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

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Abstract

Housing and family are prominent aspects of old age, but how they shape the elderly's savings, spending, and inter-generational transfer behavior remains elusive. We develop a dynamic, non-cooperative model of the family with an illiquid housing asset and joint bargaining between elderly parents and their children over the homeownership and care arrangements of the parents. The model reveals important interactions between children, homeownership, and long-term care risk. Most notably, we find that housing plays the role of a commitment device that facilitates informal care arrangements within families and delays the spend-down of parental wealth. These interactions provide useful insights into several patterns in the data: the widely divergent savings behavior of homeowners and renters, the puzzling similarities in the bequests of parents and childless individuals, and the fact that parents withhold most inter-generational transfers until their deaths. The model's novel mechanisms and predictions are consistent with several empirical patterns.

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

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1 Introduction

Housing and family are, in many respects, cornerstones of the lives of the elderly. It is, therefore, perhaps unsurprising that they have (separately) been found to be important in shaping many facets of economic behavior in old age. The evolution of retirement wealth provides a prime example. Distinguished by relatively slow rates of dis-saving and the sizable bequests left by the elderly (De Nardi et al., 2016), the disposal of wealth in old age is clearly connected to housing. 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). Family has also long been thought to play an important role, yet there remains less consensus on this point. Although, intuitively, the presence of family lowers the opportunity cost of savings (Lockwood, 2018), the fact that households with and without children display similar savings and bequest behavior casts doubt on a bequest motive (Hurd, 1989, Dynan et al., 2004) or at least one that is unique to parents (Kopczuk & Lupton, 2007). Overlooked by these studies, however, is the role of family as a source insurance. For instance, family is a substantial provider of long-term care (Barczyk & Kredler, 2018), which represents one of the largest uninsured risks facing the elderly (Brown & Finkelstein, 2011).[1]

Taking a step back, these studies suggest that there are good reasons to believe that housing and family *together* are crucial to make sense of the elderly's savings, spending, and inter-generational transfer behavior. Family can support the elderly's desire to stay in their own home if the need for care arises. This can take the form of either providing care or, if family care is infeasible, by helping to pay for formal home care. Thus, homeownership is maintained and expenditures are low (more so when informal care is given), which translates into lower dis-saving and relatively higher bequests. In anticipation of higher bequests, family are more willing to provide care without the elderly having to give substantial inter-vivos transfers in exchange for care. Since parents reason that their house may become important in inducing care, they hold on to it and so dis-saving is low even in the absence of care.[2] Family insurance and housing, therefore, also contribute to our understanding of the timing of transfers, specifically the fact that most transfers are delayed until death (Kopczuk, 2007).

In this paper, we put forward a framework to explore how and why the joint presence of housing and family matters for the saving, spending, and inter-generational transfer behavior of the elderly. To the best of our knowledge, this is the first model to combine housing and family. A key

[1] Ko (2018) and Mommaerts (2016) argue that reliance on family care leads to substantially lower demand for LTC insurance which mirrors earlier theoretical work by Pauly (1990) on why it is rational not to purchase LTC insurance. While our paper shares important similarities with these, we do not aim to explain the LTC insurance market.

[2] The presence of family also lowers the opportunity cost of holding on to the house since it can be bequeathed. Also, home ownership has the further useful insurance property that it can be liquidated to pay for a nursing home if the need arises.

innovation (with respect to previous family models) is the inclusion of an illiquid housing asset that is separate from financial wealth. The addition of this asset presents non-trivial challenges to modeling and computation. A home-owning parent's decision whether to sell or keep the home can conflict with what the child would do were she able to dictate the parent's choices. This conflict of interest can give rise to discontinuities in value functions. As housing and care arrangements in reality are jointly determined and the choice of care involves the child, we specify a bargaining protocol over the joint determination of care and housing decisions. Aside from yielding plausible empirical predictions, bargaining elegantly solves the discontinuity issues: If the child household strictly prefers that the parent household keeps the home, the child concedes in other dimensions (caregiving and monetary transfers), which can induce the parent not to sell the house.[3]

In our model, a family consists of a parent and a child household who make separate consumption-savings decisions and interact strategically. A house is an illiquid asset that delivers a flow of housing services that are superior to those delivered by the rental market. Parent households can purchase a home at age 65 and are free thereafter to sell their homes and become renters but cannot revert back to homeownership after selling. To maintain a manageable state space, we assume that children can only rent. 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 means-tested, government-provided consumption floor. To the best of our knowledge, this model is the first to include all of these care choices. The model features both exchange-motivated inter-vivos transfers, which are the side payments that result from bargaining over care and housing, as well as altruistically-motivated transfers that flow without a quid-pro-quo. Importantly, both parent and child lack the ability to commit to future actions (concerning consumption, care, and transfers). Finally, wealth at the time of death of the parent is bequeathed to the child household.

We now explain some of the key mechanisms and predictions of the model.

First, our model features a novel channel that connects housing, LTC risk, and the family. It works as follows. If the child does not give care to a disabled, home-owning parent, the parent

[3]From the technical point of view, adding a real option (selling the house) to a two-player game poses a substantial challenge. In standard dynamic-programming problems (one-player games) in continuous time, there are standard techniques for solving real-options problems: value-matching and smooth-pasting conditions. However, these techniques are not directly applicable to two-player games. The reason is that when the first player is indifferent between exercising the option and not doing so (value matching), the second player will—in general—*not* be indifferent between the two choices but will strictly prefer one of the two. If the first player exercises, this creates discontinuities in the second player's value function, which are challenging to deal with, both analytically and computationally. Period-by-period bargaining solves this issue: If the second player has a large gain from the first player *not* exercising, side payments are made that prevent the option from being executed. The option is thus only executed if it is mutually beneficial at this point.

either needs to pay for formal home care or sell the house to finance a nursing home stay, which entails a much quicker spend-down of the parent's wealth and thus lowers the child's bequest. If the child provides care, however, the parent can credibly commit to a low consumption profile. This occurs because the home offers valuable services that substitute for other consumption; in addition, the illiquidity of housing bounds the parent's net worth below at the value of the house. This mechanism can keep the promise of a sizable bequest intact for a long time and thus supports informal caregiving for longer than would be possible for otherwise identical renters.[4] Even if we shut down the superior returns to homeownership, this commitment-to-leave-larger-bequests channel alone still generates one-tenth of the baseline homeownership rate during retirement as it facilitates cheaper care arrangements. The empirical implications of this mechanism are that homeowners are more likely to receive informal care, obtain informal care for longer, and leave larger bequests, often in the form of housing. We document that these predictions are borne out in the data.

Second, our model accounts for the stark differences in savings behavior between homeowners and renters. Through the lens of the model, selection of households into homeownership accounts for about half of these differences; the other half is due to the causal effect of homeownership on savings behavior. Homeowners in the model dis-save more slowly than otherwise equal renters since (i) housing offers a superior return to financial assets and (ii) housing is illiquid. Consistent with the data, the model predicts that about half of all homeowners liquidate their homes during retirement and that many of these liquidations occur when the elderly enter nursing homes. Our model allows us to structurally estimate the share of home liquidations that are triggered directly by disability shocks; we calculate this figure to be 60%.

Third, in our framework, children have ambiguous effects on savings and bequests. This stands in stark contrast to existing dynastic models in which the existence of children unambiguously increases the savings of parents. We find it useful to decompose the effects of children into what we refer to as the *family-insurance* channel and the *altruistic-savings* channel. The former acts to lower precautionary savings of parents whereas the latter leads to additional savings or, equivalently, slower dis-saving. Our model suggests that these channels roughly offset. Specifically, comparing parent households in our benchmark economy to childless households in a counterfactual (in which both of the above channels are switched off), we find very similar saving and bequest behavior.

This observation suggests that these countervailing forces provide a potential explanation for the puzzling similarities in the savings and bequests of parents and childless individuals. Since

[4]In our model, renters have to compensate their children for caregiving with higher contemporaneous transfers and choose—individually optimally—higher consumption expenditures than owners. As a result, renters run down their assets more rapidly, which makes informal care arrangements shorter-lived.

the childless cannot count on family insurance (either through informal care or through financial transfers from their children), they face larger risks and therefore accumulate higher precautionary savings, which they leave as (unintended) bequests. We provide supporting empirical evidence which suggests that elderly without children indeed face larger end-of-life risks. In particular, we find that single elderly without children are more likely to enter nursing homes than those with children and that childless households hold more of their wealth in liquid assets and are less likely to own homes.

Finally, our model provides us with a rationale for why most, but not all, transfers are delayed and given as bequests. No-commitment leads parents to prefer to maintain control over resources for as long as possible. Were a parent to cede control of her assets to her children, they would not act in the parent's best interest: they would assign lower consumption and cheaper care arrangements to the parent than the parent herself would choose. The existence of a housing asset further exacerbates the backloading of transfers and produces the realistic feature that houses constitute a substantial portion of bequests. In addition to providing valuable housing services, a house facilitates informal care in exchange for lower inter-vivos transfers than otherwise identical renters would have to provide. Consequently, bequests are high relative to transfers. In our model, inter-vivos transfers also flow for altruistic reasons (when the child is in need), but these are relatively small since children are mostly in their highest-earning years. Taken together, our model predicts that one-fourth of all parent-to-child transfers after retirement are inter-vivos, which is in line with an often-cited figure provided by Gale & Scholz (1994) and only slightly higher than what we find in the Health and Retirement Study (one-fifth).

Related literature Our paper contributes to several literatures on old age and housing. A large literature has focused on the savings behavior of the elderly, with an emphasis on understanding why the elderly spend down their wealth more slowly than the standard life-cycle model predicts (the *retirement-savings puzzle*).[5] The most recent papers have attributed central importance to health-expenditure risks. Our model includes this element in the form of medical and LTC expenditure risk but also adds a source of family insurance in the form of time and money transfers from children, following Barczyk & Kredler (2018).[6] Additionally, in our theory of the family, there are

[5]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 is part of what we do in this paper.

[6]We discuss the relationship to this paper further below.

also several channels for inter-vivos transfers which have been argued to be important drivers behind the savings behavior of elderly parents.[7] By explicitly modeling the various channels through which family insurance operates, we break from the existing structural literature by making an explicit distinction between the economic environments facing parents and childless households. We believe that the results we obtain from this approach can point to new economic insights and potentially useful ways of identifying models.

Another strand of the literature on the retirement-savings puzzle argues for the importance of the *egoistic* bequest motive (also referred to as warm glow or joy-of-giving) for explaining the savings of the elderly. Here, a bequest is conceptualized as a consumption good, which yields utility in proportion only to the size of the bequest. Recent estimates from Lockwood (2018) suggest that bequests in such a specification are luxury goods. Additional free parameters (the strength of the warm glow and the curvature) help in achieving a good fit of old-age savings patterns. A shortcoming of this theory is that it assumes away inter-vivos transfers, although they do occur in the data.[8] A key strength of our altruism model without commitment is that a very parsimonious theory (a single altruism parameter) is enough to yield tight predictions on inter-vivos transfers, bequests, and their timing. Because the existing literature has remained largely silent on the timing of inter-generational transfers, this represents an important contribution of this paper.

A largely separate literature has sought to understand 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), 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.[9] Recent papers by Nakajima and Telyukova (2017, 2018) have incorporated housing into an old-age-savings model in a way similar to ours. They find that the interplay between 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 relative to our paper is that there is no family dimension in their theory, which we find interacts in important ways with homeownership and old-age risks.

Another recent related literature on households' consumption-savings decisions has introduced novel lines of thinking about housing as a special asset. Kaplan & Violante (2014), for exam-

[7] A recent example is Boar (2018), who finds that parents engage in precautionary savings on behalf of their children to insure them against income risk.

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

[9] Others have found modest reliance on home equity. For instance, Sinai & Souleles (2007) show that the younger elderly increase housing debt when house prices rise though some of this is re-invested.

ple, find that many households—despite being wealthy—consume hand-to-mouth, as most of their assets are locked into a high-return illiquid asset. Similar to their framework, households in our model are reluctant to liquidate their homes but do so in response to sufficiently severe shocks. Additionally, housing in our model credibly constrains consumption and provides a commitment mechanism to save in the absence of formal contracts.[10] Davidoff (2010) argues that homeownership is a substitute for LTC insurance, a channel that is also present in our model: housing can be liquidated to finance increased expenditures when disabled.

Finally, we briefly discuss how the model in the current paper differs from our previous work. The strategic interaction between parents and children in saving decisions is similar to Barczyk and Kredler (2014a, 2014b) and Barczyk (2016). Barczyk & Kredler (2018) also include a time transfer (informal care) alongside financial transfers. New in this paper are the following ingredients. First, and foremost, we include a model of housing and a joint bargaining decision on the care arrangement and the parent's house-selling decision. This is a challenging extension since housing is a discrete permanent choice, which entails several difficulties for theory and computation.[11] Second, we model formal home care as a new choice for covering LTC needs, separate from nursing homes and informal care. Also, the existence of a home naturally encodes a reason for why elderly prefer to be taken care of at home. A third difference concerns the endogenous outcome of the game between parent and child: Some agents give gifts even though the recipient has positive financial wealth, which is in stark contrast to the equilibrium in the previous papers. Although transfers within the state space turn out to be negligible, providing further justification for the equilibrium in the aforementioned papers, allowing for them provides a methodological contribution which may prove useful in different settings (e.g., when studying changes to the estate tax to allow for early transfers to minimize the tax burden). We show how to deal with such gifts computationally, which is important in the computational backward iteration of value functions.

The paper is structured as follows. In Section 2, we present the model and describe its key characteristics. Section 3 introduces our data and discusses the calibration of the model. Section 4 analyzes the model fit. Section 5 contains our main quantitative results and compares the model's implications to the empirical evidence. Section 6 concludes.

[10]The mechanics resemble what Chetty & Szeidl (2007) describe as *ex ante* consumption commitments where only large shocks lead to changes in the commitment good. 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).

[11]Note that in Barczyk & Kredler (2018), the informal care decision is a discrete choice, but it is reversible; thus, unlike the house-selling decision, it is *not* a real option.

2 The Model

We construct a model that encompasses: (i) a housing choice, (ii) a caregiving choice, and (iii) strategic interactions between parents and children. We insert these ingredients into a standard overlapping-generations structure with incomplete markets and longevity risk.

2.1 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 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 *kid household* (or just *kid*, indexed by k) 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 kid 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 kid's wealth, $a^p \geq 0$ the parent's. ϵ^k and ϵ^p are productivity states from a set $E \equiv \{\epsilon_1, \ldots, \epsilon_{N_\epsilon}\}$. $s \in S \equiv \{0, 1, 2\}$ is the health state of the parent: $s = 0$ stands for *healthy*, $s = 1$ for *disabled*, and $s = 2$ for *dead*. Finally, $h \in H \equiv \{0, h_1, \ldots h_{N_h}\}$ denotes the value of the parent's house; $h = 0$ refers to renting, and the states h_1 to h_{N_h} are house sizes from a finite set. Children always rent.[12]

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 state j.[13] 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: $y_{ss}(\epsilon^p)$, 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. Agents are healthy ($s = 0$) before retirement age. From age 65 on, the parent faces a hazard $\delta_s(j^p, \epsilon^p, s)$ of transitioning into the

[12] We make this assumption to keep the size of the state space manageable.

[13] We define the diagonal elements of a (generic) hazard matrix δ as $\delta_{ii} = -\sum_{j \neq i} \delta_{ij}$, so that all rows of δ sum up to zero.

disabled state.[14] Once $s = 1$, the parent cannot return to the healthy state again. In both health states, the parent faces a mortality hazard $\delta_d(j^p, \epsilon^p, s)$. When 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.[15] Agents do not face a death hazard before retirement.

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 age, the parent suffers a *medical event* with hazard $\delta_m(j^p, \epsilon^p, s)$. Upon such an event occurring, 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.

Housing. Children are always renters. Once the child enters retirement and becomes a parent, it can buy a house; the feasible set of houses for a kid with assets a^k is $\{h \in H : h \leq a^k\}$, due to the no-borrowing constraint. At each moment in time, i.e. for all $j \geq j_{ret}$, the parent can then decide to sell the house at 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. We assume that homeowners derive an extra-utility benefit from owning. Formally, we assume that housing services, $\tilde{h} \in \tilde{H}(h)$, consumed by a household with housing state h are chosen from

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

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

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

[14] We allow this hazard to depend on ϵ^j to capture that the disability hazards vary substantially across socioeconomic strata. We define $\delta_s(\cdot, s > 0) = 0$ for non-healthy states for notational convenience.

[15] 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).

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. We first describe the different care technologies that are available to the family; the family's decision-making process is then explained in the paragraph titled "Bargaining options" below. A disabled parent ($s = 1$) must cover her care needs from one of the following sources:

1. *informal care* (IC, $i = 1$): The child gives care to her parent. There are no direct costs from this, but the kid household gives up a fraction β of labor income, capturing the opportunity cost of time on the labor market.

2. *formal care* (FC, $i = 0$): If the family decides against IC, the parent has to obtain *formal care* from one of the following sources:

   (a) *Medicaid* (MA, $m = 1$): When choosing Medicaid, the parent lives as a renter in a government-sponsored nursing home and receives a fixed consumption level, C_{ma}.[16] Medicaid is means-tested; we describe this means test in detail in the paragraph labeled "Timing protocol" below.

   (b) *privately-paid care* (PP, $m = 0$): Alternatively, the parent can buy care services on the private market. Depending on whether the parent owns a home or rents, this takes the form of:

      i. *nursing home care* (NH): If the parent does not own a home ($h = 0$), she enters a nursing home. In NH, the parent has to buy *basic care services* at the price p_{bc} and decides on other consumption expenditures, c^p. Following Kopecky & Koreshkova (2014), we interpret $p_{bc} + c^p$ as nursing home expenditures, where the component c^p captures room and board and the amenities of the facility.

      ii. *formal home care* (FHC): Home owners ($h > 0$) stay at home and buy formal-home-care services at the price p_{fhc}. Additionally, the parent pays for housing depreciation and chooses consumption expenditures, c^p.

[16]This consumption floor includes any negative utility from MA, such as stigma effects and poorer quality of care. We assume that MA recipients are renters, thus C_{ma} is in terms of the consumption-housing aggregate; see the paragraph labeled "Preferences" below.

Preferences. *Flow felicity* of household $i \in \{k,p\}$ with consumption c^i and enjoying 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. $n^i = n(j^i, s)$ is the number of household members, which is a deterministic function of age and the disability state.[17] $\phi(n)$ 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 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, $i \in \{k,p\}$, altruism parameter. Both households discount expected utility at the rate $\rho > 0$. Once dead, the parent values the kid'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 kid bargain over two choices jointly: the 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*) that the two agents can implement instead of the outside option:

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

In words this says that (i) for healthy renters, there is nothing to bargain on; (ii) healthy homeowners only bargain on the house-selling decision; (iii) disabled renters only bargain on informal care provision; and (iv) disabled homeowners bargain jointly on informal care and house-selling. Note that the parent has the option to keep the house and buy FHC services under the outside option (and the kid may help the parent to do so by giving gifts); we thus do not specify this arrangement as an inside option.

When agreeing on an inside option $i \in \mathcal{I}(z)$, agent's can make a side payment—or *exchange-motivated transfer*— Q, in the form of a monetary flow. We denote Q as a net flow from parent

[17] We introduce this feature to generate more realistic consumption profiles over the life cycle.

to child: i.e., the transfer goes from parent to child when $Q > 0$ and from child to parent when $Q < 0$. There is also the *outside option* (denoted by *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 may change 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 inside option $b \in \mathcal{I}(z)$:

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

$$\bar{Q}_u(z,b) = \begin{cases} 0 & \text{if } s = 0 \text{ and } h > 0, \\ \bar{T}_p(z) & \text{otherwise.} \end{cases},$$

where $\bar{T}_p(z)$ and $\bar{T}_k(z)$ are (large) exogenous bounds on transfers that we set as a multiple of the receiving agents' incomes in the computations.[18] That is, (i) when IC is given to a renting parent, an exchange-motivated transfer can only flow from parent to child (since the kid provides a service for the parent); (ii) when the parent is a healthy homeowner, 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 potentially benefit from the arrangement).

Bargaining protocol. To keep the computational burden manageable, we assign bargaining power entirely to one of the two agents; this considerably speeds up the computation of the equilibrium. Specifically, the powerful agent makes a take-it-or-leave-it offer to the other agent; i.e., 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)

[18]These bounds can become binding when one agent wants to give large gifts to an agent inside the state space; see also the appendix on optimal gift-giving, F.1. When an agent is broke, an upper bound on transfers is naturally imposed by the agent's flow income.

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 assume that bargaining power depends on the situation a family finds itself in and assign it as follows. (i) If the parent is disabled and rents, the parent makes a take-it-or-leave-it offer on a transfer that compensates the child for her informal caregiving. (ii) For the case of healthy home-owning parents, we let the child make a take-it-or-leave-it offer on a transfer to compensate the parent for not selling the house.[19] (iii) Finally, for disabled home-owning parents, 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 are certainly plausible, we find that the particular choice matters little. In Appendix C, we show that the quantitative model 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 but not so much *how* the surplus from this arrangement is allocated.

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

1. *bargaining*: The party with bargaining power makes an offer (i, Q), where $i \in \mathcal{I}(z)$ and $Q \in [\bar{Q}_l(z,i), \bar{Q}_u(z,i)]$.[20] The weak party then either accepts or rejects.
2. *house-selling*: If bargaining was not successful (i.e., the weak party rejected in Stage 1), owning parents decide whether to sell their house or not, $x \in \{0, 1\}$.
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, assets, and any transfers received in Stages 1 or 3 to the government. However, they are allowed to keep their home.[21]
5. *consumption*: Parent and child choose consumption flows, $c^p, c^k \geq 0$. Renters choose housing services.

[19] Assigning bargaining power to the parent seems unreasonable in this situation, since this means the parent could extract the maximal transfer from the child in exchange for not selling the house.

[20] 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.

[21] In the equilibrium, MA individuals do not own a home. Individuals choose to sell their home before making use of MA since MA provides an undesirable consumption floor.

After all decisions are made, utility is collected, interest on saving accrues, and shocks (to income, health, and medical expenditures) realize.

Production technologies and government. In one of our counterfactuals (*Sweden*), we will consider generous government provision of formal care services. For this counterfactual to be credible, we increase Social Security contributions in order for the government to be able to finance this policy. To implement this in our model, we need to take a stand on the production technology for care and on the government's budget constraint. We specify linear technologies in labor for care services and a government budget constraint; see Appendix B.1.

2.2 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 consider the ergodic measure of families that results from these conditions to calculate aggregate variables.

2.3 Solving for equilibrium

Appendix B 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, which 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.[22] We backward iterate over multiple generations until the value functions of children at j_{ret} converge. Given the equilibrium policies resulting from these value functions, we then solve for the stationary density of families over the state space by forward-iterating on the Kolmogorov Forward Equation. Appendix F contains the details.

2.4 Equilibrium dynamics

We now briefly describe the dynamics generated by our model. While the parent is healthy, both parent and child engage in standard precautionary-savings behavior. When one of them undergoes a long spell of bad earnings realizations, this household may receive altruistically-motivated gifts from the other.

[22]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).

Figure 1: Equilibrium dynamics

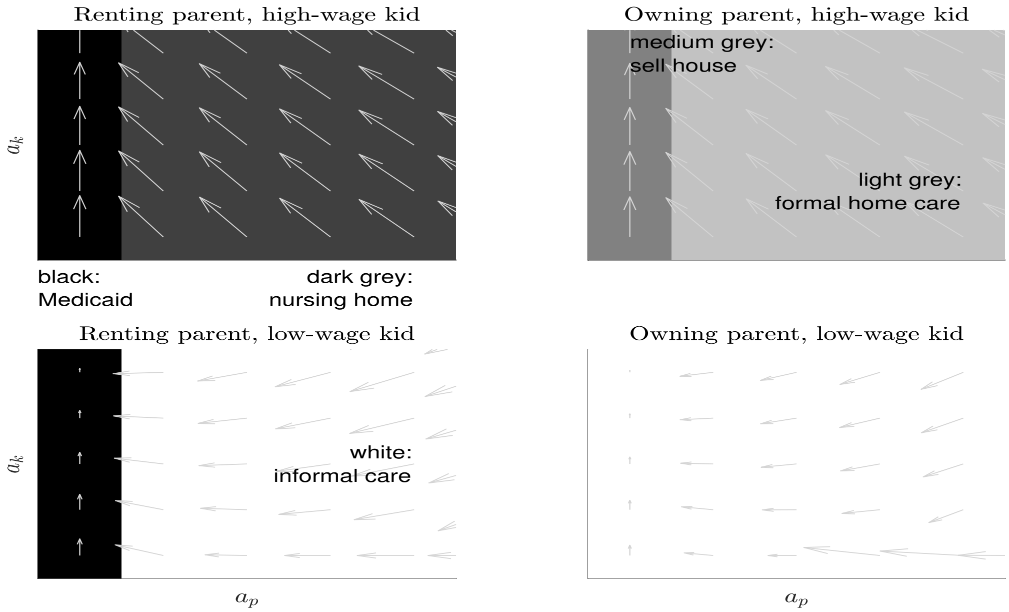


Figure shows equilibrium dynamics in baseline calibration at age $t^p = 90$ for disabled parents. The "owning parent" owns a house worth 100K. "High-wage" / "low-wage" kid refer to productivity grid points 2 and 3 of ϵ^k. In all graphs, parents have the lowest productivity realizations. Arrows depict phase vector $[\dot{a}^k, \dot{a}^p]$ in equilibrium. The asset axes (a^p, a^k) go from 0 to 300K$.

However, healthy parents only run down their asset stock at a slow pace in retirement. They maintain a buffer stock of savings for both precautionary reasons (LTC and medical-spending shocks) and to leave a bequest. Once the disability shock or a large medical-expenditure shock hits, the parent may receive transfers from the child in terms of money or time (informal care) or opt for government-provided Medicaid care.

Figure 1 illustrates typical equilibrium outcomes for disabled parents, juxtaposing renters and homeowners (left-hand-side vs. right-hand-side graphs) and high- and low-wage kids (top vs. bottom graphs). The figures show, for different levels of parent and child wealth, which care arrangement occurs (indicated by the shading of the areas) and what the wealth dynamics are (the phase arrows). We see that when the child has a high opportunity cost of caregiving, she never gives informal care to the parent. This makes the parent spend down her wealth on formal care, which occurs in the form of formal home care for home owners and in the form of nursing homes for renters. In the top-right graph, we see that the owning parent sells her house once she has run out of liquid assets; she then jumps to the upper-left graph and enters a privately-paid nursing home until her assets are spent altogether, at which point she enters a Medicaid nursing home (the black area).

We now move to the two bottom graphs of Figure 1, which depict families in an identical situation to the top row but with a low-wage child. Since the kid's opportunity cost is lower, informal care is now predominant, as the white areas indicate. In the IC areas of both bottom graphs, the parent gives an exchange-motivated transfer to the child (not shown). We note that the parent spends down her wealth slower when owning than when renting, which occurs because owning provides extra utility and because an owning parent can arrange lower transfers in exchange for IC than a renting parent, due to the promise of a higher bequest.

Finally, comparing the wealth dynamics at the vertical axes of the bottom graphs reveals a key mechanism of the model: owning a house guarantees IC to the parent of a low-wage child. We see that even when all financial assets are run down, the home-owning parent still receives IC and does not sell the house. The phase arrows show that this situation is stable; as long as the child does not receive a positive income shock, the family maintains this arrangement. In the lower-left graph, however, we see that IC can only be maintained for some time when the parent has financial wealth but is a renter. In this case, the parent spends down her financial wealth and enters Medicaid once she is broke. What is the mechanism behind this difference? The key here is that the illiquidity of the house gives the parent the power to commit to a low consumption profile. An owning parent without financial assets cannot consume more than her income flow (minus transfers to the kid) whereas renting parents with financial wealth succumb to the temptation of spending down their wealth faster. The kid knows this and demands higher transfers in return for IC, which causes parental wealth to be depleted even sooner for renters. For owning parents, however, the housing asset is maintained indefinitely and serves as a guarantee to the child of a sizable bequest and thus motivates her to give care even at low immediate transfers.

Section 5 provides a detailed analysis of the model's implications and documents supporting empirical evidence for the model's mechanisms and predictions.

3 Data and calibration

3.1 Data

Before turning to the calibration, we briefly discuss our data, which we will use throughout the remainder of the paper. We utilize data from the Health and Retirement Study (HRS), a bi-annual, longitudinal survey that is representative of U.S. households with a member over the age of 50.[23] Our analyses draw upon data from the 1998-2010 core interviews and the 2004-2012 exit inter-

[23]Based on a comparison of the HRS with the Survey of Consumer Finances (SCF), 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 nursing home residents make the HRS more suitable for our purposes than alternative surveys.

views of the HRS. Notably, the exit interviews contain data on realized bequests. For most of our analyses of these data, we restrict attention to individuals who were single at the time of death in order to focus on inter-generational transfers rather than transfers between spouses. We refer to this group as the "decedent sample."[24] In a few instances where we wish only to compute certain statistics in the cross-section and where a broader range of ages is needed, as is the case for the calibration, we instead use data for all individuals with core interviews in 1998-2010; we refer to this sample as the "core interview sample." Appendix A discusses sample selection and provides descriptive statistics. Appendix D describes the construction of key variables and the imputation of missing estate values.

3.2 Calibration

We calibrate our model to the US economy in the year 2010. Table 1 gives an overview of parameters and calibration targets, which we now briefly discuss. In general, note that we 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 a low number of degrees of freedom. We pin these down by matching five moments that are related (close to) one-for-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. As for household size, n_i, we assume that each kid household is composed of two members. After retirement, we let the number of members in healthy parent households decrease smoothly from 2 to 1 in a way that is consistent with the observed survival of males in the HRS. Once the parent is hit by the disability shock, household size is assumed to be 1 (widowhood).

Housing. The grid for housing is $h \in \{50, 100, 200, 400\}$, expressed in thousands of dollars.[25] Following Nakajima & Telyukova (2018), we set housing depreciation to $\delta = 1.7\%$ and the consumption share in utility to $\xi = 0.81$.

Shocks. We follow Barczyk & Kredler (2018) in order to estimate labor-productivity, LTC and mortality risks, and the process for out-of-pocket medical expenditures (net of LTC expenditure), where we update the data in order to account for the fact that our economy is calibrated to the year 2010 (and not to 2000). A brief description is as follows. Efficiency units of labor are

[24] Although we limit the sample to individuals who were single at the time of death, we do not exclude data from interviews earlier in the sample period in which these individuals were coupled. This is done to facilitate comparison with the model which includes both single and coupled elderly. The patterns we present are robust to excluding individuals who were ever coupled during the 1998-2012 sample period.

[25] We experimented with various housing grids, including finer ones and including grids with larger maximal housing sizes. We found that the results along a variety of dimensions do not change much. Specifically, given our earnings process, only a small fraction of agents in the economy are willing to buy large houses.

Table 1: Calibration

γ	ξ	δ	r	ρ^{ϵ}	β	ψ	p_{fhc}	p_{bc}	MA	A_y	A_f
2	0.81	1.7%	2%	0.95	2/3	54.8%	\$38.4	\$35.3	\$64.4	1	$(35.3)^{-1}$

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)	\$203.0	\$203.2
Home-ownership rate (ages 65+)	74.1%	74.6%
Medicaid uptake rate	29.6%	29.8%
Mean (annual) gift: (healthy)-parent-to-child	\$2.27	\$2.23
Mean (annual) gift: child-to-(FC)-parent	\$1.02	\$1.02
Parameter	**Description**	**Value**
ρ	Discount rate	0.0725
ω	home-ownership premium	2.000
C_{ma}	Medicaid consumption floor	\$4.75
α^p	Parent altruism	0.4458
α^k	Kid altruism	0.0258

Model-calibrated parameters. Data source: HRS core interview sample, waves 1998-2010. Samples includes all HRS respondents surveyed during this period. 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). Mean gift child-to-parent is average annual financial transfer from children to disabled parents receiving privately-financed formal care at home or in a nursing home (including zeros).

estimated using a Mincer regression with a cubic polynomial using US Census data for the year 2010. 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. 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.

Care technologies. As for the production sector, we follow Barczyk & Kredler (2018). We normalize productivity in the consumption-goods sector to $A_y = 1$. We follow Barczyk & Kredler (2018) in assuming that a kid household loses one third of labor income when providing informal care. The Medicaid consumption floor, C_{ma}, is calibrated in order for the model to match the fraction of disabled individuals that rely on Medicaid financing.

To pin down productivity in the nursing home sector, we take from the data 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}, to mean the cost of care that is absolutely essential (thus not including room and board and other amenities), which 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.[26] Under the assumption that Medicaid provides for the bare minimum of care services, we back out that $p_{bc} = \psi MA = 38,400$, from which we then recover $A_f = [p_{bc}]^{-1}$.

In contrast to Barczyk & Kredler (2018), our model also includes formal home care. In order to get an estimate of the annual cost of formal home care, we ask how much it would cost for a disabled single person to receive exclusively formal home care. A disabled single individual living in the community in our sample receives a median of 210 hours of care monthly. We then multiply by the average hourly private-pay rate of a home caregiver in 2010 as reported by the Bureau of Labor Statistics and MetLife (2012) to obtain the annual cost estimate reported in Table 1.

Preferences. We set the coefficient of relative risk aversion to $\gamma = 2$, a standard value in the macroeconomics literature. The rate of time preference, ρ, is obtained by matching median household wealth at ages 65-69, ensuring that the wealth level at the beginning of retirement is reasonable. 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-motivated transfers. Similarly, to plausibly calibrate child altruism, we rely only on those transfers in the HRS which flow from children to disabled parents receiving formal care, since most of these transfers flow for purely altruistic reasons in the model.[27]

4 Model validation

We now show that the model is successful in replicating several features of old-age economic behavior that are present in the data and which have not been directly targeted by our calibration.

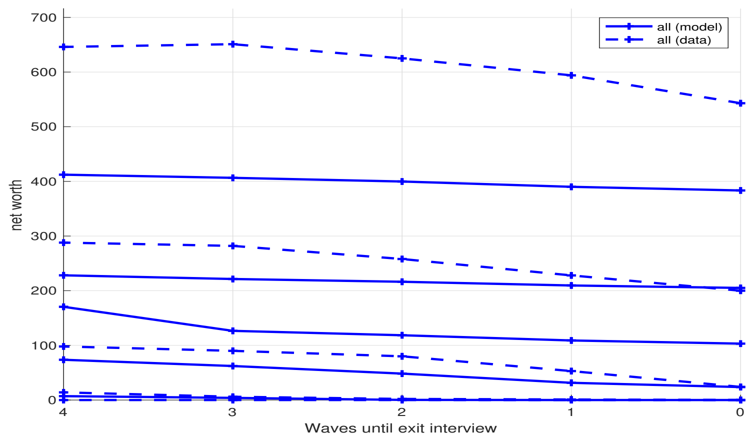
4.1 Savings behavior and homeownership rates

To evaluate the savings behavior of households, we use our model to draw an artificial panel in line with the construction of our panel of single decedents from the HRS. We then 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 2 compares the wealth trajectories between model and data, depicting how selected percentiles of the net worth distribution evolve

[26] 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.

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

Figure 2: Net-worth trajectories



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 financial plus housing wealth in 1000s of year-2010 dollars. Samples are balanced panels of decedents. Model: Artificial panel. Data: HRS core interviews 1998-2010 and exit interviews 2004-2012 for 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"). Spacing between core interviews is two years. The span between the last core interview ("1") and the exit interview is shorter: on average about 1.5 years. None of these numbers are targeted in calibration. Confidence intervals for the wealth trajectories from the data are provided in Figure OA2 in the Supplemental Appendix.

over time. Although the model generates fewer wealthy households than is the case in the data, the model fits the data very well in two key respects.

First, and foremost, 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. This pattern, particularly its appearance at the upper reaches of the wealth distribution, illustrates the well-known *retirement savings puzzle*. At the same time, in both the data and the model, 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 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.

Second, we observe that the model successfully captures the fact that the lower part of the wealth distribution holds very little wealth—a feature of the wealth distribution that is often a challenge for incomplete-markets models. Key here is that the model successfully matches the fact that the poorer half of the population already enters retirement with only modest assets, as shown in Table 2. Poor households in the model hold low wealth despite the large risks in retirement for two reasons: (i) the existence of family insurance through informal care and monetary transfers and (ii) the Medicaid consumption floor, which is taken up predominantly by poorer households.

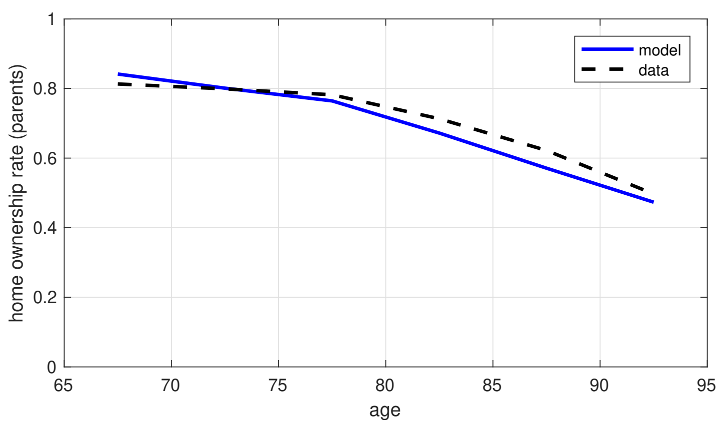
Finally, the model is also successful in predicting the liquidation of housing wealth over time.

Table 2: Net-worth distribution entering retirement (ages 65-69)

Source	p10	p25	p50	p75	p90
Data	2	52	203	557	1200
Model	15	86	203	435	712

Percentiles of net worth distribution of age group 65 to 69 in 1000s of year-2010 dollars. Data source: HRS core interviews, waves 1998-2010. Sample includes all HRS respondents surveyed during this period. For couples, the age of the eldest member of the household is used. Calculations use respondent-level weights. Only p50 is targeted in our calibration.

Figure 3: Homeownership in retirement



Cross-sectional homeownership rate by age. 5-year age bins: $[65 - 70)$, $[70 - 75)$ etc. Data source: All HRS core interviews (1998-2010), both single and coupled households; "age" is age of eldest household person. Only average home-ownership rate above 65 targeted in calibration.

This evidence appears in Figure 3, which compares the model-implied ownership rate by age to its empirical counterpart (computed in a cross-section).[28]

4.2 LTC arrangements

Although our calibration only targeted the fraction of MA recipients, Table 3 shows that the model nonetheless obtains a good fit for the other care arrangements. The fraction of private payers in NH is also almost spot-on, and crucially, the model does a very good job of generating a fairly high IC rate, in line with our data.[29] In fact, our model slightly overshoots when it comes to IC prevalence. This may be due to additional costs of IC that exist in reality; an obvious candidate is

[28] The model slightly overshoots the ownership rate at age 65 and under-predicts the ownership rate at age 95. The latter is partly due to the fact that the maximum age an individual in the model can live to is age 95, which induces many model owners to liquidate in the years before reaching 95 but which is obviously unrealistic.

[29] In contrast to Barczyk and Kredler (2018), who directly target this fraction by calibrating a utility penalty for formal care, we obtain this close match without an explicit preference for or against IC. In fact, the owning premium naturally encodes a reason why individuals may prefer IC: namely, it allows them to stay in their own home. In general, LTC choices in the model play out in a way that is similar to Barczyk and Kredler (2018), and we refer the reader to that paper for a more detailed discussion of the model fit in various care-related dimensions.

a utility cost to the caregiving child, who may feel psychologically burdened when giving care to the parent. Finally, the model generates less FHC than we measure in the data, which may be due to the availability of cheaper sources of FHC than in our calibration (undocumented workers) or to a specific preference of the elderly for this form of care.

Table 3: LTC arrangements (in %)

Source	IC	FHC	NH	MA
Data	45.1	7.8	17.5	29.6
Model	51.2	2.5	16.5	29.8

IC: informal care, FHC: formal care at home, NH: privately-paid nursing home, MA: Medicaid-financed formal care. Data source: HRS core interviews waves 2002 to 2010. Disabled, single respondents ages 65+. 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 (<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 $0.15 \times 0.479 + 0.399 \times 0.561$. Only the MA rate is targeted in the calibration.

4.3 Inter-generational transfers: Bequests and inter-vivos

The model is also successful in reproducing the fact that, in our data, most transfers are delayed and given as bequests. As we report in Table 4, we calculate that IVTs are about one-fourth the size of bequests in the HRS data. Although the ratio generated by the model (35.3%) is somewhat larger, this discrepancy may owe to the fact that the HRS measure of IVTs explicitly excludes shared food and housing, which likely constitute a large share of these transfers (as has been argued by Barczyk & Kredler, 2018). Indeed, we find that the estimate from the model is very close to the widely-cited figure (one-third) from Gale and Scholz (1994) on aggregate transfer statistics. Furthermore, we find that the model successfully matches the average ages at which a typical transfer dollar is given. This similarity is somewhat less surprising for bequests, since we feed group-specific mortality hazards into our model, but for IVTs it is a bona-fide indication that the model does well in generating a realistic timing of transfers.

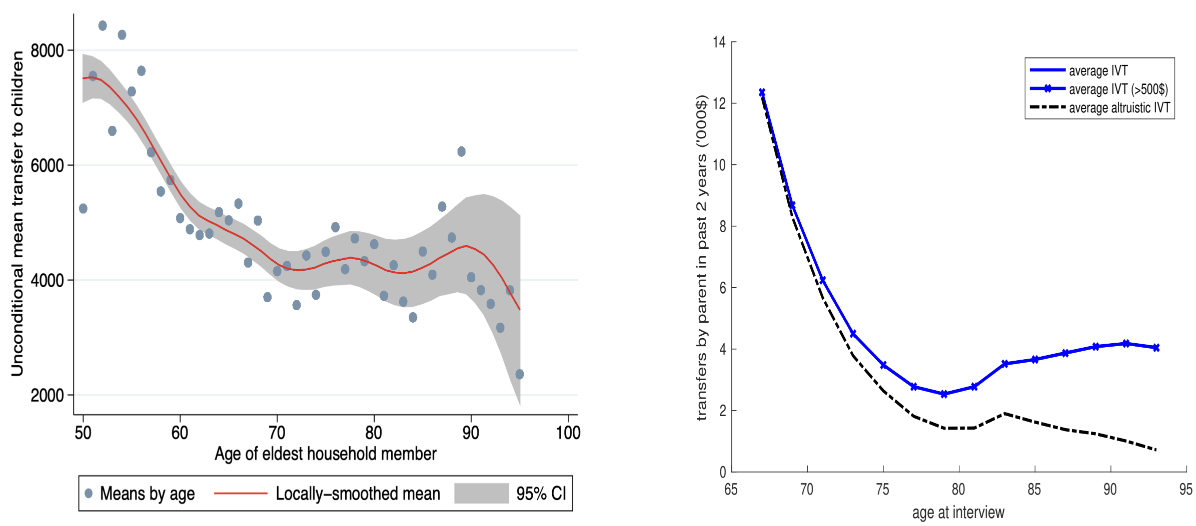
Figure 4 shows the life-cycle profile of average IVTs in our data and compares it to the model. The model is successful in producing the overall shape: IVTs are higher early in the life cycle but then stabilize at about \$2,000 per year (or \$4,000 bi-yearly, as in the graph—recall that the HRS interviews respondents only every two years). It is unsurprising that the model produces transfers that are too high in the beginning of retirement. This stems from the artifact that kids in the model begin their economic life with zero wealth when parents start retirement and thus receive more help from parents at that time. In reality, most of this help takes place when children are about 18 to 35, which coincides with parents' fifties and early sixties, as is visible in the data series in Figure 4. The figure also shows a decomposition of transfers into altruistic (g^p) and exchange-

Table 4: Timing and relative size of transfers

Statistic	Data	Model
IVT-bequest ratio	25.0% 33.3% (Gale & Scholz)	35.3%
Age (65+) at which average transfer dollar is given:		
IVT by parent	75.5	74.3
Bequests	83.7	82.6
All transfers together	81.0	80.5

IVT-bequest ratio in the data is based on our own calculation using HRS core interviews, waves 1998-2010, and exit interviews, waves 2004-2012. Gale and Scholz (1994), who use the 1983-86 Survey of Consumer Finances, report that the annual bequest flow and the annual flow of support given by parents to adult family members are 1.06% and 0.32% of aggregate net worth, respectively. IVTs in the model are computed as g^p (altruistic) $+Q^*$ (exchange-motivated).

Figure 4: Life-cycle IVTs in data and model



Data (left panel): HRS core interviews, waves 1998-2010. Unconditional mean IVTs by age of the donor. Model (right panel): Average of cumulative transfers over 2-year period from artificial panel, only core interviews used. IVT is $g^p + Q^*$, and altruistic IVT is g^p.

motivated (Q^*), 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 dominate from age 80 onward.

Finally, Table 5 contrasts the bequest distribution generated by the model—no feature of which enters the model calibration—with its empirical counterpart. The model predicts higher bequests for the bottom 50 percent, is almost spot-on at the 75th percentile, and produces lower bequests than is observed in the data for the higher percentiles. When we break down the bequest distribution by financial and housing wealth, we can see that the model does very well in terms of

Table 5: Bequest distribution

Bequest	negligible	p50	p75	p90	p95
		Data			
Total	40%	20	198	521	834
Financial	30%	3	53	224	472
Housing	55%	0	90	203	326
		Model			
Total	26%	101	203	381	413
Financial	63%	14	83	196	280
Housing	57%	19	123	217	312

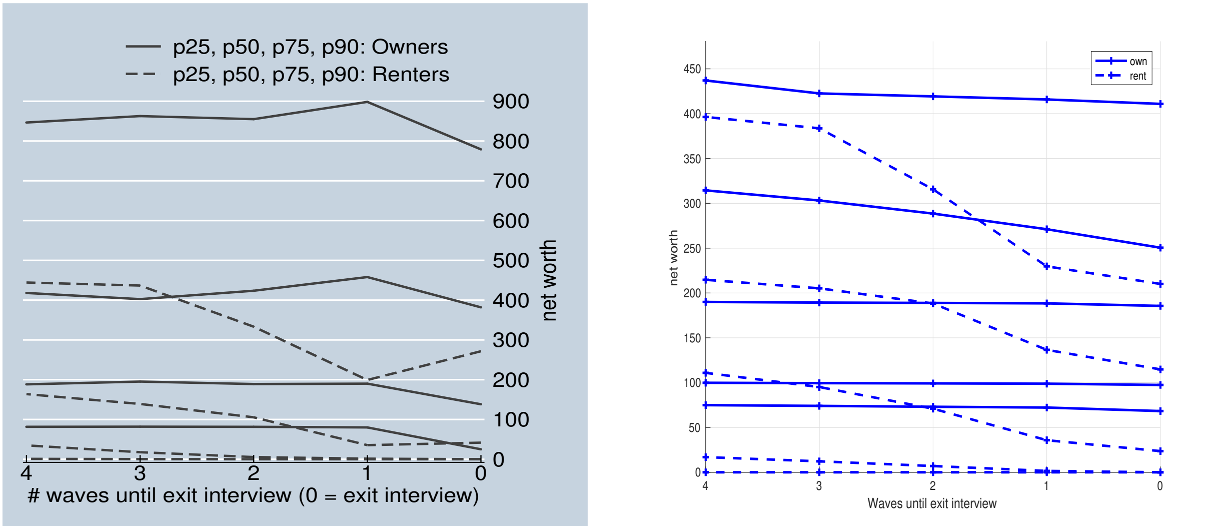
Data: "Total" bequests are from HRS exit interviews 2004-2012 for a sample of single decedents. To calculate the split between "Financial" and "Housing" bequests, we use each decedent's final core interview prior to death from waves 1998-2010. Data on the components of wealth are of higher quality in the core interviews, and we find that wealth at the last core interview is very close to bequests. We use respondent-level weights from the last core interview to compute sample statistics. "Negligible" in the data means ≤ 0 while in the model means it $< 25K$, corresponding to the mid-value of the two lowest grid points. Adopting the definition of negligible in the model, the corresponding figures in the data would be: 51% of total bequests, 68% of financial bequests, and 60% of housing bequests. None of the numbers targeted by calibration. The notation p50-p95 refers to percentiles.

predicting housing bequests: 43% of households in the model leave a housing bequest whereas this number is 45% in our data. In terms of the financial component of bequests, the model generates quite a good fit from the median to the 90th percentile, but it generates substantially more households leaving negligible financial bequests than we find in the data.[30]

5 Results

We now use the structure provided by the model to quantify the importance of housing and family in shaping the savings, spending, and transfer behavior of the elderly. We find that the model's predictions and mechanisms are consistent with empirical evidence from the HRS data, which were described in Section 3.1. Our results provide several useful insights into why the savings behavior of owners and renters is so different and into why the savings and bequests of parents and childless individuals are so strikingly similar.

Figure 5: Net-worth trajectories: Own vs. Rent



(a) Data (b) Model

Lines correspond to the 10th, 25th, 50th, 75th, and 90th net worth percentiles recorded at 4, 3, 2, and 1 interview-waves prior to the exit interview and at the exit interview ("0"). Samples are balanced panels of decedents. Left column: HRS core interviews 1998-2010 and exit interviews 2004-2012 for single decedents with four or more core interviews and an exit interview in our sample period. Right column: Artificial panel generated from the model. The ranges of the y-axes vary. None of the statistics targeted in calibration. Confidence intervals for the wealth trajectories from the data are provided in Figure OA2 in the Supplemental Appendix.

5.1 The role of housing

Figure 5 provides visual evidence of a connection between homeownership and end-of-life savings patterns. The figure plots wealth trajectories for our decedent sample and its model analog conditional on homeownership at the final core interview (approximately 1.5 years prior to death). In both the data and the model, we see that owners are considerably wealthier than renters although, again, the model does not generate quite enough wealth among owners at the highest percentiles (note that the scales in the two plots differ). We also observe pronounced differences in dis-saving rates between the groups, with owners dis-saving much more slowly than renters. The model is particularly successful in capturing this pattern. Wealth trajectories for owners are essentially flat in both model and data. Renters, on the other hand, approximately reduce their net worth by one half over their final 7.5 years of life in both model and data. We note that much of this decline represents the liquidation of housing wealth by individuals who previously owned homes but became renters by the time of their final core interview. Often, these liquidations coincide with entry into

[30] The fact that the model matches the distribution of housing and financial bequests better *separately* than *jointly* (i.e., net worth) tells us that the model fails to replicate the correlation between these bequests in the data. The model generates too little correlation of financial and housing bequests for the wealthy, which manifests itself in lower net worth in the top quantiles. In the same vein, the model generates too little correlation between the two types of bequests at the bottom: it does not generate enough households with negligible total bequests. This may indicate that the model still misses relevant sources of heterogeneity, e.g., in discount factors or altruism towards children.

a nursing home, an aspect we explore further below.

5.1.1 Model mechanisms

What are the mechanisms that allow the model to replicate these features of the data? In our model, homeowners differ from renters for two reasons. First, owners are inherently different from renters: They tend to be healthier and wealthier and to have more productive children (the *selection effect*). Second, owning a home has an effect on agents' economic behavior ceteris paribus (the *causal effect* of owning). In what follows, we use the model to separate these two effects. To do so, we create *clones* of homeowners whom we (unexpectedly) force to sell their homes at various points in the life-cycle. Because these clones are thus identical copies of the original households in all respects (pension, health, mortality, net worth, kid's characteristics), any differences between clones and owners reflect only the causal effect of owning a home.

1. Selection into homeownership

(a) Selection accounts for about half of the differences between owners and renters in expected future outcomes at retirement. The first two columns of Table 6 compare the expected future outcomes of agents who were homeowners and renters at age 65. (These groups comprise 86.3% and 13.7% of model households at age 65, respectively). The table reveals substantial disparities in the outcomes of these groups. Relative to renters, homeowners can expect to leave much larger bequests, give more transfers to their children, receive more IC, and enter nursing homes and Medicaid less often. To help us isolate the selection effect, we also report in the third column the outcomes of the owners' clones who were forced to sell their homes at age 65. Once we deduct the differences between owners and their clones, which reflect the causal effect of ownership, we see that selection accounts for about half the difference between owners and renters (at age 65) in expected bequests, expected IVTs (the sum of exchange and altruistic transfers), and the NH-entry probability, and for about two-thirds of the difference in the Medicaid-entry probability. The rest of these differences are accounted for by the causal effects of owning, which we will discuss further below.

(b) Both selection and causal effects stay relevant at onset of disability. Table 7 shows that the causal effects of owning persist at the onset of disability. From the top half of the table, we see that among those who ever become disabled (about 54% of the sample), about one-quarter enter disability as renters while three-quarters enter as owners. Although the discrepancies we observed at age 65 shrink due to the inflow of previous owners into the renters' pool, owners are again much richer than renters and can expect to leave larger bequests and IVTs. Selection now accounts for most of the differences between owners' and renters' outcomes (about 90% for expected bequests and about 60% for the NH-entry probability, for example).

Table 6: Effects of owning at age 65

Variable	renters (13.7%)	owners (86.3%)	clones (86.3%)	*causal effect*
net worth (at 65)	15.9K	390.7K	390.7K	–
exp. disc. bequest	2.6K	116.2K	55.5K	53.4%
exp. disc. net worth upon LTC	3.3K	123.4K	68.6K	45.6%
exp. disc. exchange IVT	0.8K	3.9K	7.5K	–116.1%
exp. disc. altruistic IVT	0.6K	38.6K	13.1K	67.1%
life expectancy	16.09y	18.61y	18.61y	–
exp. time h-to-m	15.37y	12.03y	6.26y	–172.8%
exp. time in IC	0.10y	1.24y	0.84y	35.1%
prob. ever LTC	54.6%	54.3%	54.3%	–
prob. ever rent	100.0%	50.2%	100.0%	–
prob. ever NH	52.5%	22.9%	35.6%	42.9%
prob. ever MA	52.4%	10.6%	26.6%	38.3%

All variables measured at age 65 for homeowners, their *clones*—identical copies who we force to rent—and renters. Nominal variables are discounted at interest rate r. *h-to-m* stands for hand-to-mouth: 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. Second row of table head gives fraction of households belonging to each category. IVT: inter-vivos transfer, IC: informal care, NH: nursing home, MA: Medicaid.

The bottom part of Table 7 splits the sample of homeowners at disability onset into those who liquidate (about two-thirds) and those who keep the house (one-third). In this restricted sample, net worth differences between owners and renters are much smaller than at previous points in the life-cycle. Unsurprisingly, liquidators are much more likely to enter nursing homes and eventually Medicaid—in fact, liquidators in the model often sell their homes because they cannot expect IC from their children. Looking at the outcomes of keepers' clones, we now see that the causal effect of owning accounts for a large part of the difference between liquidators and keepers: about half for time spent in IC and the NH-entry probability and about one-third for expected bequests.

2. Causal effects of ownership.

(a) Homeownership makes IC arrangements more likely and persistent and NH use less likely. Tables 6 and 7 show that the model generates a positive correlation between homeownership and IC and that prior ownership is predictive of future IC. By comparing homeowners to their clones, we see that homeownership *per se* increases the expected time in IC by about half when measured at age 65, by about 5% if measured just before the onset of disability, and by about 12% if measured just after the onset of disability. As for NH (respectively, MA) entry, the effect is even stronger: ownership *per se* almost cuts by one-half (respectively, two-thirds) the probability when measured at age 65 and just after the onset of disability.

(b) Homeownership reduces expenditures and increases savings. The crucial mechanism behind

Table 7: Effects of owning at the onset of disability

Variable (*before* housing decision)	renters (25.3%)	owners (74.7%)	clones (74.7%)	*causal* *effect*
net worth (at LTC entry)	39.0K	171.4K	171.4K	–
exp. disc. bequest	34.1K	125.5K	115.6K	10.8%
exp. disc. exchange IVT	13.8K	21.9K	23.9K	–24.7%
exp. disc. altruistic IVT	0.0K	1.8K	0.0K	100%
life expectancy	3.74y	3.92y	3.92y	–
prob. ever rent	100.0%	78.3%	100.0%	–
exp. time in IC	1.15y	2.28y	2.18y	8.9%
prob. ever NH	65.4%	44.4%	50.4%	28.6%
prob. ever MA	63.6%	18.8%	21.9%	6.9%
exp. time h-to-m	2.80y	1.45y	0.92y	–39.3%

Variable (*after* housing decision)	liquidators (63.7%)	keepers (36.3%)	clones (36.3%)	*causal* *effect*
net worth (at LTC entry)	147.6K	213.2K	213.2K	–
exp. disc. bequest	95.3K	178.6K	151.3K	32.8%
exp. disc. exchange IVT	23.5K	19.0K	24.5K	122.2%
exp. disc. altruistic IVT	0.0K	4.9K	0.0K	100.0%
life expectancy	4.09y	3.63y	3.63y	–
prob. ever rent	100.0%	40.3%	100.0%	–
exp. time in IC	2.06y	2.65y	2.37y	47.5%
prob. ever NH	57.5%	21.3%	37.8%	45.6%
prob. ever MA	26.7%	4.9%	13.3%	38.5%
exp. time h-to-m	1.16y	1.96y	0.50y	182.5%

Variables are measured when disability shock hits: (i) before the house-selling decision takes place (upper part of table) and (ii) right after the house-selling decision (lower part of table). *Owners*: Households (hh.) that own home when hit by disability shock. *Renters*: Hh. that were already renting when hit by disability. *Keepers*: Hh. that own home and keep it in the instance disability hits. *Liquidators*: Hh. that own but decide to sell in the instance disability hits. *Clones*: Identical copies of owners/keepers whom we force to sell home in the instance disability hits. *h-to-m*: hand-to-mouth: hh. for whom consumption equals current income. *causal effect* in the top (bottom) panel is the difference between owners (keepers) and clones as a percentage of the difference between owners (keepers) and renters (liquidators). Second row of table headers: (i) percentage out of all hh. hit by disability (upper part), (ii) percentage out of all hh. that own when hit by disability. IVT: inter-vivos transfer, IC: informal care, NH: nursing home, MA: Medicaid.

Table 8: Behavioral effects of home-owning

Group	expenditure	IC	exchange IVT	h-to-m
healthy	53.4K	–	-0.5K	71.6%
healthy clones	70.2K	–	0.0K	0.0%
disabled	34.3K	84.8%	4.1K	79.7%
disabled clones	48.3K	82.3%	6.9K	0.0%
receiving IC	24.1K	100.0%	4.9K	92.2%
IC clones	40.4K	96.0%	7.9K	0.0%

Spending behavior in cross-section of home-owning agents by health status and informal care (IC). *Clone*: Identical copy of an agent whom we force to sell the home. *h-to-m*: hand-to-mouth (i.e. 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 parent and children resulting from joint bargaining over home-selling and informal care.

homeownership's causal effect in the model is that it leads to lower expenditures on both housing and other consumption. Table 8 contrasts outcomes for homeowners with what they would have done had they been stripped of their houses in the same instant ("contemporaneous clones"). We see that owners' expenditures on housing, consumption, and care would increase by at least a third. An important driver behind these behavioral effects is what Kaplan and Violante (2014) refer to as "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. Tables 6 and 7 show that these expenditure effects are also present when looking forward in time: owners expect to be hand-to-mouth for much longer durations than clones. Table 6 shows that there are substantial effects already *before* the onset of disability. The expected net worth for owners at the time of disability is almost double the size of their clones.

The slower dis-savings rate of owners increases bequests mechanically and so incentivizes children to provide IC for longer and for smaller contemporaneous transfers, which further props up bequests. That owners can expect to obtain IC much more cheaply than clones can be seen in the "exchange IVT" column of Table 8. Children are more willing to provide IC if they can keep parents from selling the home. These lower IVTs further contribute to the slower wealth spend-down of owners. Finally, almost all effects of housing on care choices are *dynamic* and not contemporaneous. Table 8 shows that almost all owners who receive IC would still receive IC the next day if they sold the house. However, absent the house, they would spend down their wealth faster (both on higher expenditures and higher IVTs) making prolonged IC less likely.

3. LTC triggers 60% of home liquidations in retirement. In our model about half (50.2%) of all households who start retirement as owners liquidate their homes before they die. The model predicts that only about one in seven owners (13.3%) sells their home in the time span between retirement and LTC onset, whereas the probability of selling precisely at the onset of disability is about two-thirds (63.7%). Also, *after* the disability shock has hit, the probability drops again: Among owners who keep the house at the onset of disability, less than half (40.3%) then sell the house at some point before death. Expressed in a different way, the model predicts that about six in ten (59.8%) of all home liquidations in retirement are triggered by the LTC shock.[31]

4. Housing-as-commitment-device channel accounts for 10% of ownership. As we have seen, parents in our model own homes both because they offer a de-facto higher return and because they are a commitment device that induces IC. We conclude our analysis on the effects of housing by

[31] Davidoff (2010) presents evidence from the HRS, that (1) exiting ownership is uncommon except when long-term-care needs arise and, (2) that the exit rate spikes in the year of nursing home entry (see his Figure 1). For example, among respondents who first entered a nursing home in 2004, there is an exit rate from ownership of around 10% in prior years, 37% in the year of entry, and 23% in the following wave. Compared to the model, his numbers are lower in part because his sample also includes couples whereas in the model the LTC shock is tied to widowhood.

asking how much of ownership is due to the housing-as-commitment-device channel. To identify this fraction, we consider a counterfactual experiment in which we eliminate the owning premium ($\omega = 1$). Figure 7 shows the cross-sectional rates for this experiment (*no own prem.*) and reports that overall homeownership drops from 74.6% (baseline) to 9.6%. However, we note that agents in the model may also own homes because carrying wealth in a home has a slightly higher return than liquid assets since income taxes are paid on interest income but not on the implicit return from housing. We identify this effect from the ownership rate in another counterfactual economy with no ownership premium and with only childless households, which is 2.4% (not shown; note that there is no housing-as-commitment-device channel for the childless). We thus conclude that about one-tenth ($\simeq \frac{9.6-2.4}{74.6}$ =9.9%) of ownership is accounted for by the commitment channel.

5.1.2 Evidence for the model mechanisms in the data

The foregoing discussion suggests three empirically-testable implications: Namely, that all else equal, owners should dis-save more slowly and receive more informal care and for longer durations than renters, and that parents who receive informal care should leave larger bequests, particularly of housing assets. We now verify that the same patterns are visible in our sample of single decedents. We note at the outset that, rather than make strong claims about the direction of causality, our goal with these results is simply to demonstrate that strong partial correlations between these variables exist that are economically meaningful and robust to conditioning on numerous observable characteristics.

1. Owners should dis-save more slowly. We have already seen in Figure 5 visual evidence of slower rates of dis-saving by homeowners in the data. We show in Appendix Table A5 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, on multiple metrics of health, and on long-term care utilization, we find prior homeownership to be associated with significantly slower rates of dis-saving. This pattern is consistent with the model's prediction of lower expenditures by homeowners.

2. Owners should receive more IC and for longer. Table 9 presents evidence that homeowners in the data are more likely to receive informal care from their children and that these arrangements are more long-lived among owners. The table reports estimates from a series of linear probability models of receiving informal care for a sample of individuals receiving some form of long-term care, either formal or informal, in the current period.[32] Coefficient estimates for two variables are

[32]We define informal care in the data as receiving more than 50% of care hours from informal sources (family or other unpaid individuals) and receiving no nursing home care. For our sample of single elderly decedents, the vast majority of informal care is provided by adult children.

reported: the inverse hyperbolic sine of wealth and homeownership, both measured at the previous interview. All models are conditioned on an extensive set of controls (not reported) that includes measures of functional limitations and memory disease, age, sex, race and ethnicity, education, coupleness, religion, Census division, and interview wave.[33]

Table 9: Informal care arrangements and housing

	Dependent variable: Receiving informal care					
Conditional on:			No care at prev interview		IC at prev interview	
	(1)	(2)	(3)	(4)	(5)	(6)
ihs(Wealth) (t-1)	0.0078***	0.0017	0.0073***	0.0015	0.000024	-0.0029
	(0.0012)	(0.0013)	(0.0022)	(0.0027)	(0.0018)	(0.0022)
Own home (t-1)		0.13***		0.11***		0.064**
		(0.016)		(0.027)		(0.027)
N	6389	6300	1737	1704	1827	1807
Mean of dep. var.	0.47	0.47	0.59	0.59	0.67	0.67

* p<.1, ** p<.05, *** p<.01. Standard errors clustered at the household level in parentheses. Coefficient estimates from linear probability models. Dependent variable is an indicator equal to 1 if the individual is in an informal care arrangement and 0 otherwise. Informal care is defined as not receiving nursing home care and receiving more than 50% of care hours from family or other unpaid individuals. *Own home (t-1)* and *ihs(Wealth) (t-1)* are, respectively, an indicator for homeownership and the inverse hyperbolic sine transformation of net worth, both measured at the previous interview. Sample includes core and exit interviews in waves 2002-2012 for our sample of single decedents and is conditional on receiving some form of long-term care at the current interview. Columns (3)-(4): restricted to individuals who did not receive any form of care at the prior interview. Columns (5)-(6): restricted to individuals who received informal care at the previous interview. In all specifications, (not reported) controls include: age, sex (female), race (White, Black, other), Hispanic ethnicity, education (less than high school, HS or GED, some college, or college+), whether coupled, whether have children, number of children, numbers of ADL and IADL limitations (separately) and whether ever had memory-related disease, religion, Census division, and interview wave. For the complete set of coefficient estimates, see Table OA3 in the Supplemental Appendix.

As is the case in the model, we observe that prior homeownership positively predicts receipt of informal care across the specifications. 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 (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 informal care.

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, or live in different areas. We are, of course, unable to rule out unobservable confounds—for instance, that in more "loving" 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

[33]The complete set of coefficient estimates are available in companion tables in the Supplemental Appendix.

through housing wealth rather than overall net worth.[34]

3. Owners should leave larger bequests, particularly housing. Finally, we turn to the model's prediction that children in families with informal care arrangements receive larger bequests, much of which are comprised of housing assets. Table 10 reports regression results that capture the partial correlation between bequests and the receipt of informal care in the data. The dependent variables are (from left to right): an indicator for whether a non-zero estate was left, the log of the estate value, and two indicators for whether a home was bequeathed—the first measuring only cases where a home was owned at death and the second a broader measure that also includes inter-vivos tranfers of housing assets to children prior to death. The key explanatory variables are average weekly hours of care from all sources during the sample period, which we regard as a summary measure of disability, and average weekly hours of care from children, which measures receipt of informal care. All models include a large set of controls (not reported) similar to those described above.

Table 10: Bequests and informal care

	Overall Estate		Housing	
	Any Estate	Log Value	Bequest	Beq. or IVT
Avg. weekly LTC hours	-0.0017***	-0.0036***	-0.0020***	-0.0017***
	(0.00022)	(0.0012)	(0.00022)	(0.00025)
Avg. weekly child LTC hours	0.00100***	0.0045*	0.0013***	0.0019***
	(0.00038)	(0.0023)	(0.00038)	(0.00043)
N	3210	1851	3212	3212
Mean of dep. var.	0.63	11.5	0.36	0.48

* p<.1, ** p<.05, *** p<.01. Robust standard errors in parentheses. OLS coefficient estimates for linear regression models. Sample includes exit interviews 2004-2012 for our sample of single decedents. Dependent variables are (by column): (1) *Any Estate*, an indicator equal to 1 if the decedent left a non-zero estate and 0 otherwise; (2) *Log Value*, the log of the estate value; (3) *Bequest*, an indicator equal to 1 if a decedent died owning a home and 0 otherwise; and (4) *Bequest or Inter-Vivos Transfer*, an indicator equal to 1 if any of the following are true: a 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. *Average weekly LTC hours* and *Average weekly child LTC hours* are, respectively, the average number of weekly hours of care received in total and from the younger generation during the sample period. In all specifications, (not reported) controls include: age, sex (female), race (White, Black, other), Hispanic ethnicity, education (less than high school, HS or GED, some college, or college+), whether coupled, whether have children, number of children, the log of mean household income in available core interviews, religion, Census division, and interview wave. For the complete set of coefficient estimates, see Table OA5 in the Supplemental Appendix.

Unsurprisingly, the intensity of long-term care needs, as proxied by total hours of care, is negatively associated with all forms and margins of bequest-leaving. On the other hand, holding total hours of care constant, receiving more care from informal sources is associated with a higher probability of leaving or transferring assets to one's children. Moreover, the positive association

[34] As we show in Appendix Table OA4, 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.

between bequests and informal care largely counteracts the negative association with poor health, which would be consistent with informal care being protective of bequests by substituting for more costly formal care.[35]

The results again speak to the clear importance of housing. Not only are the correlations between informal care and bequests in Table 10 clearly strongest with respect to housing assets, but as we show in Appendix Table A7, the mechanism linking informal care and bequests is not present for renters. Specifically, we find that the positive correlations between informal care and bequests disappear in a sub-sample of decedents who were never homeowners. While some associations are weaker for owners as well, the link between informal care and housing bequests remains for this group.

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 device.[36]

5.2 The role of the family

We now analyze in more detail how the family—that is, the presence of children—matters for the savings (including housing) and bequest behavior of the elderly. We begin our analyses by first revisiting the well-documented similarity in the savings behavior of parents and childless individuals in retirement and demonstrating that the previously-identified patterns remain relevant in our more recent data and are visible even at the end of life.

Table 11 reports distributions of wealth in the data for households with and without children at different points in time. The numbers reveal the striking similarity between parents and childless households. We see from Panel (b), which presents the distributions of estates among single decedents, that those without children appear to hold as much, if not more, wealth at the end of life than parents. Panel (a) confirms that the same pattern is evident in the distribution of net worth near the start of retirement.

A similar pattern obtains when we turn our focus from the level of wealth to the rate at which wealth is spent down. Figure 6 presents end-of-life wealth trajectories conditional on the presence or absence of children. Panel (a) depicts the trajectories from the data for our sample of single dece-

[35] Reinforcing the idea that substitution between informal and formal care is an important mechanism behind these correlations, we report in Appendix Table A6 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 bequests.

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

Table 11: Estate and net worth distributions

(a) Net worth (all respondents, ages 65-69)

	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 (single decedents)

	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. Households whose eldest member is aged 65-69. Respondent-level weights are used. For couples, one observation is selected per household per interview. Panel (b): HRS exit interviews 2004-2012. Decedents who at time of death were neither married nor partnered. Child status is determined according to the number of children listed at the exit interview. Respondent-level weights from the last available core interview are used. In both panels, amounts are 1000s of year-2010 dollars.

dents, and Panel (b) plots trajectories from a counterfactual childless economy (*no-kids*) obtained by solving our model for a cohort of households that has no children but is otherwise identical to the baseline economy.[37]

Consistent with the evidence on wealth and estates presented in Table 11, the savings trajectories in the data are strikingly similar for parent and childless households, both in terms of the levels of wealth and the rate of spend-down. Moreover, the model reproduces this pattern almost exactly. Along the 10th, 25th, 50th and 75th percentiles, the model produces very similar profiles for both the benchmark and the childless economy. Although a discrepancy emerges at the 90th percentile, with the model predicting faster dis-saving by the childless and the data suggesting the reverse, we cannot read much into this feature as the confidence intervals for the 90th percentile of wealth among the childless are exceedingly broad. (See Supplemental Appendix Figure OA2.)

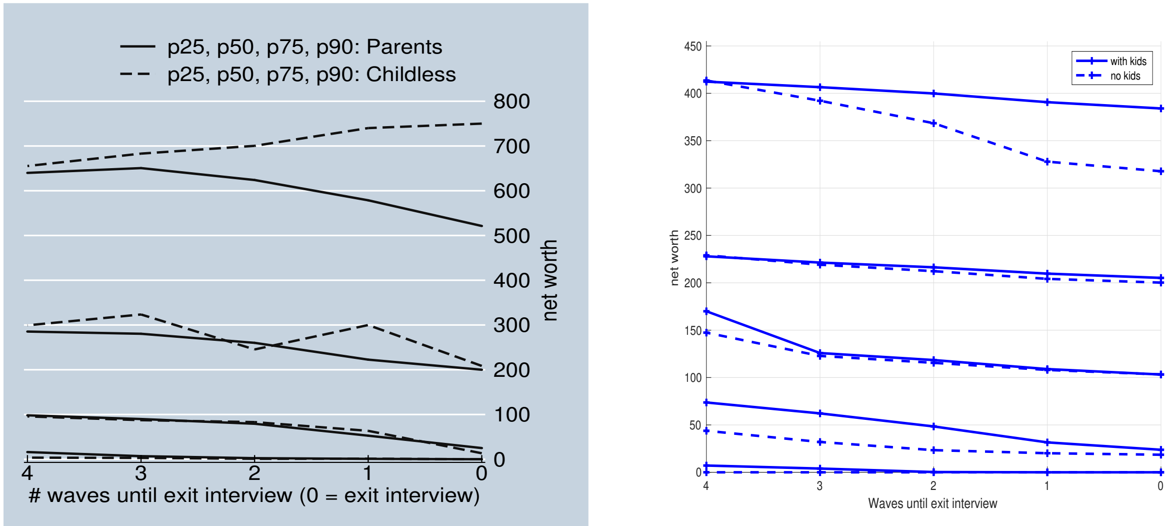
5.2.1 Model mechanisms

What are the mechanisms that enable the model to replicate these features of the data? In our model, children have ambiguous effects on parents' savings. On the one hand, children disincentivize precautionary savings as they provide insurance (*family-insurance* channel).[38] On the

[37] 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").

[38] The family-insurance channel can again be broken into an *IC-insurance* channel (the fact that parents can receive care from a cheaper source than the market) and a *gift-insurance* channel (the fact that parents receive financial trans-

Figure 6: Net-worth trajectories: Parents vs. Childless



(a) Data (b) Model

Lines correspond to the 10th, 25th, 50th, 75th, and 90th net worth percentiles recorded at 4, 3, 2, and 1 interview-waves prior to the exit interview and at the exit interview ("0"). Samples are balanced panels of decedents. Left column: HRS core interviews 1998-2010 and exit interviews 2004-2012 for single decedents with four or more core interviews and an exit interview in our sample period. Right column: Artificial panel generated from the model. Top row: Parents versus childless. Middle row: Conditions the wealth trajectories on owning or renting at the last core interview ("1") prior to death. Bottom row: Divides the sample into nursing home residents (NHR) and community residents (CR) at the time of the last core interview. Amounts are 1000s of year-2010 dollars. The ranges of the y-axes vary. None of the statistics targeted in calibration. Confidence intervals for the wealth trajectories in (a), (c), and (e) are provided in Figure OA2 in the Supplemental Appendix.

other hand, children give parents an incentive to save since the altruistic parent wishes to give transfers in the future, both in the form of bequests and IVTs (*altruistic-savings* channel). Unlike a childless agent, an altruistic parent values savings even in the state in which they are dead. Following Lockwood (2018), we call this part of the altruistic-savings channel the *incidental valuation* of savings. This incidental valuation depends in part on the economic well-being of one's children: The more well-off they are compared to their parents, the lower the incidental value is.[39] In our childless economy, both the altruistic-savings and family-insurance channels are switched off. Our model therefore suggests that the similarity in savings and bequests between parents and childless shown in Figure 6 is the result of these two channels roughly off-setting each other.

In order to disentangle the countervailing effects of children on savings, we now make use of an additional counterfactual scenario (*Sweden*) in which LTC expenditures are switched off. Specifically, *Sweden* is a counterfactual exercise with universal full insurance of care needs without a means test. In this scenario, the government covers the price of formal basic care services, p_{bc}, for anyone who obtains care *formally* at home or in a nursing home, financed through a uniform

fers from altruistic children). In the calibrated model, gifts by children are low, thus the family-insurance channel is overwhelmingly driven by the IC-insurance channel.

[39]This represents a crucial departure from the incidental motive in Lockwood (2018) and in other papers that employ the egoistic bequest motive, in which the parent's valuation is independent of the recipient's resources.

Table 12: Counterfactual exercises

Wealth: Ages 65-70	p10	p25	p50	p75	p90
baseline	15	86	203	435	712
no kids	-9	-6	+8	+35	+11
Sweden	-15	-28	-32	-9	-23
Sweden + no kids	-15	-36	-39	-12	-40

Bequests	Negligible	p50	p75	p90
baseline	26%	101	203	381
no kids	+11%	-35	-26	-101
Sweden	+18%	-47	-24	-20
Sweden + no kids	+49%	-93	-178	-229

Counterfactual experiments. Wealth and bequests are in 1000s of 2010-dollars. *Negligible* is $\leq$ 25K. *p10*, *p25*, ..., *p90* are the 10th, 25th, ..., and 90th percentiles. *no kids:* parent generation ages 65-95 has no children. *Sweden:* price of formal basic care services is paid for by the government.

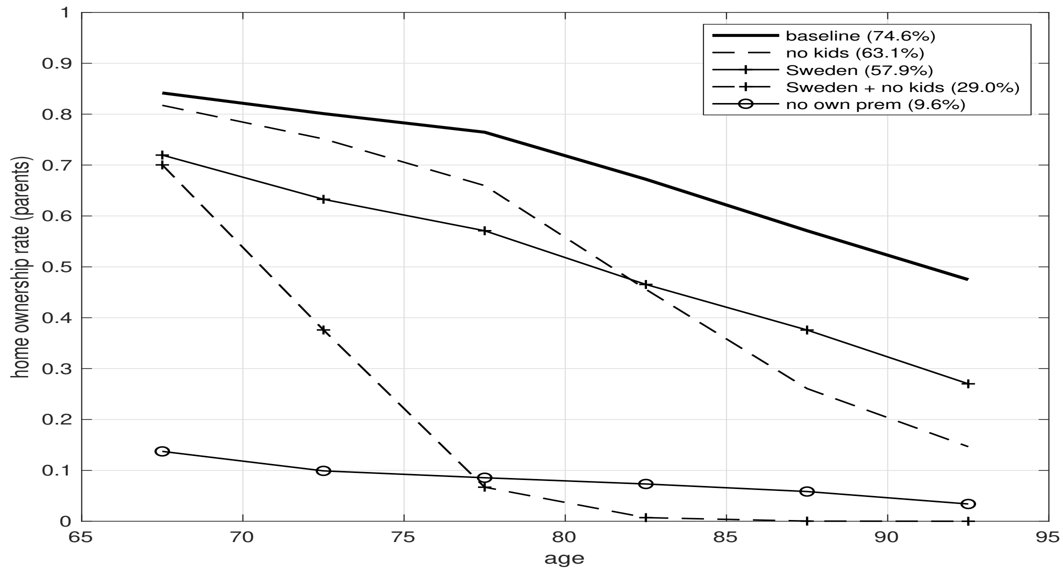
increase in the payroll tax levied on the working-age population. An overview of the results from these counterfactuals (and their combinations) is given in Table 12.[40] We provide a more complete accounting of the counterfactuals in Appendix Table A8.

1. Similarity of childless' and parents' savings driven by LTC risk. We can isolate the altruistic-savings channel by comparing the counterfactuals *Sweden* and *Sweden + no-kids*. The results are dramatic: Bequests almost disappear for the childless in the Swedish counterfactual. Because initial retirement wealth is not much affected, we deduce that the main effect is that the childless run down their assets a lot faster when insured against risk. This effect is especially strong at the higher wealth percentiles: Rich parents have low marginal utility of consumption and thus become increasingly concerned about their children's future consumption (consistent with the *luxury-good* nature of bequests, as estimated by Lockwood, 2018).

2. Incidental valuation is crucial for high homeownership. The counterfactual experiments also reveal that the incidental-valuation channel is particularly strong for the housing asset and less so for financial assets. Consider again the *Sweden* environment in which the family-insurance channel is switched off. As we show in Figure 7, when we remove children (scenario: *Sweden + no-kids*), the overall home-ownership rate is cut in half (from 58% to 29%)—a striking decrease that is en-

[40]The reader will note that the bequests of childless individuals in Table 12 are somewhat lower than those of parents. This is in contrast to the trajectories plotted in Figure 6 where the bequests of the two groups are nearly identical. The reason for the lower bequest numbers in Table 12 is that they are derived from the ergodic distribution of households which includes childless individuals alive at age 95 who have zero bequests as they face death with certainty. The trajectories are instead based on a model-generated panel constructed in line with the HRS from which we exclude individuals alive at the model's terminal age.

Figure 7: Counterfactuals: homeownership rate by age



Cross-sectional home-ownership rates in baseline model and selected counterfactual scenarios (described in text). 5-year age bins: $[65-70)$, $[70-75)$ etc.

tirely due to the childless having no incidental valuation of the housing asset. As the childless age, holding on to the home becomes less desirable: LTC risk increases and life expectancy decreases, and the savings locked up in a house yield zero return to the childless in the event of death. In fact, the homeownership rate is close to zero for ages exceeding life-expectancy in the model which is around 83 years.

5.2.2 Evidence for the model mechanisms in the data

As we describe in the previous section, the model rationalizes the similarities in the savings behavior of parents and childless individuals by attributing to the childless a greater precautionary savings motive which compensates for their lack of an altruistic bequest motive.[41] But, do the childless, in fact, face higher LTC risks in old age? A simple comparison of summary statistics

[41] We do not dispute the possibility that childless individuals and parents may differ in other dimensions not captured by the model. Indeed, as we report in Appendix Table A3, there are some statistically meaningful, observable differences between our childless and parent decedent samples. Childless individuals are more likely to be male, more educated, and in somewhat better health in the last months of life. Parents are more likely to have been coupled during the sample period. In principle, the inputs to the model could be adjusted to take these differences into account although we do not do so. And, in any case, along two of the most important economic dimensions, household income and wealth, the two groups are statistically indistinguishable. While we readily acknowledge that parents and childless individuals could also differ in unobservable ways, such as in aspects of preferences other than bequest motives, we nevertheless believe that showing that we can rationalize the similar savings behavior of parents and childless individuals without appealing to such *ad-hoc* explanations provides an important and useful step forward.

for our samples of childless and parent decedents is suggestive of this mechanism. For example, as reported in Appendix Table A3, 54% of childless decedents lived in a nursing home at some point in our sample versus 44% of parents (difference = 9.75 percentage points, p-value = 0.007). We formalize this comparison in Table 13 which presents coefficient estimates from linear probability models of nursing home entry since the previous interview. The key explanatory variable is whether the individual had children. Each specification includes an extensive set of controls (not reported) that includes wealth quintiles and homeownership from the prior interview, the number of and the change in functional limitations and memory disease, age, sex, race and ethnicity, education, coupleness, religion, Census division, and interview wave.

Table 13: Informal care and nursing home entry

	Dependent variable: Enter NH since previous interview			
	All		Single	Coupled
	(1)	(2)	(3)	(4)
Has children	-0.037***	-0.0077	-0.041***	-0.0027
	(0.0078)	(0.0098)	(0.0087)	(0.012)
Child LTC hours		-0.0028***		
		(0.00013)		
N	12306	9567	10566	1740
Mean of dep. var.	0.10	0.12	0.11	0.026

* p<.1, ** p<.05, *** p<.01. Standard errors clustered at the household level in parentheses. Coefficient estimates from linear probability models in which the dependent variable is equal to 1 if an individual moved into a nursing home since the previous interview. The sample includes all core and exit interviews for our sample of single decedents but excludes those living in a nursing home at the prior interview. Columns (3) and (4) split the same by coupleness at the time of the interview. *Has children* is an indicator for being a parent. *Child LTC hours (t)* are the weekly hours of long-term care provided by children at the current interview. In all specifications, (not reported) controls include: homeownership and quintiles of wealth measured at the previous interview, age, sex (female), race (White, Black, other), Hispanic ethnicity, education (less than high school, HS or GED, some college, or college+), whether coupled, numbers of ADL and IADL limitations (separately) and whether ever had memory-related disease, changes in these health measures from the prior interview, religion, Census division, and interview wave. For the complete set of coefficient estimates, see Table OA6 in the Supplemental Appendix.

The coefficient estimate in the first column indicates that children are associated with a 3.7 percentage point reduction in the probability of nursing home entry. This is a substantial effect relative to the 10% mean nursing home entry rate in the sample. The remainder of the table shows that this association operates through the provision of informal care. From the second column, we see that conditioning on the weekly hours of care from children eliminates the negative correlation between children and nursing home entry. From the third and fourth columns, we see that children are only negatively associated with nursing home entry for single individuals and not for coupled individuals whose spouses and partners typically provide most of their care.[42]

[42] This mechanism presumes that informal care from children is substitutable to some degree with nursing home care. Table 13 provides suggestive evidence to that effect. More careful analyses that use instrumental variables to deal with the endogeneity of informal care confirm these results. See, e.g., Van Houtven & Norton (2004) and Bonsang (2009).

The data also confirm the lower rates of homeownership among the childless generated by the model. For example, we report in Appendix Table A3 that while 72% of parents ever own homes in our sample period, only 57% of the childless elderly do (difference = 14.6 percentage points, p-value = 0.001). Appendix Table A4 reveals that holdings of liquid, non-housing wealth are greater among childless households than households with children at all percentiles of the distribution both at the start of retirement and near the end of life. The larger buffer stocks of liquid wealth held by the childless are also consistent with higher precautionary savings needs among this group.

5.3 What is the bequest motive?

Finally, we draw some lessons from our model in regards to the long-standing question of why people leave bequests.

1. No single bequest motive. Most importantly, our model suggests that the quest to find *the* (singular) bequest motive may be bound to frustrate. Instead, our results suggest that what is needed is an eclectic model of bequests. This implication is consistent with Kopczuk & Lupton (2007), who argue that bequest motives appear to be heterogeneous. Our model can provide a first step in organizing and understanding this heterogeneity, at least for the bottom 90% of the wealth distribution. Our model also offers an alternative explanation to the egoistic motive for why so many childless households leave bequests: They face higher risks, especially in the form of LTC.

2. Illiquid housing is an important driver of bequests. Although interactions are omnipresent, one channel stands out in our model: housing as an illiquid asset with a superior return. This channel is often overlooked in the literature on bequest motives (Nakajima & Telyukova, 2018 being a notable exception).

3. Altruism matters little *per se*, more so through its interactions with housing. In isolation, the altruistic bequest motive is a relatively small contributing factor to bequests in our model. In a world with neither LTC risk nor a premium for owning a home, our counterfactuals indicate that parents and the childless would leave roughly the same (very low) bequests. This is no longer true when we switch on the owning premium, however: In this case, the bequests left by parents become much larger than those of the childless. Hence, we see that altruism matters for bequests primarily through its interaction with the housing asset.

4. Family insurance has countervailing effects on bequests. In addition to altruism, the other mechanism offered by the literature for describing how children matter for bequests is the exchange motive. This idea is closely tied to the family-insurance channel in our model: Bequests (along with IVTs) act as compensation for informal care provided by children. Our model presents a nuanced picture of the importance of this mechanism. On the one hand, informal care protects assets from being spent down on nursing homes and thereby leads to higher bequests. Thus, we see higher bequests in families with IC arrangements than those with NH arrangements. On the other hand, we note that the *possibility of exchange* also has a *negative* effect on bequests: If we remove the IC technology from the family, the financial risks from LTC increase, driving up precautionary savings and thus accidental bequests.

5. The rich are different. Our model fails to match the upper tail of the bequest distribution despite the inclusion of a rich—and arguably realistic—set of reasons for why people leave bequests. This result indicates that the rich have strong concerns for holding wealth that go well beyond those present in our model. Motives for the rich may plausibly be along the lines suggested by Carroll (2000) wherein wealth is either an end in itself or yields flow services in the form of power or social status.

6 Conclusions

We have developed a model of housing and the family in order to explore their implications for the saving, spending, and inter-generational transfer behavior of the elderly. A centerpiece of the model is the joint bargaining process between parents and children over the homeownership and care arrangements of parents. The model's mechanisms and predictions are consistent with several features of the data. Counterfactual exercises provide valuable insights into why the economic behavior of owners and renters is so different while the savings and bequests of parents and the childless are so similar. Additionally, the joint presence of housing and family insurance contributes to the model's success in generating the backloading of transfers observed in the data. Interestingly, altruism by itself matters little for bequests but becomes important in the presence of the housing asset.

We conclude by noting several implications of our results for future research and for policy. First, in drawing inferences based on comparisons between parents and childless individuals, care has to be exerted to account for differing risks and saving incentives. Second, in a dynamic setting, the existence of an exchange motive for bequests can lead to *lower* bequests as the forward-looking agent also engages in less precautionary savings. Third, our model suggests that the elasticity of bequests to modest estate taxes is likely to be minor as individuals prefer to hold on to wealth—instead of transferring it early—and leave bequests due to the interplay between the presence of children and LTC risks and less because of altruism *per se*. Finally, even though we only allow for Markovian strategies, the threat of selling the house if care is not given becomes an unspoken and credible form of dis-inheritance, despite the absence of a written will.

Finally, 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 and dis-saving should be faster than in comparable countries with higher uninsured risks.[43] These predictions also provide insights for policy makers into the possible unintended consequences of policies. For example, making public formal care insurance more generous means less informal care and a reduction in homeownership rates, which further reduces and shortens informal care arrangements, increasing the costs of the policy. Policy makers concerned with reforms in the housing market should bear in mind that ownership also impacts care arrangements of the elderly and can make prolonged nursing home stays more or less likely, depending on the reform.

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[43] Indeed, Nakajima & Telyukova (2019) and Bueren (2018) document this to be the case in the data.

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Appendix

A Samples and weights

We utilize two samples from the Health and Retirement Study (HRS) for our analyses. We refer to these samples as the *decedent sample* and the *core interview sample*. We use the decedent sample to measure the distribution of estates and for all of our regression analyses. We use the core interview sample to measure the distribution of wealth at retirement age, mean bi-annual inter-vivos transfer flows by age, and other calibration targets.

A.1 Decedent sample

Our sample of decedents includes a subset of 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.[44] 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. For hours of long-term care and types of long-term care arrangements, we use data only from 2002 and later.

[44] 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.

Table A1: Decedent sample selection

Restriction	Individuals remaining	Individuals dropped
Universe of HRS respondents in RAND Longitudinal File	37,495	.
Died during waves 5-11	9,804	27,691
Exit interview in waves 7-11	6,491	3,313
Appeared in at least one of the core waves 4-10	6,434	57
Single at time of death	3,543	2,891
Proxy not DK/RF home status	3,476	67
Neither SP/P inherits home nor DK/RF about inheritor	3,434	42
Has non-missing sample weight from a core interview	3,434	0
Proxy not DK/RF about will or trust	3,265	169
Date of death does not precede most recent core interview	3,227	38
Unique individuals (observations) in final sample	3,227 (17,974)	.
With children	2,869 (16,049)	.
Without children	358 (1,925)	.

Note: DK stands for don't know. RF stands for refused to answer. SP/P stands for spouse or partner. Unique individuals are identified by a unique pair of household identifier (HHID) and person number (PN). Unique observations count the combined number of core and exit interviews for the individuals in the sample. Child status is determined as of the exit interview.

A.2 Core interview sample

The core interview sample includes all individuals that appear in the RAND Longitudinal File in the 1998-2010 waves of the HRS. Of the 37,495 unique individuals in the universe of respondents in the RAND HRS Longitudinal File, there are 32,973 individuals with data in the core interviews in the years 1998-2010. This group includes 30,181 individuals who are ever parents and 2,913 individuals who are ever childless. There are 346 individuals who switch statuses at some point and 225 individuals whose status cannot be determined at any point. Parent status is determined by the number of children at the time of the interview (using the RAND variable HwCHILD, which records the number of living and in-contact children and stepchildren). There are 136,977 unique core interviews given by the sample in the 1998-2010 survey waves. As for the decedent sample, we use data only from 2002 and later for analyses involving hours of long-term care and types of long-term care arrangements.

A.3 Sample weights

All statistics (except regression coefficients) are computed using respondent-level sample weights 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). Regression analyses control for demographic characteristics directly and are not weighted.

Table A2: Summary statistics for single decedent sample

	Exit interviews		Core interviews	
	Mean	Std. Err.	Mean	Std. Err.
Demographics				
Age	81.9	(0.19)	77.2	(0.086)
Female	0.70	(0.0081)	0.71	(0.0038)
Race: White	0.86	(0.0062)	0.86	(0.0029)
Race: Black	0.12	(0.0056)	0.11	(0.0026)
Race: other	0.029	(0.0029)	0.026	(0.0013)
Hispanic	0.050	(0.0038)	0.047	(0.0018)
Education (years)	11.3	(0.058)	11.3	(0.027)
Coupled	0	(0)	0.17	(0.0031)
Ever coupled	0.29	(0.0080)		
Children				
Has children	0.87	(0.0059)	0.87	(0.0028)
Number of children	2.89	(0.040)	2.83	(0.018)
Any coresident child	0.20	(0.0071)	0.23	(0.0035)
Any child within 10 miles			0.63	(0.0041)
Income and wealth				
Household income			30975.4	(575.3)
Own home	0.37	(0.0085)	0.58	(0.0041)
Ever own home	0.70	(0.0081)		
Non-zero estate	0.64	(0.0085)		
Home inter-vivos transfer	0.15	(0.0062)		
Health and care arrangements				
ADL limitations	3.29	(0.036)	0.93	(0.012)
IADL limitations	3.56	(0.029)	1.11	(0.013)
Ever had memory disease	0.46	(0.0088)	0.14	(0.0029)
Weekly LTC hours	78.8	(1.27)	20.9	(0.49)
Weekly child LTC hours	25.7	(0.81)	6.67	(0.24)
Informal care arrangement	0.33	(0.0083)	0.23	(0.0045)
Live in nursing home	0.42	(0.0087)	0.096	(0.0024)
Ever live in NH	0.45	(0.0088)		
Interview years				
Interview 1998	0	(0)	0.19	(0.0032)
Interview 2000	0	(0)	0.20	(0.0033)
Interview 2002	0	(0)	0.20	(0.0033)
Interview 2004	0.19	(0.0069)	0.17	(0.0031)
Interview 2006	0.18	(0.0068)	0.13	(0.0028)
Interview 2008	0.22	(0.0073)	0.083	(0.0023)
Interview 2010	0.23	(0.0074)	0.034	(0.0015)
Interview 2012	0.17	(0.0067)	0	(0)
Observations	3227		14747	

Note: Statistics are means. The unit of observation is an individual interview. *LTC* is long-term care. *NH* is nursing home. *(I)ADL* stands for (instrumental) activities of daily living.

Table A3: Summary statistics comparing parents and childless decedents

	Parents		Childless	
	Mean	Std. Err.	Mean	Std. Err.
Demographics				
Age at death	82.1	(0.20)	80.6	(0.63)
Female *	0.71	(0.0085)	0.62	(0.026)
Race: White	0.86	(0.0065)	0.83	(0.020)
Race: Black	0.11	(0.0059)	0.14	(0.018)
Race: other	0.028	(0.0031)	0.033	(0.0094)
Hispanic	0.052	(0.0042)	0.034	(0.0097)
Coupled: ever in sample *	0.31	(0.0087)	0.15	(0.019)
Education and work				
Educ: less HS/GED *	0.38	(0.0091)	0.29	(0.024)
Educ: HS/GED	0.36	(0.0089)	0.34	(0.025)
Educ: some college	0.17	(0.0070)	0.19	(0.021)
Educ: college+ *	0.098	(0.0056)	0.18	(0.020)
Work experience (years) *	27.1	(0.35)	31.4	(0.88)
Income and wealth				
Mean average household income	30289.1	(715.4)	30563.8	(1902.0)
[Median]	[20910]		[20475]	
Own home: ever *	0.72	(0.0084)	0.57	(0.026)
Own home: at death	0.37	(0.0090)	0.37	(0.025)
Non-zero estate	0.65	(0.0089)	0.61	(0.026)
Health and care arrangements				
ADL limitations: last 3 mos *	3.35	(0.038)	2.91	(0.11)
IADL limitations: last 3 mos *	3.59	(0.031)	3.33	(0.095)
Ever had memory disease *	0.47	(0.0094)	0.38	(0.026)
Average weekly LTC hours *	36.0	(0.77)	30.9	(2.00)
Live in NH: ever in sample *	0.44	(0.0093)	0.54	(0.026)
Live in NH: at death *	0.41	(0.0092)	0.51	(0.026)
Unique individuals	2869		358	

Note: Child status is measured at the exit interview. Statistics are means unless otherwise noted and are weighted using last available core interview weight. The unit of observation is an individual. Asterisks (*) indicate significant differences in means between the groups at either the 5% or 1% levels. *LTC* is long-term care. *NH* is nursing home. *(I)ADL* stands for (instrumental) activities of daily living. The ADL measures and *Ever had memory disease* are taken from the exit interview. *Work experience* is taken from the last core interview. *Average household income* is the average for an individual across core interviews. Variables labeled *ever* are calculated using all available information from core and exit interviews. Additional statistical tests—Pearson's χ^2 test for categorical variables and Kendall's τ and Somers' D tests for continuous variables—support the results of the means tests. (Kendall's τ and Somers' D are measures of ordinal association between two random variables. Tests based on these measures provide non-parametric tests for statistical dependence.)

Table A4: Distribution of liquid (non-housing financial) wealth

(a) All respondents, ages 65-69

	N	Mean	p10	p25	p50	p75	p90	p95
Children	13,568	149	-3	0	13	98	334	626
No Children	1,008	172	-0	0	22	166	431	737
All	14,576	151	-2	0	13	103	346	632

(b) Single decedents, last core interview

	N	Mean	p10	p25	p50	p75	p90	p95
Children	2,866	97	-0	0	3	48	210	434
No Children	358	132	0	0	6	88	344	620
All	3,224	101	-0	0	3	53	224	472

Note: Panel (a): HRS core interviews 1998-2010. Households whose eldest member is age 65-69. For couples, one observation is selected per household per interview. Panel (b): Final available core interview 1998-2010 for our sample of single decedents. Child status is determined according to the number of children listed at the exit interview. Non-housing financial wealth is defined to include 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. Amounts are 1000s of year-2010 dollars. Respondent-level weights are used.

Table A5: Annualized wealth changes and homeownership

Median regressions by Lagged wealth quintile:	Dependent variable: Annualized change in wealth ($ 1000s). Top		4th		3rd		2nd	
Own home (t-1)	42.1***	(11.5)	23.4***	(3.1)	10.9***	(1.4)	0.9***	(0.3)
Age	-0.3	(0.5)	0.3**	(0.1)	0.1	(0.1)	0.0	(0.0)
Female	-1.1	(7.7)	0.5	(2.4)	0.3	(1.2)	0.1	(0.3)
Race: White	0.0	(.)	0.0	(.)	0.0	(.)	0.0	(.)
Race: Black	-48.4*	(25.8)	-15.3***	(4.3)	-2.7*	(1.4)	0.0	(0.4)
Race: other	27.2	(35.7)	5.3	(9.4)	-4.8	(3.7)	0.5	(0.7)
Hispanic	-15.8	(21.4)	3.2	(5.8)	-0.1	(2.8)	-0.4	(0.7)
Educ: less HS	0.0	(.)	0.0	(.)	0.0	(.)	0.0	(.)
Educ: HS/GED	29.0***	(11.1)	8.0***	(2.6)	-0.1	(1.2)	-0.1	(0.3)
Educ: some college	23.2*	(11.9)	3.2	(3.2)	-0.4	(1.6)	-0.0	(0.4)
Educ: college+	38.3***	(12.1)	18.8***	(3.8)	4.8**	(2.3)	2.1***	(0.7)
Has children	-7.8	(13.2)	4.2	(3.8)	-2.2	(2.0)	0.1	(0.5)
Number of children	-1.9	(2.4)	-1.4**	(0.6)	-0.0	(0.3)	-0.0	(0.1)
Coupled	8.8	(8.4)	4.2	(2.6)	1.3	(1.5)	1.1**	(0.5)
ADL limitations	-1.1	(5.1)	-0.8	(1.4)	-0.1	(0.6)	0.0	(0.1)
IADL limitations	1.0	(5.4)	-0.3	(1.5)	-0.7	(0.7)	-0.1	(0.2)
Ever had memory disease	-33.7	(21.1)	-1.6	(5.4)	-2.1	(2.6)	0.3	(0.5)
Δ ADLs	1.8	(5.1)	-0.2	(1.4)	0.1	(0.6)	-0.0	(0.1)
Δ IADLs	-0.8	(5.1)	-2.8**	(1.4)	-0.4	(0.6)	0.0	(0.1)
Δ Memory disease	-1.2	(23.2)	-3.4	(6.2)	1.3	(3.0)	-0.6	(0.7)
Lives in NH	-39.2**	(16.5)	-23.9***	(4.6)	-9.6***	(2.2)	-0.4	(0.5)
Religion: Protestant	0.0	(.)	0.0	(.)	0.0	(.)	0.0	(.)
Religion: Catholic	13.2	(9.0)	-0.6	(2.6)	1.0	(1.4)	0.1	(0.4)
Religion: Jewish	0.5	(16.5)	4.1	(6.0)	15.9***	(4.2)	0.1	(0.9)
Religion: None	25.2	(15.6)	7.8	(5.3)	-1.0	(2.6)	0.3	(0.7)
Religion: Other	-61.8	(40.1)	19.6*	(10.4)	-4.5	(4.5)	1.6	(1.6)
Interview wave=5	0.0	(.)	0.0	(.)	0.0	(.)	0.0	(.)
Interview wave=6	-10.9	(9.9)	-0.3	(2.9)	0.3	(1.4)	-0.1	(0.4)
Interview wave=7	4.1	(10.7)	-0.5	(3.0)	0.1	(1.5)	-0.4	(0.4)
Interview wave=8	26.3**	(11.8)	-2.3	(3.4)	1.8	(1.7)	-0.7	(0.4)
Interview wave=9	-9.6	(13.2)	0.2	(4.2)	-2.4	(2.0)	-0.2	(0.5)
Interview wave=10	-13.5	(24.4)	-1.9	(7.0)	-4.2	(3.7)	-0.1	(0.9)
Constant	-58.2	(45.2)	-54.9***	(13.1)	-15.0**	(6.3)	-0.9	(1.4)
N	2,312		2,301		2,261		2,091	
Median lagged wealth	595		195		77		12	
Median change in wealth	-37		-6		-2		0	
Home ownership rate	0.88		0.85		0.81		0.37	

Note: * p<.1, ** p<.05, *** p<.01. Robust standard errors in parentheses. Coefficient estimates from median regressions in which the dependent variable is the change in wealth between adjacent core interviews divided by the number of years between interviews. Regressions are estimated separately conditional on quintile of net worth from the previous interview. Results for the bottom quintile, which holds very little wealth, are omitted. *Own home (t-1)* is an indicator for homeownership at the previous interview. Models also include indicators for Census division, which have been suppressed for space.

Table A6: Bequests and informal care: The impact of conditioning on nursing home utilization

	Overall Estate				Housing			
	Any Estate		Log Value		Bequest		Beq. or IVT	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Avg. weekly LTC hours	-0.0017***	-0.0012***	-0.0036***	-0.0016	-0.0020***	-0.00087***	-0.0017***	-0.00078***
	(0.00022)	(0.00023)	(0.0012)	(0.0012)	(0.00022)	(0.00023)	(0.00025)	(0.00025)
Avg. weekly child LTC hours	0.00100***	0.00037	0.0045*	0.0018	0.0013***	-0.00021	0.0019***	0.00057
	(0.00038)	(0.00040)	(0.0023)	(0.0023)	(0.00038)	(0.00038)	(0.00043)	(0.00042)
Ever in NH		-0.094***		-0.40***		-0.22***		-0.20***
		(0.017)		(0.090)		(0.018)		(0.020)
N	3210	3210	1851	1851	3212	3212	3212	3212
adj. R^2	0.221	0.228	0.243	0.251	0.107	0.147	0.086	0.115
Mean of dep. var.	0.63	0.63	11.5	11.5	0.36	0.36	0.48	0.48

Note: * p<.1, ** p<.05, *** p<.01. Robust standard errors in parentheses. OLS coefficient estimates for linear regression models. Sample includes exit interviews 2004-2012 for our sample of single decedents. Dependent variables (columns) are: *Any Estate*, an indicator equal to 1 if the decedent left a non-zero estate and 0 otherwise; *Log Value*, the log of the estate value; *Bequest*, an indicator equal to 1 if a decedent died owning a home and 0 otherwise; and *Bequest or Inter-Vivos Transfer*, an indicator equal to 1 if any of the following are true: a 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. *Average weekly LTC hours* and *Average weekly child LTC hours* are, respectively, the average number of weekly hours of care received in total and from the younger generation during the sample period. *Ever in NH* is an indicator equal to 1 if the decedent was ever reported to be living in a nursing home in the sample period. In all specifications, (not reported) controls include: age, sex (female), race (White, Black, other), Hispanic ethnicity, education (less than high school, HS or GED, some college, or college+), whether coupled, whether have children, number of children, the log of mean household income in available core interviews, religion, Census division, and interview wave. The results reported in the odd columns are the same as those reported in Table 10 in the main text.

Table A7: Bequests and informal care: Renters versus owners

	Renters		Owners			
	Any Estate	Log Value	Any Estate	Log Value	Home Beq.	Beq. or IVT
Avg. weekly LTC hours	-0.0012***	-0.0067*	-0.0016***	-0.0017	-0.0026***	-0.0019***
	(0.00035)	(0.0038)	(0.00027)	(0.0012)	(0.00033)	(0.00034)
Avg. weekly child LTC hours	0.00017	-0.00053	0.00085*	0.0027	0.0014**	0.0015***
	(0.00058)	(0.0092)	(0.00045)	(0.0021)	(0.00054)	(0.00055)
N	987	290	2217	1559	2217	2217
adj. R^2	0.186	0.256	0.149	0.245	0.085	0.045
Mean of dep. var.	0.36	10.1	0.76	11.8	0.52	0.66

Note: * p<.1, ** p<.05, *** p<.01. Robust standard errors in parentheses. OLS coefficient estimates for linear regression models. Sample includes exit interviews 2004-2012 for our sample of single decedents. In the specifications labeled *Renters* (respectively, *Owners*), the sample is restricted to individuals who never (respectively, ever) report owning homes in our sample period. Dependent variables (columns) are: *Any Estate*, an indicator equal to 1 if the decedent left a non-zero estate and 0 otherwise; *Log Value*, the log of the estate value; *Home Bequest*, an indicator equal to 1 if a decedent died owning a home and 0 otherwise; and *Bequest or Inter-Vivos Transfer*, an indicator equal to 1 if any of the following are true: a 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. *Average weekly LTC hours* and *Average weekly child LTC hours* are, respectively, the average number of weekly hours of care received in total and from the younger generation during the sample period. *Ever in NH* is an indicator equal to 1 if the decedent was ever reported to be living in a nursing home in the sample period. In all specifications, (not reported) controls include: age, sex (female), race (White, Black, other), Hispanic ethnicity, education (less than high school, HS or GED, some college, or college+), whether coupled, whether have children, number of children, the log of mean household income in available core interviews, religion, Census division, and interview wave.

Table A8: Counterfactual exercises

Wealth: Ages 65-70	p10	p25	p50	p75	p90
baseline	15	86	203	435	712
no kids	-9	-6	+8	+35	+11
Sweden	-15	-28	-32	-9	-23
Sweden+no kids	-15	-36	-39	-12	-40
no own. premium	-15	-62	-49	+23	+22
no own. premium+no kids	-15	-65	-64	+20	+6
no own. premium+Sweden	-15	-69	-87	-28	-40
no own. premium+no kids+Sweden	-15	-70	-94	-56	-94

Bequests	Negligible	p50	p75	p90
baseline	26%	101	203	381
no kids	+11%	-35	-26	-101
Sweden	+18%	-47	-24	-20
Sweden+no kids	+49%	-93	-178	-229
no own. premium	+37%	-87	-118	-92
no own. premium+no kids	+39%	-88	-127	-174
no own. premium+Sweden	+54%	-95	-181	-261
no own. premium+no kids+Sweden	+57%	-96	-183	-291

LTC provision (%)	IC	FHC	NH	MA
baseline	51.2	2.5	16.5	29.8
no kids	NA	+3.8	+24.9	+22.6
Sweden	-51.2	+0.9	+80.1	-29.8
Sweden+no kids	NA	+1.0	+80.0	-29.8
no own. premium	-17.7	-2.5	-2.8	+23.0
no own. premium+no kids	NA	-2.5	+12.2	+41.5
no own. premium+Sweden	-51.2	-2.5	+83.5	-29.8
no own. premium+no kids+Sweden	-51.2	-2.5	+83.5	-29.8

Counterfactual experiments. Wealth and bequests are in 000s of 2010-dollars. *Negligible* is $\leq$ 25K. *p10*, *p25*, ..., *p90* are the 10th, 25th, ..., and 90th percentiles. *no kids:* parent generation ages 65-95 has no children. *Sweden:* price of formal basic care services is paid for by the government. *no own. premium:* no extra-utility from owning versus renting a home, $\omega = 1$. *IC*: informal care, *FHC*: formal home care, *NH*: nursing home, *MA*: Medicaid.

B Theory appendix

B.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):

$$Y_c = L_c, \qquad Y_{bc} = A_{bc}L_{bc}, \qquad Y_{fhc} = A_{fhc}L_{fhc}, \tag{2}$$

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

$$p_{bc} = \frac{1}{A_{bc}}, \qquad p_{fhc} = \frac{1}{A_{fhc}}. \tag{3}$$

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

$$\begin{aligned} &\underbrace{\int \left[T^p(z) + T^k(z, i^*(z))\right] \mathrm{d}\lambda(z)}_{\text{tax revenue}} \\ &= \underbrace{\int (1 - i^*(z)) \Big[m^*(z)\big(p_{bc} + y_{ma} - y_{ss}(\epsilon^p)\big) + (1 - m^*(z))s_{pp}\Big] \mathrm{d}\lambda(z)}_{\text{spending on Medicaid and formal-care subsidy}} \\ &+ \underbrace{\int \int \left[\max\{M - a^p, 0\} \mathrm{d}F_m(M)\right] \delta_m(z) \mathrm{d}\lambda(z)}_{\text{means-tested benefits covering medical expenditures}} + \underbrace{G}_{\text{other expenditures}} \end{aligned} \tag{4}$$

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. $T^p(\cdot)$ and $T^k(\cdot)$ are tax functions on parents and kids. 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.

B.2 Agents' problems

Here, we characterize the agents' problems by stating the Hamilton-Jacobi-Bellman (HJB) equations. We will 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 $u \in \{k,p\}$ in stage $n \in \{1,\dots,5\}$; we denote by $V^u = V^{u,1}$ 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.[45] 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. We refer the reader to Appendix B.3 for details.

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. Given a fixed expenditure level e^u, the split between consumption and housing is determined from the problems

$$\tilde{u}^k(e^k; z) = \max_{c^k \geq 0, \tilde{h}^k \geq 0} u\big(c^k, \tilde{h}^k; n(j^k, s)\big) \qquad (5)$$

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

$$\tilde{u}^p(e^p; z, m) = \begin{cases} \max_{c^p \geq 0, \tilde{h} \in \tilde{H}(h)} u\big(c^p, \tilde{h}^p; n(j^p, s)\big) \;\text{ s.t. }\; c^p + E_h(h; \tilde{h}) \leq e^p & \text{if } m = 0, \\ \frac{C_{ma}^{1-\gamma}}{1-\gamma} & \text{if } m = 1. \end{cases} \qquad (6)$$

Note here that the child always rents and the parent consumes the consumption floor when in Medicaid ($m = 1$). Appendix B.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

[45] 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 Hamiltionians are

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

$$H^{p,5}(z, V_a; y_5, i, m) = \max_{e^p \in \mathbb{E}^p} \left\{ \tilde{u}^p(e^p; z, m) + \alpha^p \tilde{u}^k(e^k; z) + \dot{a}^p V^p_{a^p} + \dot{a}^k V^p_{a^k} \right\}, \tag{8}$$

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

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

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.[46] Parents in MA are bound to consume the consumption floor given to them by the government and cannot save.[47]

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.[48] Given the IC decision, i, and Stage-4 incomes, y_4, the Stage-4 Hamiltonians are

$$\begin{aligned} H^{u,4}(z, V_a; y_4, i) = {} & m H^{u,5}(z, V_a; [y_{k,4}, C_{ma}], 0, 1) \\ & + (1 - m) H^{u,5}(z, V_a; [y_{k,4}, y_{p,4} - p_{pp}(h)], i, 0), \qquad \text{for } u \in \{k, p\}, \end{aligned} \tag{9}$$

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

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

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-

[46] 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.

[47] 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).

[48] 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

$$\begin{aligned} V^{u,3}(z, V_a; y_3, i) =& V^u(z) + \mathrm{d}t\Big[\max_{g^u \in \mathbb{G}^u} H^{u,4}(z, V_a; [y_{k,3} + g^p - g^k, y_{p,3} - g^p + g^k], i)\Big] \\ &+ \mathrm{d}t\Big[V^u_{j^u}(z) - \rho V^u(z) + J^u(z)\Big] \qquad \text{for } u \in \{k, p\} \end{aligned} \tag{10}$$

,

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

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.[49] 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, see the appendix for the definition. 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. In line with previous work by Barczyk & Kredler, we find that the vast majority of gifts flow when the recipient is constrained.[50]

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

[49] We set these bounds as multiples of the receiving agents' incomes in the computations. They only bind within the state space in equilibrium.

[50] However, we find that there are also some positive gifts inside the state space, i.e. when both players have positive wealth. We find this to be the case for very rich dynasties at high ages. These gifts are a very small fraction of all transfers in the economy (less than 0.1%) 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

$$[b^*, Q^*] = \arg\max_{b,Q} V^{2,s}\big(z, V_a; [y_1^k + Q - b_i\beta y(\epsilon^k, j^p), y_1^p - Q], b\big) \tag{11}$$
$$\text{s.t. } b \in \mathcal{B}(z), \qquad Q \in [\bar{Q}_l(z, b), \bar{Q}_u(z, b)],$$
$$V^{2,w}\big(z, V_a; [y_1^k + Q - b_i\beta y(\epsilon^k, j^p), y_1^p - Q], b\big) \geq V^{2,w}\big(z, V_a; [y_1^k, y_1^p], out\big).$$

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

$$V^u(z) = V^{u,2}\big(z, V_a; [y_1^k + Q^* - b_i^*\beta y(\epsilon^k, j^p), y_1^p - Q^*], b^*\big) \qquad \text{for } u \in \{k, p\}, \tag{12}$$

which completes our recursive characterization of the value functions.

B.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. (10):

$$J^u(z) = \underbrace{\delta_s(j^p,\epsilon^p,s)\big[V^u(s=1,\cdot)-V^u(z)\big]}_{\text{shock to health}} + \underbrace{\sum_{\epsilon'\in E}\delta_\epsilon(\epsilon_k,\epsilon')V^u(\cdot,\epsilon')+}_{\text{shock to income}} \tag{13}$$
$$+\,\delta_m(j^p,\epsilon^p,s)\underbrace{\int_0^{\bar m}\left(V^u(\max\{a^p-m,0\},\cdot)-V^u(z)\right)\mathrm{d}M(m)+}_{\text{medical-spending shock}}$$
$$+\,\underbrace{\delta_d(j^p,\epsilon^p,s)[V^u(a^k+a^p+h,0,s=2,\epsilon_k,0,h=0,j^p)-V^u(z)]}_{\text{death}},$$

Note here that both the medical-spending and the death shock entail jumps in the asset variables. When the parent dies, her assets (both financial and housing) become zero and are inherited to the child. When a medical shock hits (the lump sum m), the parent's wealth falls by m, but not below zero.

Indirect utility function. The FOCs for a renter with respect to consumption, c, and housing, h, given total expenditures e in the Problems (5) and (6) are

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

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 $c=e-\delta h$ and the aggregate becomes

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

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 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 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 kid could dictate it and let $\tilde{c}^k$ denote kid'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 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:

$$g_{s.b.}^p = \min\{g_{f.b.}^p, c_{unc}^k - y^k\}, \qquad g_{s.b.}^k = \min\{g_{f.b.}^p, c_{unc}^p - y^p\}. \tag{22}$$

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:

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

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.[51]

1. No agent broke: $a^p > 0$ and $a^k > 0$. In this case, agents' diagonal derivatives $\mu^u(z)$. It is obvious from Eq. (10) that the gift is either set to the upper or the lower bound:
   (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 kid 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 $g^k(z) = \max\{0, g^k_{s.b.}(z)\}$.
4. Both agents broke: $a^p = a^k = 0$. Then the following cases can 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 $q^k(z) = 0$.
   (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: $g^p(z) = g^k(z) = 0$.

[51] 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.

Bargaining. In order to reduce the set of inside options to one element for all scenarios, 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 when the house is sold under the outside option. Technically, this is due to the continuous-time setup and the no-commitment assumption. The intuition for the result 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).

Proposition 1 (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.) for almost all t (i.e. except a set of Lebesgue-measure zero).*

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

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

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, $i(\cdot, a_h^p, h = 0, t)$, that prevails under renting. Letting $\mathrm{d}t \to 0$, we see that the third claim of the proposition follows. ■

We now turn to the question if the 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 will arise 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 number 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 all 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 what the gift has to be in the optimum 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 kid's consumption equal to the marginal utility of the parent's own consumption as long as the child doesn't 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 a weakly increasing function in c^p.

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

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

We see that there is a maximal consumption choice c^p_{max} that makes the constraint of this problem being binding, which is 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 pick up 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 in place, we now turn to the more general problem when at least one of the players is broke. It turns out that there are threshold transfers in the bargaining stage beyond which one of the agents returns 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*

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

and define the upper indifference threshold *as*

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

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, that*

is

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

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 kid's surplus is strictly increasing in Q on the interval $[Q_l^*(z),Q_u^*(z)]$.*

Proof:

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 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 $u_c^k(y^k+Q)\geq V^k_{a_k}>V^k_{a^k}$, 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 kid'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 $\alpha^p u_c^k(y^k+Q)<\alpha^p u_c^k(y^k+Q_l^*)=V^p_{a^p}$, 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 kid 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 kid 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. We will now bring all elements together by defining the set $[Q_{lb}(z), Q_{ub}(z)]$ of bargaining transfers that we have to consider at state z in our analysis:

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

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

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 OK 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 $\bar{Q}_l$.[52] 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 kid's surplus is strictly increasing and the parent's surplus is strictly decreasing.[53] This allows us to define the *reservation transfer*, i.e. the lowest transfer for which an agent is willing to consider the inside option[54] over the outside option in state z, as

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

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

where $S^u(z, Q)$ denotes agent u's surplus of the inside 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.

In all other cases, 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 agent u can obtain from the set of

[52] 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 F.1.

[53] 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.

[54] Recall that by Prop. 1, there is only one inside option left for each bargaining scenario.

transfers Q that induce the other agent to prefer the inside option over the outside option:

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

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

Here, we have assigned $-\infty$ for the cases in which the bliss point is undesirable for one of the agents since then no bargain is possible. Note that for the special case in which both players own 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.

Finally, since the parent has all bargaining power, we only have to compare the values for $\bar{S}^p$ to find the bargaining outcome. The following proposition summarizes the solution; the proof then goes over all cases again and gives our solution algorithm:

Proposition 2 (Bargaining solution) *Let the inside option be* keep *for healthy homeowners,* IC *for disabled renters, and* keep+IC *for disabled home owners; let s index the party with bargaining power and let w index the party without. Then, if $\bar{S}^s(z) \geq 0$, the inside option is played and the equilibrium transfer is $\underline{Q}^w(z)$. Otherwise, the outside option is played.*

Proof and solution algorithm: First, we note that by Proposition 1, we only have to consider the inside option *IC+keep* for disabled owners, which justifies restricting ourselves to the inside options mentioned in the proposition.

We now go over the list of possible cases 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): This is the common case. By setting agents' surplus under the inside option to zero, we can calculate a candidate for the weak party's reservation transfers – this is only a candidate, since we neglect the exogenous bounds for transfers here:

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

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

Otherwise, we can find the reservation transfer as

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

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 played iff 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 kid to have wealth, the candidate set collapses to $[Q_{lb}(z), Q_{ub}] = [\bar{Q}_u, \bar{Q}_u]$, see Eq. (32) and (33), and the inside option is played iff both agents prefer the inside option and this transfer to the outside option. If the kid prefers the parent to have wealth, the candidate set collapses to $\bar{Q}_l$ 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 F.1.

Clearly, under the inside option both agents' gifts are zero and consumption is equal to the unconstrained levels, c^p_{unc} and c^k_{unc}.

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 do overlap.

   (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.[55] 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.[56] 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 kid then gives a positive gift in the gift-giving stage.

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

[56] 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) 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 $Q^* = Q_{ub}$.

      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.[57]

   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 shows the desired result. ■

[57]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 $V^u_{a^{-u}}$)).

C Robustness: Bargaining power

This appendix shows that the main features of our model are robust to our assumptions on bargaining power. Table A9 compares key model moments in the baseline model to two extreme alternatives: One in which the parent has bargaining power in all scenarios[58] (*parent power*) and one in which the kid has the power in all scenarios (*kid power*).

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 *kid power*. This scenario yields the largest change with respect to the baseline, which is a decrease in IC by 9 percentage points. This turns out to be 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 kid can extract the maximal transfer. In line with this, the second-to-last block of results shows that exchange-motivated transfers increase substantially, especially for renters. Also, median wealth is up by 7K at age 65, but then parents dissave faster and median wealth drops below the baseline in less than 10 years (not shown in table) and a larger number of parents leaves no bequest (6 p.p. down).

In the scenario *parent power*, changes to the baseline are even smaller than in the kid-power scenario. Most affected are the inter-vivos transfers that disabled owners give to children, which is a situation in which children often determine transfers in the baseline model (recall that we assumed they have bargaining power if the parent sells under the outside option, which is almost always most parents then move into a nursing home in our calibration). This results in a slightly lower home-ownership rate (down by two p.p.) and slightly lower bequests

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

Table A9: Counterfactual exercises for bargaining power

Wealth: Ages 65-70	p10	p25	p50	p75	p90
baseline	15	86	203	435	712
parent power	-4	-1	-1	-5	-4
kid power	-2	+4	+7	+11	+3

Bequests	Negligible (%)	p50	p75	p90
baseline	26	101	203	381
parent power	+2	-1	-1	-3
kid power	+6	+1	+4	+4

LTC provision (%)	IC	FHC	NH	MA
baseline	51.2	2.5	16.5	29.8
parent power	-1.9	-0.1	+0.2	+1.8
kid power	-9.2	0.0	-0.1	+9.3

IV transfers by disabled parents	% owners > 0	mean (cond'l on > 0)	% renters > 0	mean (cond'l on > 0)
baseline	63.2	9.2	97.3	12.9
parent power	-21.1	+5.0	-0.2	-0.1
kid power	+18.2	+7.5	+2.6	+30.0

Calibration moments	home-own'p rate	mean IVT by healthy par.	mean IVT to PC parent
baseline	74.8	2255	1120
parent power	-2.4	-21	-70
kid power	+0.5	-35	-147

Counterfactual experiments for bargaining power. Wealth and bequests are in 000s of 2010-dollars. *Negligible* is $\leq$ 25K. *p10*, *p25*, ..., *p90* are the 10th, 25th, ..., and 90th percentiles. *parent power:* parent generation makes take-it-or-leave-it offers in all scenarios. *kid generation:* kid generation makes take-it-or-leave-it offers in all scenarios. *IC*: informal care, *FHC*: formal home care, *NH*: nursing home, *MA*: Medicaid.

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

by Daniel Barczyk, Sean Fahle, and Matthias Kredler

D Definitions of key variables

D.1 Wealth measures

We use two wealth measures from the RAND Longitudinal Files. Our measure of liquid non-housing wealth (HwATOTF) is defined to include 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. Our measure of net worth (HwATOTB) includes liquid non-housing wealth in addition to the net values of primary and secondary residences and other real estate, vehicles, businesses, and IRA and Keogh accounts.

D.2 Bi-annual bequest and inter-vivos transfer flows

Inter-vivos transfers to children are taken directly from the RAND Family Files. The HRS records financial help totaling more than $500 to 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.

To calculate the ratio of inter-vivos transfers to bequests, we first sum (with sample weights) all inter-vivos transfers and bequests and then take their ratio. We include only households whose eldest member is 65 years of age or older, and we consider only bequests left by individuals with children, as defined by the number of children listed at the exit interview. The 25% figure reported in the text is calculated using data from waves 6-9 and excluding observations with wealth over $2 million (in year-2010 dollars). (We assign decedents' estates to their final core interview wave.)

D.3 Long-term care categories and hours of care

To measure hours of long-term care, we use data from 2002 and beyond, which corresponds to when the HRS standardized their coding of these variables. We top-code hours of care from any particular non-institutional (non-nursing home) caregiver at 16 hours per day for 31 days per month. In cases where hours of care are missing for a non-institutional caregiver, we impute hours for that caregiver using a nearest neighbor match routine.[59] Following the imputations, hours are summed by category of helper and then across all categories to obtain total monthly hours of care. The HRS does not elicit hours of care from institutional (nursing home) helpers. For individuals who receive any nursing home care, we impute total monthly care hours using a separate nearest neighbor match procedure.[60]

Among all of the interviews for care recipients in our sample of single elderly decedents, 58.7% are not missing hours data for any helpers. No imputations are done in these cases. Another 32.1% are missing hours data only for institutional helpers, which the HRS does not record. For these individuals, only total monthly hours are imputed. Only 9.2% of the interviews for care recipients in our sample are missing care hours data for a non-institutional helper. For these individuals, we impute hours of care for the caregivers with missing hours data. If these individuals also receive institutional care, we separately impute total care hours.

As a summary measure for the regression analyses, we construct average weekly hours of care over the sample period for each individual and each care source. These are weighted averages in which the hours reported at each interview are weighted by the number of days elapsed since the previous interview. Effectively, we are assuming that the monthly hours of care reported at each interview are provided at the same rate in every month since the prior interview.

We categorize long-term care arrangements using source of care as follows.[61] 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

[59]Neighbors are matched using fitted values from a regression of (the inverse hyperbolic sine of) care hours on a care recipient's age, gender, and ADL and IADL limitations; indicators of a caregiver's relative importance (based on the order caregivers are listed) in helping with ADLs, IADLs, and managing money, plus indicators for whether care was also received from another helper who was a spouse, partner, or nursing home; and interactions of many of these variables. A single nearest neighbor is selected with replacement, and ties are broken randomly. Fitted values and matching are done separately for core and exit interviews.

[60]Here, we match care recipients in nursing homes with similar care recipients living in the community on the basis of fitted values for (the inverse hyperbolic sine of) total monthly hours of care. Covariates in this regression are: an indicator for an exit interview; an indicator for a proxy core interview; age; an indicator for ever having memory disease; and ADL and IADL limitations, included linearly, squared, and interacted. Notice that, because we impute total hours separately for individuals receiving institutional care, the sum of hours across non-institutional caregivers will not equal total care hours of these individuals.

[61]We define four broad categories of caregivers: *young*, which includes child, child-in-law, stepchild, ambiguous child relationship, grandchild, spouses of children or grandchildren; *other informal*, which includes (late) spouse/partner, parents, parents-in-law, other relatives, siblings, and other unpaid individuals; *nursing home*; and *other formal care*, which includes professionals, organizations, other paid individuals. For most analyses, we collapse young and other informal into a single *informal care* category.

recipients.

An individual is classified as *disabled* (used interchangeably with *sick*) if the individual is both not coupled and receives ninety or more total hours of care per month. If either of these criteria is not satisfied, an individual is considered not disabled (*healthy*).

D.4 Estate values

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.

D.4.1 Missing estate values

Table OA2 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.

D.4.2 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 and 0 otherwise. 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 OA1.

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 OA1. 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 OA1. 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.

D.4.3 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.[62] Given that relatively few observations were affected, we did not see much value in deviating from RAND's well-established procedure.

D.4.4 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.

[62]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.

E 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.

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 OA1. 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.

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:

$$\text{Prob}\left(X \geq x\right) \;=\; \int_{x}^{\infty} p\left(X\right)\mathrm{d}X = \left(\frac{x}{x_{min}}\right)^{-\alpha+1}$$

Taking logs reveals the linear relationship we see in Figure OA1 between the log anti-CDF and the log of the data:

$$\log\left(\text{Prob}\left(X \geq x\right)\right) = (-\alpha + 1)\log\left(x\right) - (-\alpha + 1)\log\left(x_{min}\right)$$

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 OA1 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 $\widehat{x_{min}}$.

F Computational appendix

We will discuss here the solution method concerning model ingredients that are novel. We refer the reader to Barczyk & Kredler (2014*a*), Barczyk & Kredler (2018) and their appendices for elements that are already present in past papers. The online appendix to Barczyk & Kredler (2014*a*) contains a description of the Markov-chain approximation methods and how to use the Kolmogorov Forward Equation to forward-iterate distributions.

F.1 Transfers within the state space

As shown above, 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):

$$\bar{Q}_l(z) = -\bar{q} y^p_{net}(z), \qquad \qquad \bar{Q}_u(z) = \bar{q} y^k_{net}(z), \tag{38}$$

where $\bar{q} > 0$ is a tuning parameter of the algorithm and where $y^k_{net}(z)$ is the kid'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

$$\tau^i(z) = 1 - \frac{V^i_{a^i}(z)}{V^i_{a^{-i}}(z)}. \tag{39}$$

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 $\phi : [0,\infty) \to [0,1]$:

$$\phi(\tau) = \min\left\{\frac{\tau}{\bar{\tau}}, 1\right\}, \tag{40}$$

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 in the state space:

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:[63]

   (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 under to $Q^*(z) = -\phi(-\tau(z))\bar{Q}_l(z)$ when trying to find a bargaining solution for an inside option.

[63]Note here that this distinction also takes care of situations in which *both* players want to give gifts, and it 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).

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.

F.2 Other computational issues

Grid size. 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. We choose a grid size of $N_a = 31$ for the two asset grids with an upper bound of $\bar{a} = 1,500$, leading to a mesh size of $\Delta a = 50$ (here, 1 unit corresponds to 1,000$ in 2010). Our choice for $\bar{a}$ is large enough to ensure that agents always dissave when at this bound, thus the drift points inward, which is important for stability of the algorithm.. For the two productivity grids, we choose grid size $N_\epsilon = 3$. The grid is given by the vector $[-1.25; 0; 1.25]\sigma_w$, where $\sigma_w = .75605$ is the standard deviation of the residual of a Mincer regression for log wages (see calibration). For housing, the grid size is $N_h = 5$. There is one renting state and we let the four house sizes be the vector $[1; 2; 4; 8] \times \Delta a$. We set the time increment in the algorithm to $\Delta t = 1/38 = 0.026$ years. With this choice, the probabilities in the Markov-chain approximation method stay safely on the positive side: The probability of staying at the same grid point is 0.47 at its lowest. This leads to a time grid of $N_j = 30 \times 38 = 1,140$ points. In total, we thus have a grid with $2 \times N_a^2 \times N_\epsilon^2 \times N_h \times N_j \simeq 100,000,000$ grid points (the multiplication by 2 is due to distinction between the healthy and disabled states). There is also a smaller grid with $N_a \times N_h \times N_j \simeq 100,000$ 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".[64] 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 kid'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 F.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 a rather high value: $\sigma_a = 0.05$.

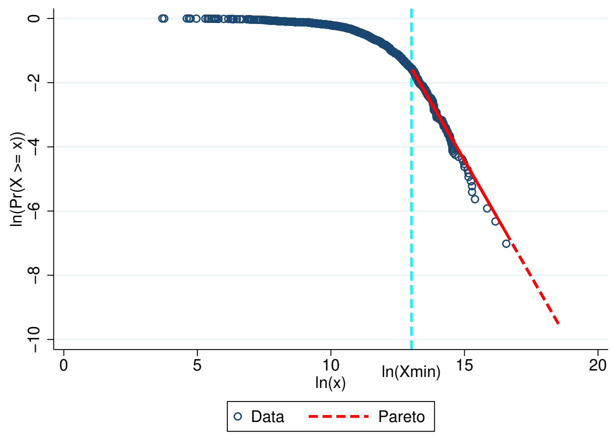
Extrapolation. At the upper bound of the grids for a^p and a^k, we have to make choices for how to proceed with extrapolation. There are still random movements due to shocks to assets that can make assets increase at this upper bound, though. We reflect back such paths at the boundary, which we found 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.

F.3 Measuring the timing of transfers

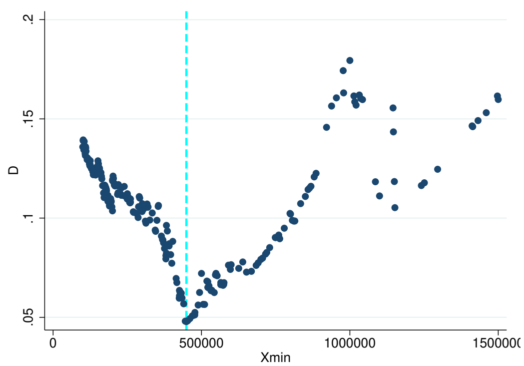
Artificial panel. We draw an artificial panel with 50,000 model families that we follow from parent age 65 until the parents death. In line with the HRS practice, we "interview" families in intervals of two years (i.e. at age 67.0, 69.0 etc.) and again at their death. Stock variables (financial wealth, 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.

[64] See `https://es.mathworks.com/matlabcentral/fileexchange`

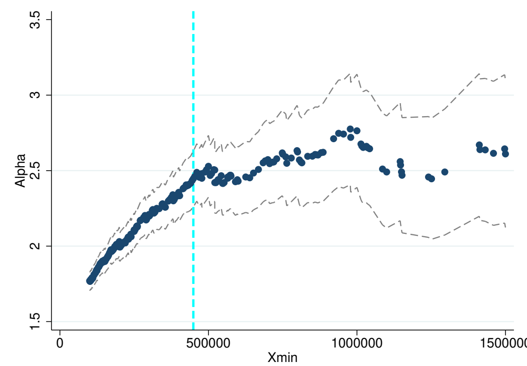
Figure OA1: The Pareto tail of the estate value distribution



(a) Pareto tail



(b) Kolmogorov-Smirnov distance



(c) ML estimates for $\widehat{\alpha}$

Note: 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}.

Table OA1: Imputation models

	(1) Any Estate	(2) Bracket	(3) ihs(Value)
ihs(Net Worth) (most recent)	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: HS/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+	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 (preload)	0.869***	0.752***	1.163***
	(0.122)	(0.120)	(0.200)
Medicaid Coverage (most recent)	-0.892***	-1.076***	-1.654***
	(0.104)	(0.141)	(0.228)
Intended Bequest 10k+ (most recent)	0.00549***	0.00271*	0.00304
	(0.00142)	(0.00155)	(0.00267)
Intended Bequest 100k+ (most recent)	0.00914***	0.0167***	0.00920***
	(0.00194)	(0.00159)	(0.00254)
N	2922	1402	1127
R^2			0.363
adj. R^2			0.356
pseudo R^2	0.305	0.176	

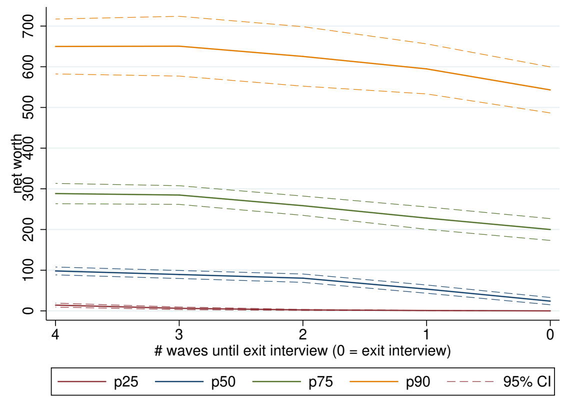
Note: Standard errors in parentheses. * p<.1, ** p<.05, *** p<.01. *ihs* refers to the inverse hyperbolic sine: $\ln\left(x + \sqrt{1+x^2}\right)$. Net worth and bequest intentions are taken from the most recent available core interview data. Medicaid coverage is taken from the exit interview, if available, or the most recent core data otherwise. Age is age at death. Homeownership is from the preloaded information for the exit interview. Specifications also include a constant (not reported).

Table OA2: Types and frequencies of estate value reports

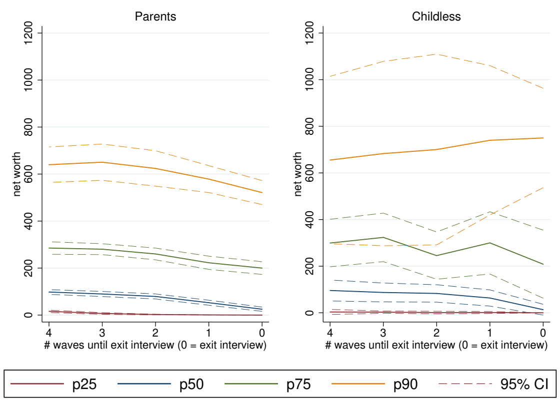
	N	Percent	Cum. Percent
No asset	1,180	36.57	36.57
Continuous report	1,202	37.25	73.81
Complete brackets, closed	302	9.36	83.17
Complete brackets, top bracket	1	0.03	83.20
Incomplete brackets, closed	46	1.43	84.63
Incomplete brackets, open top	224	6.94	91.57
No bracket information	253	7.84	99.41
Don't know ownership	19	0.59	100.00
N	3227		

Note: Counts and frequencies are for our final 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.

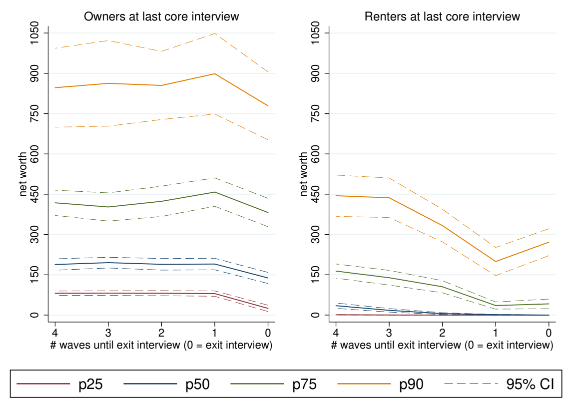
Figure OA2: Wealth trajectories with 95% confidence intervals



(a) All



(b) With and without children



(c) Own or rent in last wave prior exit

Note: Wealth trajectories are as reported in the text. Panel (a): See Figure 2 (dashed lines). Panel (b): See Panel (a) of Figure 5. Panel (c): See Panel (a) of Figure 6. Consult those figures for additional notes. This figure adds ninety-five percent confidence intervals for each of the trajectories. Panels (b) and (c) have been broken into separate plots for readability.

Table OA3: Informal care arrangements and housing (Table 9 with complete set of coefficient estimates)

Conditional on:	Dependent variable: Receiving informal care		No care at prev interview		IC at prev interview	
	(1)	(2)	(3)	(4)	(5)	(6)
ihs(Wealth) (t-1)	0.0078*** (0.0012)	0.0017 (0.0013)	0.0073*** (0.0022)	0.0015 (0.0027)	0.000024 (0.0018)	-0.0029 (0.0022)
Own home (t-1)		0.13*** (0.016)		0.11*** (0.027)		0.064** (0.027)
Age	-0.0071*** (0.00087)	-0.0061*** (0.00087)	-0.0074*** (0.0012)	-0.0064*** (0.0012)	-0.0023* (0.0012)	-0.0019 (0.0012)
Female	0.037** (0.017)	0.036** (0.017)	0.042* (0.024)	0.038 (0.024)	0.027 (0.026)	0.027 (0.026)
Race: Black	0.096*** (0.023)	0.092*** (0.023)	0.057* (0.033)	0.058* (0.033)	0.11*** (0.027)	0.10*** (0.027)
Race: other	0.093* (0.049)	0.10** (0.048)	0.093 (0.073)	0.100 (0.072)	0.082 (0.058)	0.085 (0.059)
Hispanic	0.098** (0.038)	0.093** (0.038)	0.044 (0.055)	0.044 (0.054)	0.17*** (0.050)	0.17*** (0.050)
Educ: HS/GED	-0.035* (0.018)	-0.034* (0.018)	-0.041 (0.027)	-0.041 (0.027)	-0.0082 (0.026)	-0.0042 (0.026)
Educ: some college	-0.075*** (0.023)	-0.063*** (0.023)	-0.058* (0.034)	-0.050 (0.034)	-0.021 (0.035)	-0.0084 (0.036)
Educ: college+	-0.099*** (0.027)	-0.090*** (0.027)	-0.10** (0.041)	-0.082** (0.041)	-0.059 (0.044)	-0.053 (0.045)
Coupled	0.11*** (0.027)	0.093*** (0.027)	0.13*** (0.042)	0.12*** (0.042)	0.068 (0.041)	0.053 (0.041)
Has children	0.14*** (0.025)	0.14*** (0.025)	0.086** (0.041)	0.094** (0.041)	0.12*** (0.044)	0.12*** (0.043)
Number of children	0.014*** (0.0036)	0.013*** (0.0036)	0.013** (0.0056)	0.012** (0.0056)	0.0080* (0.0046)	0.0081* (0.0046)
ADL limitations	-0.054*** (0.0043)	-0.054*** (0.0043)	-0.045*** (0.0070)	-0.045*** (0.0070)	-0.041*** (0.0069)	-0.042*** (0.0069)
IADL limitations	-0.045*** (0.0056)	-0.041*** (0.0057)	-0.048*** (0.0095)	-0.047*** (0.0095)	-0.032*** (0.0092)	-0.030*** (0.0093)
Ever had memory disease	-0.10*** (0.015)	-0.098*** (0.015)	-0.055** (0.026)	-0.057** (0.026)	-0.10*** (0.024)	-0.097*** (0.024)
Religion: Catholic	-0.018 (0.020)	-0.013 (0.020)	0.030 (0.029)	0.028 (0.029)	-0.055* (0.030)	-0.051* (0.030)
Religion: Jewish	-0.17*** (0.039)	-0.15*** (0.039)	-0.21*** (0.063)	-0.20*** (0.064)	-0.17* (0.095)	-0.16* (0.095)
Religion: None	0.076* (0.045)	0.077* (0.044)	0.0093 (0.057)	0.012 (0.056)	0.11* (0.061)	0.11* (0.061)
Religion: Other	-0.0049 (0.081)	0.0014 (0.079)	-0.0095 (0.11)	0.0021 (0.11)	0.057 (0.10)	0.050 (0.11)
Constant	1.17*** (0.086)	1.07*** (0.086)	1.23*** (0.13)	1.15*** (0.13)	0.89*** (0.13)	0.85*** (0.13)
N	6389	6300	1737	1704	1827	1807
adj. R^2	0.236	0.246	0.154	0.157	0.120	0.123
Mean of dep. var.	0.47	0.47	0.59	0.59	0.67	0.67

Note: Table reports the (nearly) complete set of coefficient estimates for Table 9 in the main text. See that table for additional notes. Reference categories (White, less than HS education) and indicators for each interview wave and Census division have been suppressed for space.

Table OA4: Informal care arrangements and housing (Table 9) with added child characteristics

	Dependent variable: Receiving informal care								
Conditional on:				No care at t-1			IC at t-1		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
ihs(Wealth) (t-1)	0.0017	0.0024*	0.0023	0.0015	0.0018	0.0011	-0.0029	-0.0025	-0.0041*
	(0.0013)	(0.0014)	(0.0014)	(0.0027)	(0.0027)	(0.0029)	(0.0022)	(0.0023)	(0.0025)
Own home (t-1)	0.13***	0.13***	0.13***	0.11***	0.11***	0.11***	0.064**	0.067**	0.095***
	(0.016)	(0.016)	(0.017)	(0.027)	(0.027)	(0.029)	(0.027)	(0.027)	(0.030)
Num. daughters		0.025***	0.019**		0.015	-0.00051		0.016	0.020*
		(0.0080)	(0.0078)		(0.012)	(0.013)		(0.011)	(0.011)
Mean child age		-0.0012	-0.00022		0.00068	0.0010		-0.00069	0.00045
		(0.0012)	(0.0012)		(0.0019)	(0.0020)		(0.0018)	(0.0019)
Num. grandchildren		0.0030	0.0040		0.0050	0.0056		-0.00068	0.00096
		(0.0027)	(0.0025)		(0.0038)	(0.0040)		(0.0034)	(0.0034)
Mean child educ.		-0.011***	-0.0059		-0.014**	-0.014**		-0.0069	-0.0063
		(0.0042)	(0.0046)		(0.0063)	(0.0072)		(0.0060)	(0.0065)
Num. married		-0.020**	-0.0080		-0.014	-0.017		0.0058	0.015
		(0.0088)	(0.011)		(0.013)	(0.017)		(0.012)	(0.014)
Num. own homes			0.016*			0.032**			0.00081
			(0.0089)			(0.015)			(0.012)
Num. in 10 miles			0.0091			0.0074			-0.0056
			(0.0087)			(0.014)			(0.012)
Mean child income			-0.021**			-0.0064			-0.0071
			(0.0098)			(0.016)			(0.016)
Num. work full-time			-0.0048			-0.0020			0.0040
			(0.0086)			(0.015)			(0.011)
Num. co-resident			0.21***			0.16***			0.11***
			(0.020)			(0.031)			(0.025)
N	6300	6038	5362	1704	1644	1466	1807	1737	1527
adj. R^2	0.246	0.255	0.299	0.157	0.163	0.183	0.123	0.124	0.141
Mean of dep. var.	0.47	0.48	0.47	0.59	0.59	0.59	0.67	0.68	0.67

Note: 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. Child variables are the means across all available 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 OA5: Bequests and informal care (Table 10 with complete set of coefficient estimates)

	Overall Estate		Housing	
	Any Estate	Log Value	Bequest	Beq. or IVT
Avg. weekly LTC hours	-0.0017***	-0.0036***	-0.0020***	-0.0017***
	(0.00022)	(0.0012)	(0.00022)	(0.00025)
Avg. weekly child LTC hours	0.00100***	0.0045*	0.0013***	0.0019***
	(0.00038)	(0.0023)	(0.00038)	(0.00043)
Age	0.0061***	0.026***	-0.0029***	-0.0010
	(0.00081)	(0.0047)	(0.00083)	(0.00088)
Female	0.053***	0.020	0.039**	0.022
	(0.017)	(0.087)	(0.019)	(0.019)
Race: Black	-0.16***	-0.55***	-0.0026	-0.055**
	(0.025)	(0.16)	(0.024)	(0.025)
Race: other	-0.058	0.29	-0.069	-0.066
	(0.053)	(0.28)	(0.045)	(0.052)
Hispanic	-0.036	-0.057	0.0080	-0.0044
	(0.037)	(0.22)	(0.036)	(0.040)
Educ: HS/GED	0.076***	0.37***	0.031	0.026
	(0.020)	(0.10)	(0.020)	(0.021)
Educ: some college	0.084***	0.55***	0.0096	0.0028
	(0.025)	(0.12)	(0.026)	(0.027)
Educ: college+	0.089***	0.73***	0.0094	-0.028
	(0.028)	(0.15)	(0.033)	(0.034)
Has children	0.022	-0.13	-0.027	0.064**
	(0.028)	(0.15)	(0.029)	(0.030)
Num. children	-0.00041	0.0094	0.0017	0.0022
	(0.0040)	(0.022)	(0.0042)	(0.0044)
Ever coupled	0.0047	0.13	0.034*	0.056***
	(0.018)	(0.085)	(0.020)	(0.021)
log(Avg household inc.)	0.21***	0.92***	0.15***	0.14***
	(0.014)	(0.077)	(0.015)	(0.015)
Religion: Catholic	-0.0092	0.065	-0.0025	0.025
	(0.020)	(0.098)	(0.021)	(0.022)
Religion: Jewish	-0.13***	0.18	-0.054	-0.094*
	(0.041)	(0.23)	(0.046)	(0.050)
Religion: None	0.024	0.16	0.065	0.046
	(0.037)	(0.18)	(0.040)	(0.041)
Religion: Other	-0.081	-0.090	-0.10	-0.12*
	(0.070)	(0.37)	(0.066)	(0.072)
Interview wave=8	-0.078***	-0.013	-0.023	0.0082
	(0.024)	(0.12)	(0.026)	(0.027)
Interview wave=9	-0.12***	0.10	-0.072***	-0.014
	(0.024)	(0.12)	(0.025)	(0.027)
Interview wave=10	-0.12***	-0.29**	-0.068***	-0.053*
	(0.024)	(0.12)	(0.025)	(0.027)
Interview wave=11	-0.13***	-0.35**	-0.054*	-0.034
	(0.026)	(0.14)	(0.028)	(0.030)
Constant	-1.85***	-0.35	-0.91***	-0.81***
	(0.16)	(0.97)	(0.17)	(0.17)
N	3210	1851	3212	3212
adj. R^2	0.221	0.243	0.107	0.086
Mean of dep. var.	0.63	11.5	0.36	0.48

Note: Table reports the (nearly) complete set of coefficient estimates for Table 10 in the main text. See that table for additional notes. Reference categories (White, less than HS education, Protestant) and indicators for each interview wave and Census division have been suppressed for space.

Table OA6: Children, informal care, and nursing home entry (Table 13 with complete set of estimates)

	Dependent variable: Enter NH since previous interview			
	All		Single	Coupled
	(1)	(2)	(3)	(4)
Has children	-0.037***	-0.0077	-0.041***	-0.0027
	(0.0078)	(0.0098)	(0.0087)	(0.012)
Child LTC hours		-0.0028***		
		(0.00013)		
Age	0.0018***	0.0020***	0.0020***	0.0011**
	(0.00027)	(0.00031)	(0.00030)	(0.00045)
Female	-0.0075	-0.0025	-0.011*	0.0031
	(0.0053)	(0.0064)	(0.0064)	(0.0074)
Race: Black	-0.030***	-0.028***	-0.032***	-0.016
	(0.0075)	(0.0086)	(0.0083)	(0.011)
Race: other	-0.0099	-0.00010	-0.010	0.025
	(0.016)	(0.017)	(0.017)	(0.035)
Hispanic	-0.066***	-0.065***	-0.074***	-0.015
	(0.012)	(0.014)	(0.014)	(0.014)
Educ: HS/GED	0.018***	0.014**	0.019***	0.012
	(0.0060)	(0.0070)	(0.0069)	(0.0079)
Educ: some college	0.024***	0.018**	0.023***	0.026**
	(0.0074)	(0.0087)	(0.0086)	(0.011)
Educ: college+	0.019**	0.0091	0.024**	-0.00092
	(0.0091)	(0.011)	(0.011)	(0.013)
Coupled	-0.0060	-0.020***	0	0
	(0.0047)	(0.0064)	(.)	(.)
Own home (t-1)	-0.029***	-0.026***	-0.031***	-0.0064
	(0.0073)	(0.0084)	(0.0080)	(0.013)
Wealth quintile=2	0.012	0.0044	0.0092	0.041*
	(0.0096)	(0.011)	(0.010)	(0.021)
Wealth quintile=3	0.011	0.0057	0.010	0.017
	(0.011)	(0.012)	(0.012)	(0.018)
Wealth quintile=4	-0.0061	-0.011	-0.0074	0.0074
	(0.012)	(0.013)	(0.013)	(0.018)
Wealth quintile=5	-0.0047	-0.011	-0.0067	0.015
	(0.012)	(0.014)	(0.014)	(0.020)
ADL limitations	0.0085**	0.017***	0.0078*	0.012
	(0.0037)	(0.0041)	(0.0040)	(0.0083)
IADL limitations	0.045***	0.066***	0.047***	0.021***
	(0.0038)	(0.0044)	(0.0041)	(0.0078)
Memory disease	0.077***	0.082***	0.078***	0.085**
	(0.017)	(0.017)	(0.019)	(0.041)
Δ ADLs	0.017***	0.018***	0.016***	0.021**
	(0.0036)	(0.0039)	(0.0038)	(0.0089)
Δ IADLs	0.014***	0.011***	0.014***	0.016
	(0.0038)	(0.0041)	(0.0040)	(0.0097)
Δ Memory disease	-0.0051	-0.020	-0.0072	0.013
	(0.019)	(0.019)	(0.020)	(0.059)
N	12306	9567	10566	1740
adj. R^2	0.250	0.310	0.244	0.216
Mean of dep. var.	0.10	0.12	0.11	0.026

Note: Table reports the (nearly) complete set of coefficient estimates for Table 13. See that table for additional notes. Reference categories (White, less than HS education, bottom wealth quintile); indicators for each interview wave, religion, and Census division; and the constant have been suppressed for space.