*	(3.3)	-0.4	(0.3)
5 IADL limitations	5.9	(14.0)	4.1	(5.4)	-3.6*	(2.1)	-0.4	(0.3)
Ever had memory disease	-13.2	(14.0)	-8.5**	(4.3)	-1.0	(1.5)	0.2	(0.2)
Nursing home resident	-21.7	(16.8)	-20.9***	(3.7)	-6.8***	(1.7)	-0.2	(0.2)
Exit interview	-76.6***	(20.7)	-2.1	(5.9)	-6.4*	(3.3)	-0.8**	(0.3)
Constant	-56.9	(35.9)	-45.6***	(12.5)	-20.6***	(5.2)	-1.0	(0.6)
Observations	2,119		2,123		2,182		2,281	
Median lagged wealth	555		188		72		8	
Median change in wealth	-49		-9		-4		-1	
Home ownership rate	0.86		0.83		0.77		0.28	

Coefficient estimates from median regressions. Robust standard errors in parentheses. Asterisks denote statistical significance at the 1% (***), 5% (**), and 10% (*) levels. The dependent variable in all models is the change in wealth (in 1000s of 2010 dollars) between interviews divided by the number of years elapsed between interviews. Sample: core and exit interviews for single decedents with children. We use data from all interviews at which these individuals were single (uncoupled). An observation is a person-interview. Regressions are estimated separately by quintile of net worth from the previous interview. See the column headings. Results for the bottom quintile, which holds very little wealth, are omitted. Models also include (not reported) indicators for religion, interview wave, and Census division.

Table K.5: Informal care arrangements and housing (Table 9): All coefficient estimates

Conditional on:	Dependent variable: Receiving > 50% care hours from children				No care at prev. interview				IC at prev. interview			
	(1)		(2)		(3)		(4)		(5)		(6)	
Net worth (prev. interview)	0.0066***	(0.001)	0.0010	(0.002)	0.0077***	(0.002)	0.0032	(0.003)	-0.00045	(0.002)	-0.0034	(0.003)
Own home (prev. interview)			0.12***	(0.02)			0.094***	(0.03)			0.064**	(0.03)
Age	-0.0016	(0.001)	-0.00095	(0.001)	0.000049	(0.001)	0.00052	(0.001)	-0.00054	(0.002)	-0.00012	(0.002)
Female	0.083***	(0.02)	0.082***	(0.02)	0.11***	(0.03)	0.11***	(0.03)	-0.0055	(0.03)	-0.0036	(0.03)
Race: Black	0.089***	(0.03)	0.081***	(0.03)	0.053	(0.04)	0.049	(0.04)	0.079**	(0.03)	0.077**	(0.03)
Race: other	0.077	(0.06)	0.090	(0.06)	0.042	(0.07)	0.055	(0.07)	0.084	(0.07)	0.093	(0.07)
Hispanic	0.089**	(0.04)	0.083*	(0.04)	0.056	(0.06)	0.052	(0.06)	0.13**	(0.06)	0.13**	(0.06)
Educ: high school or GED	-0.038*	(0.02)	-0.038*	(0.02)	-0.039	(0.03)	-0.039	(0.03)	-0.016	(0.03)	-0.018	(0.03)
Educ: some college	-0.053*	(0.03)	-0.043	(0.03)	-0.062*	(0.04)	-0.056	(0.04)	0.0052	(0.04)	0.013	(0.04)
Educ: college graduate	-0.090***	(0.03)	-0.085***	(0.03)	-0.093**	(0.04)	-0.086**	(0.04)	-0.064	(0.05)	-0.069	(0.05)
Number of children	0.027***	(0.004)	0.028***	(0.004)	0.034***	(0.005)	0.035***	(0.005)	0.0069	(0.005)	0.0070	(0.005)
1 ADL limitation	-0.019	(0.02)	-0.019	(0.02)	-0.0067	(0.04)	-0.0044	(0.04)	-0.055	(0.04)	-0.055	(0.04)
2 ADL limitations	-0.077***	(0.03)	-0.077***	(0.03)	0.012	(0.04)	0.0093	(0.04)	-0.091**	(0.04)	-0.094**	(0.04)
3 ADL limitations	-0.100***	(0.03)	-0.10***	(0.03)	-0.080*	(0.05)	-0.086*	(0.05)	-0.076	(0.05)	-0.076	(0.05)
4 ADL limitations	-0.19***	(0.03)	-0.19***	(0.03)	-0.12***	(0.05)	-0.13***	(0.05)	-0.18***	(0.05)	-0.19***	(0.05)
5 ADL limitations	-0.20***	(0.03)	-0.20***	(0.03)	-0.15***	(0.04)	-0.15***	(0.04)	-0.16***	(0.04)	-0.16***	(0.05)
1 IADL limitation	0.13***	(0.05)	0.13***	(0.05)	0.23***	(0.06)	0.23***	(0.06)	-0.013	(0.07)	-0.019	(0.07)
2 IADL limitations	0.087**	(0.04)	0.086**	(0.04)	0.14**	(0.06)	0.14**	(0.06)	-0.0061	(0.06)	-0.0072	(0.06)
3 IADL limitations	-0.023	(0.05)	-0.018	(0.04)	0.10*	(0.06)	0.11*	(0.06)	-0.18***	(0.07)	-0.18**	(0.07)
4 IADL limitations	-0.049	(0.04)	-0.044	(0.04)	0.037	(0.06)	0.034	(0.06)	-0.16**	(0.07)	-0.16**	(0.07)
5 IADL limitations	-0.057	(0.05)	-0.049	(0.04)	0.023	(0.06)	0.019	(0.06)	-0.18***	(0.07)	-0.18**	(0.07)
Ever had memory disease	-0.10***	(0.02)	-0.094***	(0.02)	-0.064**	(0.03)	-0.063**	(0.03)	-0.084***	(0.03)	-0.079***	(0.03)
Religion: Catholic	-0.010	(0.02)	-0.0088	(0.02)	0.0059	(0.03)	0.0059	(0.03)	-0.038	(0.03)	-0.039	(0.03)
Religion: Jewish	-0.17***	(0.04)	-0.17***	(0.04)	-0.19***	(0.06)	-0.19***	(0.06)	-0.079	(0.09)	-0.079	(0.09)
Religion: none	0.023	(0.06)	0.021	(0.06)	-0.014	(0.07)	-0.016	(0.07)	0.14**	(0.07)	0.14**	(0.07)
Religion: other	-0.020	(0.08)	-0.011	(0.08)	-0.010	(0.1)	0.0049	(0.1)	-0.086	(0.1)	-0.089	(0.1)
Census: Mid Atlantic	0.018	(0.04)	0.018	(0.04)	-0.063	(0.06)	-0.066	(0.06)	0.099*	(0.06)	0.094	(0.06)
Census: EN Central	0.0086	(0.04)	0.0054	(0.04)	-0.023	(0.06)	-0.032	(0.06)	0.11*	(0.06)	0.10*	(0.06)
Census: WN Central	-0.081*	(0.04)	-0.072	(0.04)	-0.079	(0.07)	-0.084	(0.07)	-0.022	(0.07)	-0.021	(0.07)
Census: S Atlantic	0.027	(0.04)	0.022	(0.04)	0.040	(0.06)	0.027	(0.06)	0.084	(0.06)	0.073	(0.06)
Census: ES Central	0.12**	(0.05)	0.11**	(0.05)	0.094	(0.07)	0.079	(0.07)	0.18**	(0.07)	0.17**	(0.07)
Census: WS Central	-0.026	(0.04)	-0.030	(0.04)	-0.053	(0.06)	-0.062	(0.06)	0.076	(0.06)	0.069	(0.06)
Census: Mountain	-0.076	(0.05)	-0.076	(0.05)	-0.11	(0.07)	-0.12	(0.07)	0.063	(0.08)	0.053	(0.08)
Census: Pacific	0.030	(0.04)	0.030	(0.04)	0.0085	(0.06)	-0.0011	(0.06)	0.092	(0.06)	0.084	(0.06)
Census: Not U.S.	-0.40***	(0.06)	-0.33***	(0.06)	-0.50***	(0.08)	-0.44***	(0.08)				
Interview wave=6	-0.0011	(0.02)	-0.0029	(0.02)	0.010	(0.05)	0.012	(0.05)	0.015	(0.05)	0.017	(0.05)
Interview wave=7	-0.014	(0.03)	-0.012	(0.03)	0.010	(0.05)	0.014	(0.05)	-0.039	(0.05)	-0.035	(0.05)
Interview wave=8	-0.0016	(0.03)	0.00098	(0.03)	0.0054	(0.05)	0.011	(0.05)	0.017	(0.05)	0.021	(0.05)
Interview wave=9	-0.012	(0.03)	-0.011	(0.03)	0.014	(0.05)	0.017	(0.05)	-0.014	(0.05)	-0.012	(0.05)
Interview wave=10	-0.00055	(0.03)	-0.0012	(0.03)	0.016	(0.06)	0.024	(0.06)	-0.072	(0.06)	-0.071	(0.06)
Interview wave=11	0.016	(0.04)	0.016	(0.04)	0.042	(0.07)	0.045	(0.07)	0.010	(0.07)	0.012	(0.07)
Exit interview	0.0033	(0.02)	0.0021	(0.02)	0.028	(0.03)	0.029	(0.03)	-0.025	(0.03)	-0.028	(0.03)
Constant	0.50***	(0.1)	0.43***	(0.1)	0.21	(0.1)	0.16	(0.1)	0.86***	(0.2)	0.82***	(0.2)
Observations	6,148		6,130		2,097		2,088		1,817		1,813	
R^2	0.16		0.17		0.12		0.13		0.13		0.13	
Mean of dep. var.	0.40		0.40		0.49		0.49		0.65		0.65	

Table reports the complete set of coefficient estimates for Table 9 in the main text. See that table for additional notes. Omitted reference categories are: Race: white, Educ: less than high school, No I/ADL limitations, Religion: Protestant, Census: New England, and Interview wave=5.

Table K.6: Informal care arrangements and housing (Table 9): Role of child characteristics

Conditional on:	Dependent variable: Receiving > 50% care hours from children								
				No care at prev. interview			IC at prev. interview		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Net worth (prev. interview)	0.0010	0.0015	0.0015	0.0032	0.0039	0.0033	-0.0034	-0.0030	-0.0034
	(0.0016)	(0.0017)	(0.0016)	(0.0027)	(0.0027)	(0.0028)	(0.0026)	(0.0026)	(0.0027)
Own home (prev. interview)	0.12***	0.12***	0.11***	0.094***	0.093***	0.081***	0.064**	0.065**	0.062*
	(0.018)	(0.019)	(0.019)	(0.029)	(0.029)	(0.030)	(0.030)	(0.030)	(0.032)
Num. daughters		0.032***	0.028***		0.036***	0.027**		0.00072	0.0044
		(0.0088)	(0.0085)		(0.013)	(0.013)		(0.013)	(0.013)
Mean child age		0.0016	0.0026**		0.00092	0.0027		0.0014	0.0027
		(0.0012)	(0.0011)		(0.0020)	(0.0020)		(0.0018)	(0.0019)
Num. grandchildren		0.000062	-0.00087		0.0021	0.0013		-0.0028	-0.0027
		(0.0029)	(0.0028)		(0.0041)	(0.0041)		(0.0038)	(0.0038)
Mean child educ.		-0.010**	-0.0034		-0.018***	-0.012*		-0.0087	-0.0015
		(0.0044)	(0.0044)		(0.0064)	(0.0071)		(0.0065)	(0.0069)
Num. married		-0.020**	0.0081		-0.029**	-0.012		0.0011	0.020
		(0.0096)	(0.012)		(0.013)	(0.017)		(0.014)	(0.017)
Num. own homes			0.014			0.033**			0.014
			(0.0099)			(0.015)			(0.013)
Num. within 10 miles			0.034***			0.048***			0.0083
			(0.010)			(0.015)			(0.013)
Mean child income			-0.031***			-0.017			-0.020
			(0.010)			(0.015)			(0.017)
Num. work full-time			-0.0080			-0.012			-0.019
			(0.011)			(0.015)			(0.016)
Num. co-resident			0.24***			0.25***			0.12***
			(0.022)			(0.031)			(0.030)
Observations	6,130	5,847	5,090	2,088	2,007	1,751	1,813	1,757	1,533
R^2	0.17	0.18	0.25	0.13	0.14	0.19	0.13	0.13	0.16
Mean of dep. var.	0.40	0.41	0.41	0.49	0.49	0.50	0.65	0.65	0.64

Columns (1), (4), and (7) replicate the main results from Table 9 in the main text. Other columns add child characteristics. All specifications include the same set of controls (not reported) as in Table 9 in addition to the variables appearing in the table above. Child variables are the means across core interviews. Results are similar when child variables are instead carried forward from previous waves. Variables labeled *mean* are constructed by first taking means across children at each interview and then averaging across interviews. Child income is reported as a categorical variable with values ranging 1-5. See Table 9 for additional notes.

Table K.7: Bequests and informal care

	Overall Estate		Housing	
	Any Estate	Log(Value)	Bequest	Bequest+
Avg. Total Weekly LTC Hours	-0.051***	-0.15***	-0.074***	-0.067***
	(0.0077)	(0.039)	(0.0081)	(0.0086)
Avg. Weekly Hours from Children	0.023***	0.14***	0.046***	0.061***
	(0.0081)	(0.043)	(0.0081)	(0.0087)
Observations	2,818	1,641	2,820	2,820
R^2	0.22	0.26	0.13	0.10
Mean of dep. var.	0.65	11.53	0.37	0.50

Coefficient estimates from linear regression models. Robust standard errors in parentheses. Asterisks denote statistical significance at the 1% (***), 5% (**), and 10% (*) levels. Sample includes exit interviews for our sample of single decedents with children. An observation is an individual. Dependent variables are (by column, from left to right): an indicator equal to 1 if the decedent left a non-zero estate (Any Estate); the log of the estate value (Log(Value)); an indicator equal to 1 if a decedent died owning a home (Bequest); and a broader measure of housing bequests that includes inter-vivos transfers of housing assets (Bequest+). Average Total Weekly LTC Hours and Average Weekly Hours from Children are, respectively, the average number of weekly hours of long-term care received in total and from children (plus their spouses, partners, and children) during the last six years of life. To reduce the influence of outliers, we use log(1 + average hours). In all specifications, (not reported) controls include: age, sex, race (White, Black, other), Hispanic ethnicity, education (less than high school, high school / GED, some college, or college graduate), whether ever coupled in sample, number of children, the log of mean household income across core interviews, religion, Census division, and interview wave. For the complete set of coefficient estimates, see Table K.8.

Table K.8: Bequests and informal care (Table K.7): All coefficient estimates

	Overall Estate				Housing			
	Any Estate		Log(Value)		Bequest		Bequest+	
Avg. Total Weekly LTC Hours	-0.051***	(0.0077)	-0.15***	(0.039)	-0.074***	(0.0081)	-0.067***	(0.0086)
Avg. Weekly Hours from Children	0.023***	(0.0081)	0.14***	(0.043)	0.046***	(0.0081)	0.061***	(0.0087)
Age	0.0071***	(0.0011)	0.030***	(0.0060)	-0.0013	(0.0011)	0.00029	(0.0012)
Female	0.053**	(0.021)	0.023	(0.099)	0.032	(0.024)	0.020	(0.024)
Race: white	0	(.)	0	(.)	0	(.)	0	(.)
Race: Black	-0.17***	(0.032)	-0.70***	(0.22)	-0.0091	(0.033)	-0.067**	(0.033)
Race: other	-0.11*	(0.060)	0.35	(0.28)	-0.11**	(0.050)	-0.12**	(0.059)
Hispanic	-0.016	(0.044)	0.14	(0.22)	-0.0100	(0.045)	-0.0011	(0.050)
Educ: less than high school	0	(.)	0	(.)	0	(.)	0	(.)
Educ: high school / GED	0.082***	(0.024)	0.37***	(0.12)	0.030	(0.024)	0.027	(0.025)
Educ: some college	0.094***	(0.031)	0.39***	(0.14)	0.0012	(0.032)	-0.0074	(0.032)
Educ: college graduate	0.15***	(0.034)	0.61***	(0.17)	0.045	(0.040)	-0.0024	(0.040)
Num. children	-0.0049	(0.0046)	-0.0046	(0.026)	-0.0022	(0.0049)	-0.0042	(0.0051)
Ever coupled	0.034	(0.022)	0.21**	(0.098)	0.037	(0.024)	0.063**	(0.025)
log(Avg. household inc.)	0.16***	(0.023)	0.95***	(0.085)	0.13***	(0.021)	0.12***	(0.018)
Religion: Protestant	0	(.)	0	(.)	0	(.)	0	(.)
Religion: Catholic	-0.0051	(0.025)	0.12	(0.11)	0.0044	(0.026)	0.040	(0.027)
Religion: Jewish	-0.11**	(0.048)	0.30	(0.24)	-0.00066	(0.055)	-0.038	(0.060)
Religion: none	0.063	(0.042)	0.15	(0.23)	0.089*	(0.050)	0.064	(0.050)
Religion: other	-0.20*	(0.10)	-0.072	(0.26)	-0.24***	(0.072)	-0.18**	(0.092)
Census: New England	0	(.)	0	(.)	0	(.)	0	(.)
Census: Mid Atlantic	-0.058	(0.046)	-0.13	(0.28)	-0.059	(0.049)	-0.11**	(0.055)
Census: EN Central	-0.020	(0.043)	-0.054	(0.26)	0.027	(0.049)	-0.038	(0.054)
Census: WN Central	-0.041	(0.050)	-0.032	(0.26)	0.021	(0.054)	-0.11*	(0.059)
Census: S Atlantic	-0.022	(0.043)	0.29	(0.25)	0.10**	(0.049)	0.023	(0.053)
Census: ES Central	-0.067	(0.057)	-0.080	(0.30)	0.057	(0.062)	-0.029	(0.065)
Census: WS Central	-0.047	(0.048)	-0.058	(0.27)	0.13**	(0.053)	0.079	(0.057)
Census: Mountain	-0.12**	(0.059)	-0.10	(0.33)	0.0072	(0.062)	-0.084	(0.067)
Census: Pacific	-0.018	(0.044)	0.56**	(0.25)	0.11**	(0.051)	-0.025	(0.055)
Census: Not U.S.	-0.12	(0.26)	-0.34	(0.32)	-0.37***	(0.082)	-0.38**	(0.18)
Interview wave=7	0	(.)	0	(.)	0	(.)	0	(.)
Interview wave=8	-0.092***	(0.028)	-0.0080	(0.15)	-0.043	(0.031)	-0.0055	(0.033)
Interview wave=9	-0.097***	(0.027)	0.20	(0.13)	-0.055*	(0.030)	-0.0068	(0.031)
Interview wave=10	-0.081***	(0.028)	-0.27*	(0.15)	-0.024	(0.030)	-0.019	(0.032)
Interview wave=11	-0.12***	(0.030)	-0.28**	(0.14)	-0.034	(0.034)	-0.031	(0.035)
Constant	-1.38***	(0.26)	-0.97	(1.08)	-0.72***	(0.23)	-0.59***	(0.21)
Observations	2,818		1,641		2,820		2,820	
R^2	0.22		0.26		0.13		0.10	
Mean of dep. var.	0.65		11.53		0.37		0.50	

Table reports the complete set of coefficient estimates for Table K.7. Coefficient estimates from linear regression models. Robust standard errors in parentheses. Asterisks denote statistical significance at the 1% (***), 5% (**), and 10% (*) levels. Sample includes exit interviews for our sample of single decedents with children. An observation is an individual. Dependent variables are (by column, from left to right): an indicator equal to 1 if the decedent left a non-zero estate (Any Estate); the log of the estate value (Log(Value)); an indicator equal to 1 if a decedent died owning a home (Bequest); and a broader measure of housing bequests that includes inter-vivos transfers of housing assets (Bequest+). Average Total Weekly LTC Hours and Average Weekly Hours from Children are, respectively, the average number of weekly hours of long-term care received in total and from children (plus their spouses, partners, and children) during the last six years of life. To reduce the influence of outliers, we use log(1 + average hours). In all specifications, controls include: age, sex, race (white, Black, other), Hispanic ethnicity, education (less than high school, high school / GED, some college, or college graduate), whether ever coupled in sample, number of children, the log of mean household income across core interviews, religion, Census division, and interview wave.

Table K.9: Bequests and informal care: The impact of conditioning on nursing home utilization

	Overall Estate				Housing			
	Any Estate		Log(Value)		Bequest		Bequest+	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Avg. Total Weekly LTC Hours	-0.051***	-0.016*	-0.15***	-0.066	-0.074***	-0.018*	-0.067***	-0.026**
	(0.0077)	(0.0094)	(0.039)	(0.048)	(0.0081)	(0.010)	(0.0086)	(0.011)
Avg. Weekly Hours from Children	0.023***	-0.0038	0.14***	0.078	0.046***	0.0027	0.061***	0.030***
	(0.0081)	(0.0091)	(0.043)	(0.048)	(0.0081)	(0.0093)	(0.0087)	(0.0099)
Share of Interviews in NH		-0.24***		-0.68***		-0.39***		-0.28***
		(0.036)		(0.22)		(0.035)		(0.041)
Observations	2,818	2,818	1,641	1,641	2,820	2,820	2,820	2,820
R^2	0.22	0.23	0.26	0.26	0.13	0.16	0.10	0.12
Mean of dep. var.	0.65	0.65	11.53	11.53	0.37	0.37	0.50	0.50

Coefficient estimates from linear regression models. Robust standard errors in parentheses. Asterisks denote statistical significance at the 1% (***), 5% (**), and 10% (*) levels. Sample: exit interviews for our sample of single decedents with children. An observation is an individual. Dependent variables are (by column, from left to right): an indicator equal to 1 if the decedent left a non-zero estate (Any Estate); the log of the estate value (Log(Value)); an indicator equal to 1 if a decedent died owning a home (Bequest); and a broader measure of housing bequests that includes inter-vivos transfers of housing assets (Bequest+). Average Total Weekly LTC Hours and Average Weekly Hours from Children are, respectively, the average number of weekly hours of long-term care received in total and from children (plus their spouses, partners, and children) during the last six years of life. To reduce the influence of outliers, we use log(1 + average hours). Share of Interviews in NH is the share of interview during the last six years of life in which the individual was a nursing home resident. In all specifications, (not reported) controls include: age, sex, race (White, Black, other), Hispanic ethnicity, education (less than high school, high school / GED, some college, or college graduate), whether ever coupled in sample, number of children, the log of mean household income across core interviews, religion, Census division, and interview wave. The results reported in the odd-numbered columns are the same as those reported in Table K.7.

Table K.10: Bequests and informal care: Renters versus owners

	Renters		Owners			
	Any Estate	Log(Value)	Any Estate	Log(Value)	Home Beq.	Home Beq.+
Avg. Total Weekly LTC Hours	-0.054***	-0.29**	-0.040***	-0.12***	-0.092***	-0.077***
	(0.014)	(0.12)	(0.0088)	(0.039)	(0.010)	(0.010)
Avg. Weekly Hours from Children	0.021	0.18	0.0077	0.11**	0.047***	0.055***
	(0.013)	(0.13)	(0.0096)	(0.043)	(0.011)	(0.011)
Observations	826	242	1,985	1,397	1,985	1,985
R^2	0.20	0.32	0.15	0.26	0.12	0.08
Mean of dep. var.	0.36	9.97	0.76	11.78	0.52	0.67

Coefficient estimates from linear regression models. Robust standard errors in parentheses. Asterisks denote statistical significance at the 1% (***), 5% (**), and 10% (*) levels. Sample: exit interviews for our sample of single decedents with children. In the specifications labeled Renters (respectively, Owners), the sample is restricted to individuals who never (respectively, ever) report owning homes in our sample period. An observation is an individual. Dependent variables are (by column, from left to right): an indicator equal to 1 if the decedent left a non-zero estate (Any Estate); the log of the estate value (Log(Value)); an indicator equal to 1 if a decedent died owning a home (Home Beq.); and a broader measure of housing bequests that includes inter-vivos transfers of housing assets (Home Beq.+). Average Total Weekly LTC Hours and Average Weekly Hours from Children are, respectively, the average number of weekly hours of long-term care received in total and from children (plus their spouses, partners, and children) during the last six years of life. To reduce the influence of outliers, we use log(1 + average hours). Share of Interviews in NH is the share of interview during the last six years of life in which the individual was a nursing home resident. In all specifications, (not reported) controls include: age, sex, race (White, Black, other), Hispanic ethnicity, education (less than high school, high school / GED, some college, or college graduate), whether ever coupled in sample, number of children, the log of mean household income across core interviews, religion, Census division, and interview wave.