Why do People Leave Bequests? A Quantitative Exploration

Daniel Barczyk[1], Sean Fahle[2], and Matthias Kredler[3]

PRELIMINARY VERSION

Abstract

A longstanding puzzle has been to understand reasons for why people leave bequests, and, relatedly, why inter-generational transfers occur predominantly as bequests and not as inter-vivos transfers. This paper provides a quantitative theory to both of these questions. We document empirical facts on bequests and old-age savings using the Health and Retirement Study and find that (i) longevity risk, (ii) long-term care arrangements, (iii) altruism, and (iv) illiquidity of housing are central in determining bequests. We build a rich limited-commitment model that allows us to study the importance of these factors. Limited commitment explains why parents delay most (but not all) transfers until their death: By holding on to their wealth, they have more of say on the allocation of resources. We find that no *single* bequest motive is sufficient to rationalize the patterns in the data. The two cannels that matter most *per se* are longevity risk and homeownership. However, the different motives interact in novel ways that can only be understood in a dynamic framework. For example, altruism may actually *decrease* bequests: When parents can count on an altruistic child to help out in times of disability, they decrease their precautionary savings, leading to lower bequests.

[1] McGill University and CIREQ, [2] State University of New York at Buffalo, [3] Universidad Carlos III.
We thank seminar participants at the CIREQ Macro Conference 2015, the NYU Alumni meetings 2015, the Simposio in Girona 2015, and at Ludo Visscher's Bachelor Conference 2016 for comments. Matthias Kredler acknowledges research funding by the Fundación Ramón Areces, by the Spanish Ministerio de Economía y Competitividad, grants MDM 2014-0431, and Comunidad de Madrid, MadEco-CM (S2015/HUM-3444). Sean Fahle acknowledges research funding from the Alfred P. Sloan Foundation (Grant G-2015-14131).

1 Introduction

There are at least three reasons why it is important to study the question of why people leave bequests. First, studying the determination of bequests is inextricably related to understanding saving motives. In turn, having a firm grasp of saving motives is of central importance when studying potential policy reforms (e.g. pension reform, health insurance reform, estate taxation). Second, understanding why people leave bequests sheds light on the question how much of wealth creation is attributable to (intended) intergenerational transfers and to what extend to life-cycle motives. Finally, models in macroeconomics and public finance often need to make an assumption about the nature of the bequest motive, a choice that may not be innocuous, so that having a better understanding should prove useful.

Using the Health and Retirement Study (HRS) we find that the right tail of the estate distribution follows a Pareto (power-law) distribution for estates above approximately $450,000. Our estimate for the power-law coefficient imply that while the mean exists, higher moments do not. The average estate value is around $128,000 but the median estate is only around $11,000. This implies that the Central Limit Theorem does not apply, which makes any estimates relying on central moments (such as means and regression coefficients) extremely sensitive to outliers. We thus carry out our analysis relying on quantiles and regressions in logarithms. When comparing the estate distribution and saving behavior among individuals with and without children we find that they are remarkably similar. Stark differences arise when comparing home owners to renters, with renters being substantially poorer than owners and displaying a higher rate of dissaving over the final years of life. A similar characterization also applies when contrasting nursing-home residents with persons residing at home. Nursing-home residents are poorer and deplete their assets more quickly than those who remain at home despite the fact that individuals at home typically also have demanding care needs. The difference lies in the source of care namely that at home care is often provided informally which acts in a way to protect the estate from a spend-down on uninsured nursing-home expenses.

The evidence we find in the HRS points to the importance of modeling housing equity separately from financial wealth[1]. Additionally, the data suggest that a prolonged nursing-home stay is decisive in the formation of bequests. The empirical finding of the similarity in

[1]Using the HRS and the SIPP, Venti & Wise (2004) find that in the absence of changes in the household structure elderly families are unlikely to move and that movers rarely reduce home equity. Giving up ownership is most often associated with the death of a spouse or entry into a nursing home. Systematically, home equity is not liquidated (reverse annuity mortgages are also rarely used) to support non-housing consumption.

saving behavior of parents and non-parents poses at first a challenge to the theory of intended bequests, be it due to pure altruism, warm glow or exchange. Were everything else equal among parents and non-parents this empirical fact would be troubling for such a theory. The presence of children, however, may induce saving behavior for parents along another margin that goes in the opposite direction to the saving incentives provided by altruism or warm glow. For example, if childless individuals face larger end-of-life risks than parents, their need for higher precautionary savings could explain the resemblance in bequests (e.g. in the absence of informal caregivers such as a spouse or children prolonged expensive nursing home care may be substantially more likely). In order to find out about the importance of altruism in generating transfers, our model includes it in the form of parents caring about their children's well-being.[2] Additionally, since in the data informal care by children is provided even in the absence of any future payoff our framework also models children to be altruistic.

Our model is a continuous-time life-cycle model in which a parent household and a child household overlap for many time periods and interact strategically. We allow for (i) longevity, medical expenditure, and long-term-care risks, (ii) altruism by both parents and children, (iii) an informal-care choice by children, and (iv) an illiquid housing asset. Allowing for informal care by children can be interpreted as a strategic/exchange motive whereby care is provided in exchange for larger bequests. However, there are no explicit contracts regarding the terms of trade, instead, children are motivated to provide care in anticipation of a larger bequest which is achieved by enabling the frail parent to avoid a costly nursing-home stay (on top of the fact that care is also partially altruistically motivated and so care may be provided even in the absence of a future bequest). We employ a non-cooperative dynamic altruism model (Barczyk & Kredler, 2014a,b); this approach has the advantage that we can allow both the parent and the child to save.

In our (still preliminary) calibration we find the follow results.

First, consistent with the data, the model predicts that the elderly cling to their wealth and leave most of their wealth in the form of bequests to their children (Kopczuk 2007, 2012). The reason for this are the strategic interactions in the model. Since there is no commitment, parents do not want to hand over control to their children too early. If the parent handed over wealth prematurely, the child would allocate a lower resource share to the parent because altruism is imperfect. A second negative effect of handing over control over assets too early is that it removes incentives for the child to give informal care to the

[2] We see *warm glow*, i.e. a bequest motive that only depends on the size of the bequest but not the child's continuation utility, as a particularly convenient form of modeling altruism and see it subsumed in this channel.

parent. This makes parents stick to most of their wealth until death. However, parents also give inter-vivos transfers to their children in our model. But these are lower than bequests and only flow in situations when the child is in acute need.

Second, we conduct counterfactual analysis to answer the question which saving motives matter most to the formation of bequests. We find that there is no single most-important motive; several motives have effects of similar size. When removing one motive at a time, longevity risk and the illiquidity of housing matter most: The median bequest decreases by more than two-thirds when a) making the time of death certain or b) allowing individuals to borrow against their house. Eliminating the parent's altruism and taking away the possibility of exchange (i.e. to give informal care) has only limited effects on bequests.

Third, we find that there are important – and interesting – interactions between the different saving motives. Interestingly, the effect of removing the *child's* altruism on bequests is a lot larger than that of eliminating the parent's altruism. In fact, shutting down the child's altruism has an effect that is almost as strong as that of removing the uncertainty of death or the illiquidity of housing. Also, it goes in the opposite direction: Parent's bequests *increase* when they cannot count on an altruistic child. The reason is that they accumulate more precautionary savings since they lack an important insurance channel. This mechanism is a good candidate to explain why we find that in the data, that the childless leave bequests that are similar in size to bequests of elderly with children. A similar mechanism is at work for exchange: When removing the opportunity to receive informal care from children, parents actually save more and bequests slightly increase. Our contribution here is to point out that one has to be careful when testing sign restrictions for bequest motives. The childless may leave bequests that are indistinguishable from parents' bequests; but this may not be because parents lack altruism but because the childless face higher old-age risks that make them save similar amounts.

Existing literature brings forward two sets of explanations to explain old-age savings. One finds that life-cycle motives including longevity risk and uncertain medical expenditures are key to understand old-age saving behavior, see Yaari (1965); Modigliani (1988); Palumbo (1999); Dynan et al. (2004); DeNardi et al. (2010); Kopecky & Koreshkova (2014). The other literature, while not ignoring the importance of old-age risks, advocates an important role for intended bequests, see Kotlikoff & Summers (1981); Gale & Scholz (1994); Carroll (2000); De Nardi (2004); Kopczuk & Lupton (2007); Ameriks et al. (2011), DeNardi et al. (2013); Lockwood (2017). In terms of bequest motives, the second strand of literature has found that a warm-glow (joy-of-giving, egotistic, capitalist spirit) motive is particularly successful in rationalizing various features of the data. This type of motive expresses the idea that individuals have a preference to have positive net worth upon death. It could act as a modeling short-cut to altruism (but if you enjoy leaving wealth so much than why not have warm-glow during one's lifetime for transfers?) or to capture other concerns that are unrelated to one's children which is what Kopczuk & Lupton (2007) find. However, Kopczuk (2013) argues that our understanding behind the nature of the bequest motive remains incomplete. In a survey of this literature, 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 precisely what this paper does.

As for the timing of inter-generational transfers, most papers in the literature restrict attention to either bequests or inter-vivos transfers but do not consider a choice between them. An exception is Barczyk (2016), who relies on the dynamic-altruism setting in Barczyk & Kredler (2014a,b), just as we do in this paper. However, his analysis is concerned with the consumption response to tax cuts and lacks a housing and exchange channel for bequests. Also Barczyk & Kredler (2017) use the same dynamic-altruism setting, but put the focus on long-term-care policy. Their model, features an endogenous informal-care decision by children, which can be motivated by inter-vivos transfers, bequests and/or altruism. Their model implies that a large part of informal-caregiving is motivated by expected bequests; however, they do not quantify this motive. Furthermore, their model excludes housing, which may explain why bequests are somewhat lower than in the HRS data.

There is also a large number of empirical papers on bequests. Laitner & Ohlsson (2001) is most similar to our paper in its intent – to distinguish between different bequest motives –, but is entirely empirical in its methods. The authors compare bequest data from Sweden and the U.S. They find some evidence in favor of the altruism model: Bequests are increasing in life-time incomes of the parent and decreasing in the life-time incomes of children. However, they note that these effects are much smaller in magnitude than a standard dynastic altruism model would predict.

In line with an altruistic motive, McGarry (1999) finds that inter-vivos transfers are given disproportionately to children who are less well-off. She also finds that bequests are divided rather equally across children, which is a common finding in the earlier literature. However, there is a number of recent papers that finds that children who give care to their parents receive substantially larger bequests, which is in line with the exchange motive. This is true both *within* families (see Groneck, 2016) and *across* families (see Brown, 2007; Fahle, 2015; Barczyk & Kredler, 2017).[3]

Kopczuk & Lupton (2007) is one of the few studies that we are aware of that attempts to quantify the bequest motives. They specify a standard life-cycle model in which agents

[3]Francesconi et al. (2015) also challenge the notion that bequests are divided equally among children, but focusing more on non-conventional ("complex") families and parents who have not signed wills.

face random arrival of death and derive a warm-glow utility from bequests; they term this an *egoistic* motive, but it is actually most closely related to the altruistic motive in our framework. The strength of this warm glow is allowed to differ across individuals. They find that a bit less than half of observed bequests are due to longevity risk, which is in line with our results. Heterogeneity in warm glow is responsible for the large variation of bequests across the population. However, their model lacks the exchange and housing motive and does not consider long-term-care and medical-expenditure risks. Thus any variation in bequests stemming from these channels would be attributed to heterogeneity in warm glow in their model. Our model may be seen as an attempt to further dig into this heterogeneity.

There is a macroeconomic literature on old-age savings and bequests that is very much related to our paper. Two recent papers by Lockwood (2012, 2014) argue that a standard life-cycle model with a bequest motive is consistent with several facts about the elderly's choices: Most elderly in the U.S. do not buy annuities nor long-term-care insurance and draw down their wealth rather slowly. Our focus is different: We assume, from the start, that neither annuities nor long-term-care insurance are available and instead have a richer set of bequest motives. One interesting result from Lockwood's calibration is that bequests have to be luxury goods in a joy-of-giving specification; we note that our altruistic preferences have the same property: Since children have their own income and wealth, the parent's marginal utility from transfers to the child only exceeds the marginal utility of own consumption once the parent has reached a certain consumption level.

Most papers in the macroeconomic literature put the focus on old-age-savings behavior and not bequests (although the two are, of course, intimately related). It is well-known that the large medical-expense risk can go a long way in explaining that elderly Americans dissave slowly in retirement (DeNardi et al., 2009; Love et al., 2009). In a survey of this literature, 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 precisely what this paper does.

2 Empirical facts on bequests

In order to build a credible model, we first study empirically a sample of individuals who at time of their death are widow(er)s/singles, i.e. we focus on *inter-generational bequests* and not bequests that spouses leave to each other. In order to do so, we utilize the Health and Retirement Study (HRS) which provides data on realized bequests in addition to a multitude of other useful information. Specifically, for realized bequests we make use of exit interviews from the years 2004-2012. For data collected during respondents' lifetime (wealth, health, etc.) we draw on data from as early as 1998.

2.1 Estate distribution

Does the distribution of estate values have a Pareto tail? 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 precisely this is the case for the distribution of wealth in the U.S.: Klass et al. (2006) estimates imply that the mean and all higher moments are infinite. We first ask whether the same applies to the upper tail of the distribution of estate values.

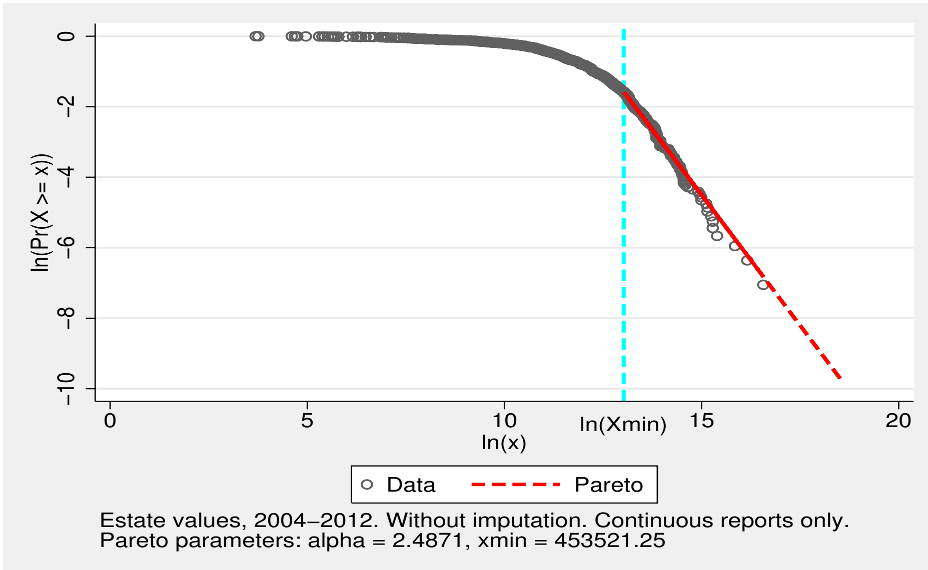
Visually, a Pareto tail manifests itself as a linear relationship between the natural log of a variable and the natural log of its anti- (or complementary) CDF. We present this evidence in Figure 1. The gray circles are the log of the empirical anti-CDF of estate values plotted against log estate value. For this figure, we use data on all non-missing estate values for the full sample of single decedents who left bequests in the 2004-2012 exit interviews. (The figure includes no imputed data.) The linear pattern is clearly evident in the right tail of the distribution. Imposed on top of the gray 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.

We estimate the threshold and the shape parameter α of the Pareto distribution following the procedure outlined in Clauset et al. (2009). See Section A of the Appendix for further details. 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 2.48. This value implies that the mean of the distribution exists, but the variance and all higher moments do not (since $\alpha \in (2, 3)$). An infinite variance implies that the Central Limit Theorem does not hold, so that averages of bequests do not have the usual convergence properties. This is why we carry out our analyses using quantiles of the distribution of estate values, which are certain to exist, rather than the mean, and we use log or inverse hyperbolic sine transformations of the estate data in our regression analyses.[4]

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. Approximately 25% of our sample has incomplete estate-value data of one form or another. To impute these

[4]Indeed, we find that averages and regressions with raw estate values as a dependent variable are extremely sensitive to outliers.

Figure 1: The Pareto tail of the estate value distribution



The gray circles represent data on reported estate values from a sample of single decedents in the 2004-2012 exit interviews 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 $\alpha = 2.481711440718236$ and $x_{min} = 453521.25$. This line has been shifted down to align with the empirical log anti-CDF.

missing values, we closely follow the procedure used by the RAND Corporation to impute missing income and wealth data in the HRS (Hurd et al., 2016). In brief, the imputation sequence has three main steps. First, we impute estate ownership (i.e., whether a bequest was left) for the handful of individuals for whom we do not have this information. Second, we impute bounds (which we refer to as "brackets") on the dollar value of the estate for individuals with missing or incomplete bracket information. Third, we impute a precise dollar amount for the missing estate value. For further details on the imputation procedure, refer to Section B of the Appendix.

Table 1 shows the estate distribution for our sample of widow(er)s/singles. About 57% of the sample leaves a positive estate value. The average estate value is around \$128,000. However, the median estate is only around \$11,000, indicating that the estate distribution is strongly skewed to the right. Especially the fifth quantile of the distribution is in absolute terms substantially larger than the values of the estates in the lower quantiles.

Given the question of this paper, an obviously interesting question to ask is how the estate distribution differs depending on whether or not the decedent has children. Table 2 sheds light on this question. In the upper part we show the estate distribution separately for decedents with and without children during our observation period. Widow(er)s/singles

Table 1: Unconditional estate distribution

quantile	N	mean	p10	p25	p50	p75	p90	p95	p99
1	1,288	0	0	0	0	0	0	0	0
3	519	19,187	1,251	3,150	14,973	33,000	46,070	50,000	52,129
4	591	122,357	62,100	81,459	115,176	162,918	198,090	200,000	208,516
5	560	508,260	259,145	312,773	449,184	600,000	989,161	1,042,578	1,151,755
Total	2,958	127,995	0	0	10,861	156,387	434,448	600,000	1,042,578

Source: HRS exit interviews 2004-2012. Sample of individuals who at time of death are widow(er)s/singles. The first and the second quantile are combined into a single row since all values are zero. Year-2010 dollar values. Respondent-level weights used from last core interview available.

with children leave slightly larger estates up to the 75th percentile beyond which childless individuals leave higher estates behind.[5] An important difference however arises when we consider the composition of net worth (measured at the time of their final interview): as we can see from the second part of Table 2, childless individuals' wealth portfolio contains a higher fraction of financial (non-housing) wealth at least up to the 90th percentile and is in absolute terms higher than financial wealth of those with children.

In summary, almost half of all widow(er)s/singles leave no estate behind. For the other half, the value of the estate is strongly right-skewed, with childless individuals, especially in the top 10 percent, leaving higher estates and carrying more of their assets in liquid form than those who have children. This hints at the possibility that having children can paradoxically lead to lower bequests despite the potential existence of an altruistic component of the bequest motive because the need for precautionary savings to insure against longevity risk and dependency is lessened. The fact that childless individuals hold more liquid (non-housing) wealth is consistent with this interpretation.

[5] Hurd (ECMTR 1989) finds that households with and without children behave similarly and interprets this as evidence against a bequest motive. This also mirrors a finding by Dynan, Skinner, and Zeldes (04, Do the Rich Save More?), p.426. They find that, if anything, the saving rates of households without children are higher. They interpret this as evidence against the dynastic model as in, for example, Becker and Tomes (1986). In such a model bequests arise in order to smooth dynastic consumption. In contrast, Kopczuk and Lupton (RESTUD 2007) argue that a significant portion (three-quarters) of elderly households – with and without children – behave in a manner consistent with a bequest motive. They employ an egoistic bequest motive: an individual simply derives utility from dying with positive net worth. Their estimated bequest motive is fairly strong: The level of consumption over two years that makes households indifferent between consuming and leaving a bequest in the last period of life is $47,687. This level is substantially lower, and in this sense the bequest motive is larger, than the one they estimate when assuming that only households with children have a bequest motive.

Table 2: Estate distribution by child status

kids	N	mean	p10	p25	p50	p75	p90	p95	p99
yes	2,599	126,617	0	0	11,518	160,000	427,457	575,878	1,042,578
no	359	136,884	0	0	2,304	147,712	510,476	800,000	1,042,578

Source: HRS exit interviews 2004-2012. Individuals who at time of death are widow(er)s/singles separated by whether or not they have children. Year-2010 dollar values. Respondent-level weights used from last core interview available.

Financial (non-housing) wealth in final interview

kids	N	mean	p10	p25	p50	p75	p90	p95	p99
yes	2,653	49,253	-485	0	2,000	36,856	151,450	271,238	605,802
no	365	66,259	0	0	2,900	48,600	195,502	383,669	974,250

Source: HRS core interviews 2004-2012. Individuals who at time of death are widow(er)s/singles separated by whether or not they have children. Year-2010 dollar values. Respondent-level weights used.

2.2 How do bequeathers and non-bequeathers differ?

We now contrast characteristics between decedents who leave any estate and those who do not, as well as between decedents with and without an end-of-life plan (i.e. those with a written will or trust referred to as *testator*) irrespective of whether anything of value is actually left behind.

Table 3 shows that, unsurprisingly, testators and those who leave an estate share similarities since they are often the same individuals. In contrast to the other two groups, they are more commonly caucasian, live longer, come from smaller families (fewer siblings,) have smaller families (fewer children), are less likely to have been single during the observation period, and are more highly educated. As already suggested by the estate distributions above, childlessness does neither predict the existence of an EOL nor the occurrence of an estate.

Both the incidence of ever having been a nursing home patient and nursing home utilization, in terms of cumulative days spent in a nursing home over the observation period, differ substantially especially between the estate and no-estate group. Among those who do not leave an estate, half have been admitted to a nursing home at some point and spent about double the amount of time in a nursing home. Despite the fact that they have shorter lives, a higher fraction of them have been diagnosed with a memory-related disease, and a smaller fraction reports to be in good health. The lower levels of education together with the higher rate of disability and lifetime nursing-home use correlates with a much heavier reliance on Medicaid. The differences between testators and non-testators along these dimensions are somewhat less pronounced indicating that long-term care expenses can substantially reduce

Table 3: Respondent characteristics by EOL and estate

characteristic	all	EOL	no EOL	estate	no estate
N	3,020	1,830	1,190	1,670	1,350
caucasian	81.0%	91.2%	63.5%	88.5%	70.8%
female	69.9%	72.1%	66.2%	70.7%	68.8%
age	81.8	**84.2**	**77.7**	84.2	77.7
siblings	1.8	1.5	2.1	1.8	2.2
children	2.9	2.7	3.3	2.8	3.1
childless	12.3%	**12.4%**	**11.9%**	11.9%	12.7%
ever couple	80.4%	**93.3%**	**58.2%**	93.3%	58.3%
education	11.2	**11.9**	**10.0**	11.8	10.3
ever nursing home	45.1%	46.7%	42.3%	**39.5%**	**50.0%**
cum NH days	394	404	377	**272**	**552**
(I)ADLs	6.8	7.0	6.6	6.6	7.1
memory issue	46.5%	45.6%	48.2%	41.3%	53.3%
days in bed	36	34	39	36	39
good health	37.2%	41.2%	30.6%	40.8%	32.6%
LTC insurance	5.9%	8.1%	2.1%	7.9%	3.3%
Medicaid	25.5%	13.6%	46.0%	**11.1%**	**45.0%**
NHR at exit-1	22.0%	22.0%	22.1%	**16.6%**	**29.1%**
NHR	42.3%	43.9%	39.5%	37.0%	49.3%
own home at exit-4	63.1%	74.3%	41.6%	**79.0%**	**41.5%**
own home at exit-1	43.9%	54.7%	25.3%	**60.8%**	**21.6%**
inter-vivos home transfer	9.9%	9.5%	10.6%	**6.9%**	**13.7%**
mean fincl wealth	51.5K	76.4K	8.8K	83.7K	9.8K
median (fincl) wealth	2.1K	11.5K	0.0K	16.9K	0.0K
pr leave bequest (exit-4)	62.5%	77.8%	34.6%	79.5%	39.2%
pr leave bequest (exit-1)	57.1%	71.8%	27.2%	75.8%	24.1%

Source: HRS core interviews 1998-2012 and exit interviews 2004-2012. EOL: will or trust is present. Estate: positive estate value left behind. Caucasian stands for fraction of non-hispanic white. Female is fraction of females in sample. Age is mean age at death. Siblings and children are mean number alive at time of death. Ever couple is whether decedent was married/partnered over years observed. Education is average number of years of schooling. Ever nursing home whether decedent was living in nursing home over years observed. Cum NH days: cumulative nursing home days over observation period. (I)ADLs refers to average number of functional limitations in the last three months prior to death. Memory issue is reported by proxy respondent about decedent in the final month of life and includes "fair" and "poor". Days in bed is the average number of days decedents spent majority of time in bed in final three months prior to death. Good health is self reported health in last core interview prior to death and includes "excellent" and "good". NHR at exit-1 means the respondent is a nursing home resident in the final interview. NHR means the respondent is a nursing home resident in final three months prior to death. Own home (exit-4) and own home (exit-1) are homeownership rates four and one wave prior to exit interview, respectively. Inter-vivos home transfer is fraction of respondents who transferred home ownership to kids prior to death and house value is not included in estate value. Financial wealth is of last core interview; dollars in terms of year 2010. Probability to leave bequest is self-reported probability four, (exit-4), and one wave, (exit-1), prior to exit interview.

the size of the estate. When comparing nursing-home residency at the time of the individual's final interview (NHR at exit-1) between testators and non-testators there is practically no difference, while the fraction of nursing-home residents in the estate group is notably lower than in the no-estate group.

Another stark difference between the groups is the much higher homeownership rate among the estate group. Among those who eventually leave an estate, a large majority also owns a home four waves prior to the exit interview (about 8 years). The fraction of homeowners decreases in the estate and the no-estate group but remains substantial in the estate group during the last interview prior to death (around 1.5 years). However, among the no-estate group there is a larger fraction of respondents who have transferred homeownership sometime prior to death. Individuals in the no-estate group report little financial wealth in their final core interview with median financial wealth of zero. Finally, the self-reported probabilities of leaving a bequest are in line with the actual occurrence of an estate.

In summary, there are marked differences between bequeathers and non-bequeathers. Leaving an estate is positively correlated with lifetime income (as proxied by education) and homeownership, and negatively with long-term care needs. Whether or not children are in the family is uninformative as to whether an EOL plan is available and about the incidence of an estate. There is some evidence that among those who do not leave an estate a somewhat larger fraction has transferred homeownership prior to death.

2.3 Care arrangements: characteristics and estates

We have shown suggestive evidence that long-term care in a nursing home may have a significant impact on the occurrence and the size of an estate. However, a nursing home can in principle be avoided if care is provided by, for example, family members, or formal caregivers at home. Does informal care help to protect the estate from a spend-down due to uninsured long-term care expenses? Do individuals without end-of-life long-term-care needs leave larger estates?

In Table 4 we group individuals by whether during the last three months of their lives they receive no care, informal care at home (ICH), formal home care (FHC), nursing home care (NHC), a combination of informal and formal care at home (ICH + FHC), or a combination of informal care and nursing home care (IC + NHC). The most obvious observation is that almost all receive care during the last three months of life with only about one-tenth of the sample receiving no care (11%). Care is very commonly provided informally either as the sole source of care at home, in combination with FHC, or in addition to NHC (81%). Exclusive FHC or NHC is fairly uncommon (8%). Care needs, as measured by the number

Table 4: Characteristics and estates by care arrangements

characteristic	all	no care 10.9%	IHC 24.0%	IHC + FHC 20.3%	IC + NHC 37.1%	FHC 2.5%	NHC 5.3%
age	81.8	**74.1**	**78.4**	**83.0**	**85.7**	76.3	83.8
(I)ADLs	6.8	**0.2**	**5.9**	**8.0**	**8.8**	5.3	7.3
memory issue	46.5%	**11.1**%	**38.3**%	**42.9**%	**63.6**%	33.5%	56.9%
total care hours	338	**0**	**250**	**430**	**448**	230	375
days in bed	36	4	29	42	45	33	44
NH days before dth	216	0	0	0	541	0	690
cmltv NH days	412	10	6	60	920	122	1,046
caucasian	81.1%	79.8%	78.0%	77.9%	87.4%	72.1%	70.0%
female	70.1%	49.6%	68.7%	72.5%	76.4%	72.1%	64.5%
children	2.9	2.5	3.4	3.1	2.8	2.5	2.2
childless	12.2%	17.0%	**6.7**%	8.6%	13.5%	**24.5**%	**26.9**%
daughters	1.9	1.6	2.1	1.9	1.7	1.8	1.7
siblings	1.8	2.2	2.0	1.7	1.5	1.5	1.5
education	11.2	12.0	11.0	11.3	11.1	11.3	10.3
kid co-residing	20.7%	13.5%	**39.5**%	**32.0**%	6.9%	13.9%	6.7%
kid age	52.8	46.6	49.6	53.1	56.4	50.5	54.3
kid education	13.4	13.5	**12.9**	13.6	13.6	12.2	13.1
kid ft work	33.7	52.2%	33.0%	31.7%	29.2%	39.0%	40.8%
EOL plan	63.2%	60.9%	59.3%	66.5%	**68.8**%	42.5%	**43.0**%
any bequest	62.0%	67.7%	63.4%	70.0%	**59.4**%	54.4%	**35.1**%
mean estate	128.0K	157.7K	124.5K	163.7K	116.0K	82.0K	50.7K
25th pct estate	0.0K	0.0K	0.0K	0.0K	0.0K	0.0K	0.0K
50th pct estate	10.8K	42.0K	18.4K	**50.0K**	1.9K	1.1K	0.0K
75th pct estate	156.4K	220.0K	171.8K	231.2K	115.5K	28.8K	3.0K
90th pct estate	434.5K	500.0K	372.2K	521.3K	417.0K	381.8K	200.5K

Source: HRS exit interviews 2004-2012. Respondents receiving care from various sources during last three months of life: IHC is informal care at home, FHC is formal home care, and NHC is nursing home care. IHC + FHC is both informal care at home and formal home care. IC + NHC is both informal care at nursing home and nursing home care. *Age* is mean age at death. *(I)ADLs* refers to average number of functional limitations in last three months prior to death. *Memory issue* reported by proxy respondent about decedent for final month of life and includes "fair" and "poor". *Total care hours* are average monthly hours of from all sources of care. *Days in bed* is average number of days decedents spent majority of time in bed in final three months prior to death. *NH days before dth* is average number of days respondent resides in nursing home just prior death. *Cumltv NH days* is cumulative number of nursing home days over observation period. *Caucasian* is fraction of non-hispanic white. *Female* is fraction of females in sample. *Children* is mean number alive at time of death. *Daughters* is average number of daughters among children. *Siblings* is mean number alive at time of death. *Education* is average number of years of schooling. *Kid age* is average over variable "average age of kids in family". *Kid education* is average over variable "average school years of kids in family". *Ft work* is fraction for which all children are full-time employed. *Kid co-residing* is fraction of respondents who co-reside with at least one child. *EOL plan* is whether will or trust present. *Any Bequest* is whether positive estate is available.

of functional limitations, the existence of memory issues, and the number of days spend the majority of time in bed, positively correlates with age. Higher care needs are associated with increasing reliance on formal sources of care. Nonetheless, the intensity of IHC as shown by the total hours of care is very substantial. Even when receiving IHC and FHC, we find that somewhat more than 50% of the total hours continue to be informally provided (not shown in table), which is in the ballpark of what is provided informally to those who receive exclusively IHC. Only in the case of IHC and NHC is care provided primarily by nurses.

The second part of the table highlights some respondent and child characteristics. Males are overrepresented among the no-care group. The percentage of females increases as they tend to outlive their male counterparts. Those who obtain more informal care tend to have more children and fewer are childless. Childlessness is particularly striking among those who exclusively receive FHC or NHC, indicating that children are an important source of informal care. Co-residency of parent and child is much more common when IHC takes place which is unsurprising given how much hours of care is provided. When the only source of care is IHC, the average level of education among children is lower than for children of respondents who receive combined care.

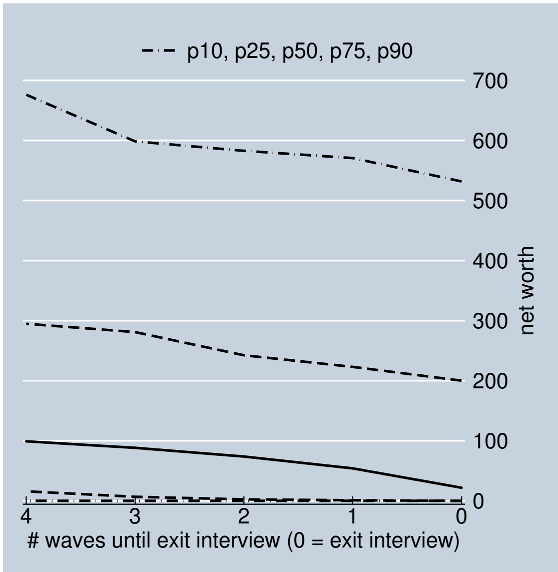
The last part of the table provides some features about the estate. When care stems solely from NHC, a written will or trust is substantially less common, as is the incidence of an estate, and the size of the estate is lower than for nursing-home residents who also obtain informal care. Those who receive care at home from both informal and formal sources leave the highest estate and most commonly leave any estate. This suggests that care provided at home can be effective in protecting the estate from a spend-down on nursing home expenses but does require a substantial amount of time provided by a child. Individuals who receive no care also leave a sizable estate. It is important to take into account, however, that individuals in this group are also substantially younger than the overall sample and so the size of the estate might simply be a reflection of this shorter lifespan.

2.4 Saving behavior

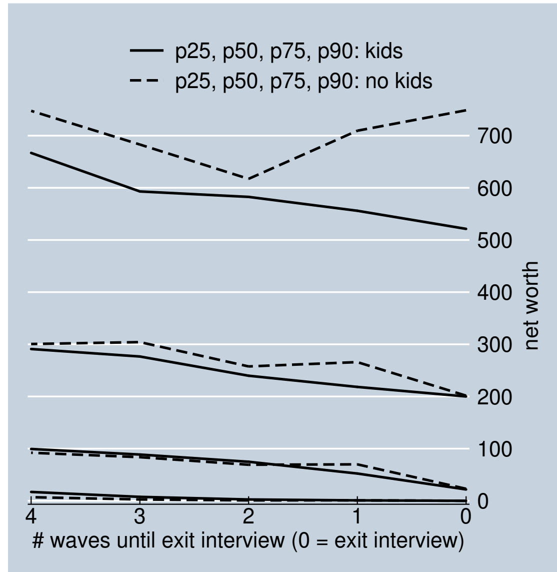
We now consider how wealth changes over time for groups of people who differ along pertinent dimensions such as having children, owning a home, and residing in a nursing home, in order to provide a rudimentary picture of savings behavior over the final years of life.

Figure 2 shows wealth trajectories in terms of percentiles for all members of the sample and separately for persons with and without children. The 10th and the 25th percentiles have essentially no net worth during the observation period (about 8 years) while the median percentile displays a strong decrease from about $100K four waves prior to the exit interview

Figure 2: Wealth trajectories



(a) All



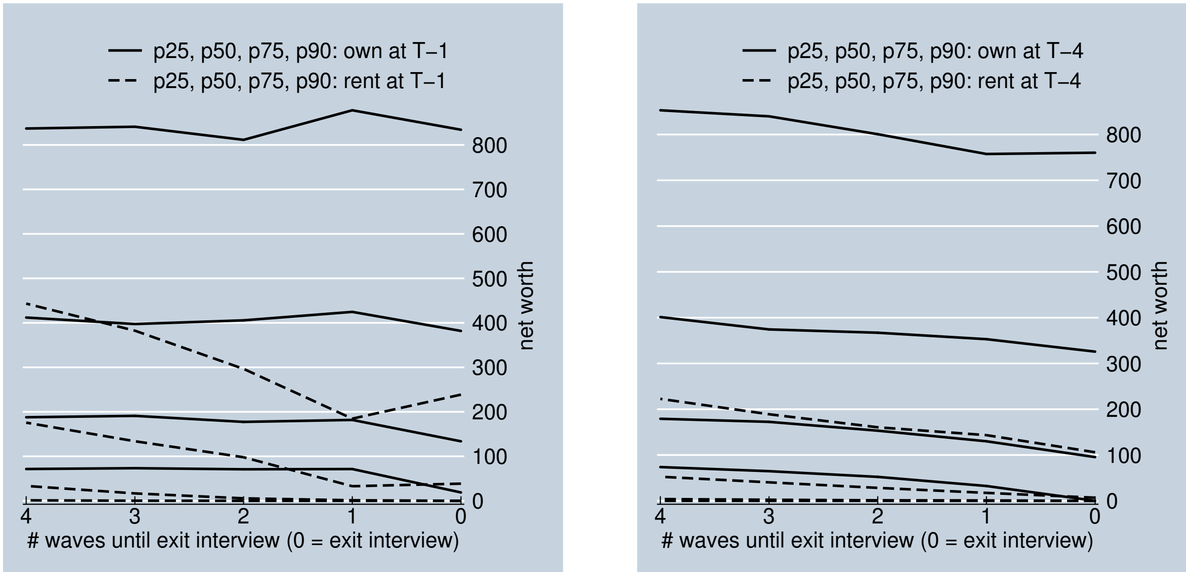
(b) With and without kids

Source: HRS core interviews 1998-2012 and exit interviews 2004-2012. Wealth percentiles 10, 20, 50, 75 and 90 at 4, 3, 2, and 1 interview-waves prior to the exit interview (= 0). Part (a) is for the entire widow(er)/single sample and part (b) differentiates between those with and without children throughout the observation period. Dollar values in terms of year 2010.

to the median estate value of $11K. Above the median, net worth is relatively high and exhibits a slower rate of dissaving. When separating the sample by childlessness, essentially the same dissavings pattern emerges. In terms of levels the differences are also underwhelming, the most that can be said is that childless individuals have somewhat less wealth, especially below the 75th percentile. The fact that childless individuals are also less often coupled during the observation period means that they are actually wealth-richer on a per person basis. Interpreting the evidence here without a model would suggest that observed saving behavior is strongly at odds with the importance of an altruistic bequest motive. Yet there is no reason to believe that these two groups shared savings behavior is driven by the same underlying motives. Perhaps the existence of children influences other savings motives which are counteracting the force of an altruistic motive. For example, children may weaken the precautionary savings motive as they provide a margin of insurance which is unavailable to childless individuals (e.g. care, financial support).

Figure 3 shows wealth trajectories depending on whether a respondent owns or rents his home. In part (a) the own/rent status is measured at the time of the last core interview prior to the exit interview, and in part (b) in the interview four waves prior to the exit interview. The most striking difference is that renters are substantially poorer than homeowners – the median renter has practically no wealth at any point in time. Those who are still

Figure 3: Wealth trajectories by homeownership



(a) Own or rent in last wave prior exit

(b) Own or rent in four waves prior exit

Source: HRS core interviews 1998-2012 and exit interviews 2004-2012. Wealth percentiles 10, 20, 50, 75 and 90 at 4, 3, 2, and 1 interview-waves prior to the exit interview (= 0). Owning or renting is conditioned on (a) last core interview prior to death and on (b) four waves prior to death. Dollar values in terms of year 2010.

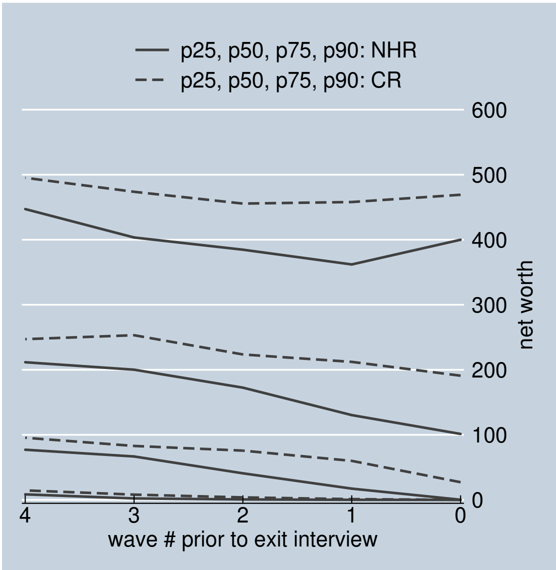
homeowners in the last wave have a flat wealth profile while renters' wealth profile decreases fairly rapidly. When conditioning on homeownership four waves before the exit interview, the wealth profile decreases also for those who own a home in that wave. This suggests that for some of these homeowners a situation arises in which there are high expenditures (divorce, medical expenses, widowhood, etc.) or that they transfer the ownership of their home to a child or relative. If they were to simply switch from owning to renting, without an increase in expenditure or transfer in homeownership, we would expect their net-worth profile to remain flat.

Finally, Figure 4 shows wealth profiles when conditioning on an individual's residency status (nursing home or in the community) at different points in time. The most obvious observation is that nursing home residents are wealth-poorer than community residents at any point in time, and have a faster spend-down of wealth, in particular, for individuals who reside in a nursing home at the time of the final interview.

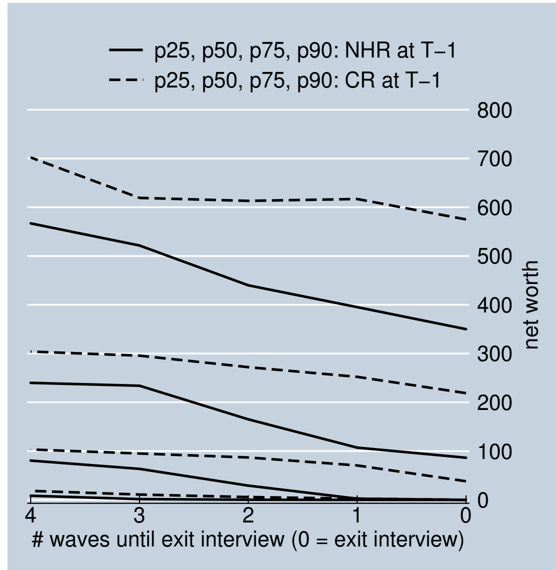
2.5 Bequests and the receipt of informal care

We turn now to a multivariate regression framework to examine the relationship between bequest-leaving and the receipt of informal care from adult children. Table 5 presents these

Figure 4: Wealth over time by nursing home status



(a) NHR or CR in last three months of life



(b) NHR or CR at time of final interview

Source: HRS core interviews 1998-2012 and exit interviews 2004-2012. Wealth percentiles 10, 20, 50, 75 and 90 at 4, 3, 2, and 1 interview-waves prior to the exit interview (= 0). NHR means nursing home resident and CR stands for community resident. In part (a), nursing home status is from exit interview with respect to the last three months of life, and in part (b) with respect to the last core interview. Dollar values in terms of year 2010.

results. The dependent variables in columns (1)-(3) are, respectively, the inverse hyperbolic sine of the estate value, an indicator variable for whether any bequest was left or not, and the natural log of the estate value. Hence, column (1) combines the extensive and intensive margins of bequest-leaving, which are then separated in columns (2) and (3). All three specifications are estimated with OLS.

The coefficients of interest in Table 5 are on the variables measuring hours of long-term care, both overall hours and hours of care received from adult children (shown in the first two rows). The HRS asks survey respondents to report the number of hours of help with the activities of daily living (ADLs), such as eating or bathing, and instrumental ADLs, such as preparing meals. For each helper, the exit interviews ask for the number of hours provided in a "typical" month while the core interviews ask about hours in the last month. The measures used for this table were computed after cumulating the hours within each interview and averaging across all core and exit interviews. Total hours includes hours from all sources while child care hours includes care from adult children as well as grandchildren and spouses/partners of children and grandchildren.[6]

[6]We imputed missing hours at the helper level except for nursing home helpers whose hours are not recorded in the survey. For HRS respondents who were nursing home residents, we separately imputed total hours at the individual level. Details are available upon request.

Table 5: Partial correlations

	(1) Estate Value (inv hyp sine)	(2) Any Estate (0/1)	(3) Estate Value (log)
Avg LTC hours (all IWs)	-0.00780***	-0.000502***	-0.00116**
	(0.00115)	(0.0000935)	(0.000499)
Avg Child LTC hours (all IWs)	0.00686***	0.000525***	0.00239***
	(0.00189)	(0.000150)	(0.000789)
Non-hispanic white	1.352***	0.136***	0.0945
	(0.265)	(0.0225)	(0.121)
Female	0.151	0.0268	-0.0211
	(0.233)	(0.0186)	(0.0896)
Age	0.365***	0.0228**	0.0531
	(0.123)	(0.0102)	(0.0628)
Age squared	-0.00170**	-0.000100	-0.000159
	(0.000763)	(0.0000631)	(0.000383)
Education	0.266***	0.0146***	0.0696***
	(0.0377)	(0.00299)	(0.0151)
Ever couple	0.219	0.00853	0.0325
	(0.256)	(0.0197)	(0.0854)
IHS of Avg Income (all IWs)	2.086***	0.150***	0.892***
	(0.293)	(0.0197)	(0.0820)
Has child	0.258	0.0290	-0.0196
	(0.364)	(0.0300)	(0.160)
Number of children	-0.0701	-0.00287	-0.00656
	(0.0499)	(0.00415)	(0.0220)
Constant	-37.24***	-2.430***	-2.481
	(5.449)	(0.434)	(2.761)
N	2959	3018	1665
adj. R^2	0.219	0.172	0.169
Mean of Y	6.765	0.611	11.33

Robust SE in parentheses. * p<.1, ** p<.05, *** p<.01

Age is age at death. Ever couple is equal to 1 if the respondent was ever married or partnered in the core interview data and 0 otherwise. Has child and Number of children refer to the number of living children at the time of death. Total hours and Child hours are the average number of monthly hours of care received in total and from the young generation, respectively, across all available core IWs and the exit IW. Average income is average household income across all core interviews. IHS and inv hyp sine refer to the inverse hyperbolic sine transformation.

We regard average total care hours as a decent summary measure of the degree of disability in the years before death. In all three specifications the coefficient on this variable is negative and significant at the 1% level. These results indicate, unsurprisingly, that individuals in worse health are less likely to leave a bequest and leave smaller bequests conditional on leaving one. For instance, a decedent that required 100 hours of care on average in the last years of life (100 is approximately equal to both the mean and standard deviation of this variable) would be 5.3% less likely to leave a bequest and would leave a bequest .189 log points (around $14,000, relative to the mean) smaller than a decedent who didn't require care. These estimates reflect the large toll that long-term care (and nursing home care, in particular) takes on wealth and bequests, which is evident in the wealth trajectory figures presented above.

The positive (and significant at 1%) coefficients on hours of care from children contrast with the negative association between total care hours and bequests. On both the extensive and intensive margins, an hour of informal care from children almost exactly offsets the negative correlation between total hours of care and the probability of leaving a bequest. (We can only reject that the sum of these two coefficients is zero in the intensive margin results at the 10% level.) One plausible interpretation of these results is that informal care is "protective" of bequests. Children can offset the negative effect of a parent's poor health by intervening and providing "free" informal care to the parent who would otherwise have needed to enter a nursing home. Though we make no claims of a causal interpretation here and other explanations are certainly possible, this association is consistent with the idea that informal care from children is motivated in part by exchange.

The other coefficient estimates in the table are consistent with expectations. Being a higher income, more highly educated, older, non-Hispanic white increases the likelihood and/or the size of bequests. These variables are all either measures or proxies of higher socioeconomic status. Perhaps notably, apart from the connection with informal care, neither having children nor the number of children is associated with different bequest behavior.

2.6 Lessons learned

A credible quantitative model to study bequest motives should allow to differentiate between housing and financial wealth, between family-provided care and care received in nursing homes, and should entail altruism from both parents to children as well as from children to parents. Differentiating between housing and financial wealth is important since holding on to a home may in part occur due to a preference for remaining in a familiar environment (attachment to the house as opposed to keeping it for other reasons) and simultaneously anticipating that the home eventually will be bequeathed which is also desirable from the parent's point of view (altruistic motive). The intensity of care needs certainly also contributes to the choice of remaining a homeowner. Differentiating between family-provided care and care received in nursing homes is important for the following reasons. If family-provided care can be provided more cheaply than care in a nursing home, it can be used as a way for children to protect the future estate against a spend-down due to high expenses. Furthermore, since nursing home expenditure are the largest uninsured medical risk in old age, having family-provided care provides an additional source of insurance that influences precautionary savings behavior – having a family provides a buffer in situations where those who are alone have to make use of undesirable Medicaid-financed nursing home care. Finally, family-provided care may be a manifestation of the exchange motive that may account for part of elderlies' desire to withhold resources in order to purchase care and attention. Parental altruism matters insofar that the marginal value of a dollar saved is higher than for an individual without altruism, ceteris paribus.

3 The Model

This section presents a model that encompasses four motives for which bequests may flow: (i) longevity risk, (ii) altruism, (iii) exchange, and (iv) the role of housing as an illiquid asset. Furthermore, we want to capture old-age risks in sufficient detail to have a framework that is quantitatively credible. The strategic interaction between parents and children in saving decisions and the informal-care decision are modeled in a fashion that is similar to our previous papers (BK 2014a, b, 2016). What is new is that we include a model of housing in the style of Nakajima & Telyukova (2016).

3.1 Setup

Time is continuous. We study the interaction of a parent household (indexed by p) and a kid household (indexed by k) in a partial-equilibrium model. The overlap between the parent's and the kid's life span is as depicted in Figure 5. Both household work while they are younger than 65 years old and then retire. The maximum age they can reach is 95. There are no markets to insure against risks. Both agents can save in a safe asset with return $r > 0$ and face a no-borrowing constraint.

State variables. The parent's age is denoted by j. a^i, $i \in \{k, p\}$, denotes the agents' asset positions. ε^i denotes their productivity state, which comes from a finite set $E \equiv \{\varepsilon_1, \dots, \varepsilon_{N_\epsilon}\}$. $s \in \{0, 1\}$ is a discrete disability state of the old household: $s = 1$ denotes

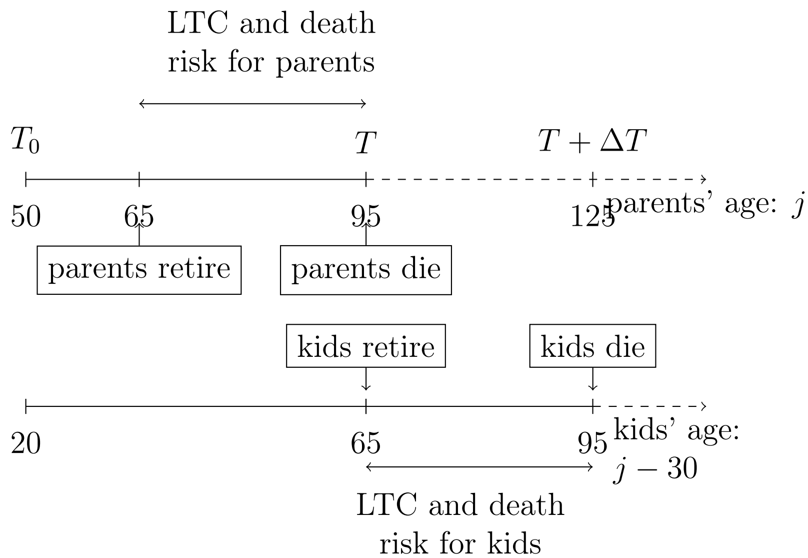


Figure 5: Overlapping-generations structure

disability and a need for long-term care; $s = 0$ denotes the healthy state. 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, the states h_1 to h_{N_h} are house sizes from a discrete grid. While the parent is alive, the family's state is given by the vector $z \equiv (j, a^k, a^p, \varepsilon^k, \varepsilon^p, s, h)$.

Sources of uncertainty. Both agents, $i \in \{k, p\}$, face uncertainty about their labor productivity before entering pension age: ε^i follows a Poisson process with age-independent hazard matrix $\delta_\varepsilon = [\delta_\varepsilon(\varepsilon_i, \varepsilon_j)]$, where entry $\delta_\varepsilon(\varepsilon_i, \varepsilon_j)$ gives the hazard rate of switching from state i to state j. For notational convenience, we define the diagonal elements of the hazard matrix as $\delta_{ii} = -\sum_{j \neq i} \delta_{ij}$, so that all rows of δ sum up to one. 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: $y_{ss}(\epsilon^i)$, where ss stands for social security.

The parent is healthy ($s = 0$) before retirement age. From age 65 on, the parent faces a hazard $\delta_s(j, \epsilon^p)$ of transitioning into the disabled state.[7] Once $s = 1$, the disabled state cannot be left again. In both health states, the parent faces a mortality hazard $\delta_d(j, \varepsilon^p, s)$. When the parent dies, the parent's assets a^p are transferred to the child. There is no estate tax. This is realistic since only 0.2% of households are wealthy enough to pay estate taxes under current rules, see Joint Committee on Taxation (2015). For the child household, we assume that it is subject to the same disability and mortality hazards once it reaches age 65 (where, of course, the hazards depend on the kid's own characteristics).

Out-of-pocket medical expenditures are known to be a severe financial risk that drives

[7]We allow this hazard to depend on ϵ^j to capture that the disability hazards are very different across socioeconomic strata.

the savings decisions of the elderly in the U.S. We thus include this feature in our model. When aged above 65, the parent suffers a *medical event* with hazard $\delta_m(j, \epsilon^p, s)$. Upon such an event occuring, the parent draws a lump-sum cost M from a cdf $F_M(M)$. The child faces the same medical-expenditure risk, the hazard again depending on its own states.

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, $\{c^i\}_{i\in\{k,p\}} \geq 0$, and savings are residually determined from the budget constraint.

Housing. Each parent household is endowed with a house of value $h_{50} \in H$ at age 50, which is drawn from an initial distribution $F_h(h_{50})$. At each moment in time, i.e. for all $j \geq 50$, the parent can then decide to sell the house at price h_{50} and become a renter. We denote this decision by $x \in \{0, 1\}$, where $x = 1$ stands for selling. Houses cannot be bought, only sold. Housing services, $\tilde{h} \in \tilde{H}(h)$, are chosen from a set

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

Renters can freely choose the size of their apartment in each period. The house size h determines housing services for owners, but owners receive an extra benefit from owning: We assume that $\omega > 1$. The flow expenditures for housing are given by the function

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

where $\delta > 0$ is the depreciation rate of housing and r. Owners only have to pay for repairs to their house that keep depreciation at bay. Renters have to pay the rental rate that forms in a perfectly competitive rental market, $r + \delta$. In order to economize on the number of states, we assume that all children have a house of the same size $h^k = \bar{h}$.

Long-term care. When the parent is disabled ($s = 1$), she has to obtain either *informal care* (IC) from the kid or formal care. First, the child decides if to give informal care ($i = 1$) or not ($i = 0$). When giving care, $i = 1$, the kid household gives up a fraction β of labor income, capturing the opportunity costs of the time spent on care in the labor market. If the child decides not to give care, $i = 0$, the parent has to obtain formal-care services. While the parent has positive wealth and/or sufficiently high income, she can pay for these services privately (*private-payer care*, PP). In PP care, the parent has to buy *basic care services* at a price p_{bc}; these encompass the cost of care in a nursing home or at home *excluding* expenses on room and board, amenities of the nursing facility etc. Apart from these care services, the parent also chooses consumption, c^p, which encompasses the other dimensions of spending, such as room and board of different quality.

If the parent is disabled and has no assets nor housing left ($a^p = h = 0$), then she can opt for *Medicaid*. In Medicaid, the government collects the parent's pension income, $y_{ss}(\varepsilon^p)$, and any gifts from the child, g^k, and provides the parent with care and a consumption floor c_f. This captures the means-tested Medicaid program in the U.S., see BK2016 for details.

Preferences. *Flow felicity* of household $i \in \{k, p\}$ is given by

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

Here, $\xi \in (0,1)$ is the housing 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 both time and across states of the world. $n^i = n(j^i)$ is the number of household members, which is a deterministic function of age, and $\phi(n)$ is a household equivalent scale. *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 and where $\alpha^i > 0$ is household's i altruism parameter. Both household discount expected utility at a common rate $\rho > 0$, i.e. household i at t_0 maximizes $\int_{t_0}^{\infty} e^{-\rho t} U^i(t) \mathrm{d}t$.

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

1. A parent chooses whether or not to sell her home, $x \in \{0, 1\}$.
2. the child decides if to give informal care or not, $i \in \{0, 1\}$.
3. parent and child choose gift flows, $g^p, g^k \geq 0$,
4. parent and child choose consumption flows, $c^p, c^k \geq 0$, renters choose housing services x, and parents in formal care decide between MA and a privately-financed care.

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

3.2 Equilibrium definition

We adopt a standard equilibrium definition. Both agents respond optimally to each other in each stage and in each instant of the game. We require subgame perfection, at each node of the game players have to play a Nash equilibrium. Since the horizon is finite, this implies that players will only condition on the payoff-relevant state and equilibrium strategies are Markovian, as is well-known. This allows us to use Hamiltonian-Jacobi-Bellman Equations to characterize the solution to the game, which we do in the following.

3.3 Solving the Δt-game

We will now solve the instantaneous game by backward induction over the four stages of the game. If the parent is not disabled, the game simplifies. The appendix discusses the case when a parent dies and when a child lives alone; we also give more details on long-term care and medical expenses.

Stage 4 We will first introduce an indirect felicity function to facilitate the exposition. Denote by e the expenditure flow on housing and other consumption jointly. Given a fixed e, the split between expenditure on the consumption good and housing services is determined from the problem

$$\begin{aligned}\tilde{u}(e;h) = \max_{c\geq 0,\tilde{h}\in\tilde{H}(h)} & \left\{c^{\xi}\tilde{h}^{1-\xi}\right\} \\ \text{s.t.} \quad & c + E_h(x;\tilde{h}) \leq e.\end{aligned}$$

Appendix C.1 derives the functional form of $\tilde{u}$. Expenditures e are chosen given stage-4 income:

$$y^4 = \begin{bmatrix} y^{4,p} \\ y^{4,k} \end{bmatrix} = \begin{bmatrix} y^p + g^k - g^p - s(1-i)p_{bc} \\ (1-i\beta)y^k + g^p - g^k \end{bmatrix},$$

where $i = 1$ if informal care takes place. Now, denote by $V^{j,1}$ the stage-1 value function of household j inherited from the previous iteration. The stage-4 Hamiltonian is given by

$$\begin{aligned} H^{4,j}(\cdot, y^4; V^j_a) = \max_{f_j\in\{0,1\},e^j} & \left\{f_j u(c_f) + (1-f_j)\left[\tilde{u}(e^j;n,h) + \dot{a}^j V^{1,j}_{a^j}\right]\right\} + \\ & +\alpha^j \tilde{u}(e^{-j};n,h) + \dot{a}^{-j} V^{1,j}_{a^{-j}} \\ \text{s.t.} \quad \dot{a}^j =& (1-f_j)\left(ra^j + y^{4,j} - e^j\right) \\ \dot{a}^{-j} =& (1-f_{-j})\left(ra^{-j} + y^{4,-j} - e^{-j}\right) \end{aligned}$$

where $f_j = 1$ means that agent j opts for the government consumption floor (in which case all assets have to be handed in). Note that medical expenditures are absent since we do not model them as a flow expenditure but instead as a lump-sum cost that has to be paid instantaneously.

As has been discussed in our previous work, the determination of expenditure is straightforward despite the fact that game-theoretic considerations are present. The FOC which determines optimal expenditure is given by

$$\tilde{u}_e(e^j; n, h) \geq V^{j,1}_{a^j} \quad \text{with equality if unconstrained,} \tag{1}$$

where $\tilde{u}$ is given by Equation (2). The appendix gives the solution for optimal expenditure resulting from this FOC; the solution has the familiar characteristics from consumption-savings problems.

Stage 3 In the third stage, parents and kids choose inter-vivos transfers given stage-3 income

$$y^3 = \begin{bmatrix} y^{3,p} \\ y^{3,k} \end{bmatrix} = \begin{bmatrix} y^p - s(1 - ip_{bc}) \\ (1 - i\beta)y^k \end{bmatrix}.$$

In line with the gift-giving game in Barczyk and Kredler (2014b), we find that in equilibrium gifts only flow when the recipient is constrained. Like this, the donor keeps the recipient's consumption spending in check. When giving gifts, the donor implements her preferred consumption rate c^{-j} according to FOC

$$\alpha^j u_c(c^{-j}, \cdot) = u_c(c^j, \cdot).$$

Appendix C.2 gives the details on the optimal gift choices.

Stage 2 In the second stage the kid decides whether to provide informal care for her parent in need of care. If the kid provides care, the parent will neither have to pay for care privately nor will she have to rely on Medicaid. On the other hand, providing care incurs the opportunity cost of a fraction β of kids' household income. This choice boils down to the following comparison

$$i = \mathbb{I}\{V^{1,k}_{a^p} q > V^{1,k}_{a^k} \beta y^k\} \quad \text{or} \quad i = \mathbb{I}\{\alpha^k u(c^p_f) > V^{1,k}_{a^k} \beta y^k\}$$

The kid uses the marginal value of saving with respect to the parent's wealth to value the cost for care in a nursing home. This constitutes the marginal benefit of providing care to the child (protecting parent's assets). The marginal cost is given by forgone labor earnings which the kid values by her marginal value of saving. For the situation in which the parent will choose Medicaid in the next stage, the child compares the parent's marginal utility of consumption when being provided with a consumption floor with the opportunity cost of not working.

At this point we have determined optimal choices with respect to consumption, housing services, transfers, as well as care arrangements for families in which parent households are sick. All of these are flow decisions (i.e. choices with respect to flow variables) and are contained in the following Hamiltonian function

$$H^{2,j}(t,h,s,y,a;V^{1,j}_{a^j},V^{1,j}_{a^{-j}}) \equiv \max_{c,x,g,i}\left\{u(c,x;s,h)+\alpha^j u(c,x;s,h)+\dot{a}_j V^{1,j}_{a_j}+\dot{a}_{-j}V^{1,j}_{a^{-j}}\right\},$$

$$\begin{aligned} &\text{s.t.}\\ \dot{a}^j_t &= ra^j_t + y^j_t + g^{-j}_t - g^j_t - c^j_t - e(x^j_t) - i^j_t\\ \dot{a}^{-j}_t &= \quad \dots \end{aligned}$$

The stage-2 value function satisfies the following HJB

$$\begin{aligned} -V^{2,j}_t + \rho V^{2,j} = {} & H^{2,j}(t,h,s,y,a;V^{1,j}_{a^j},V^{1,j}_{a^{-j}}) + \underbrace{\sum_{s'\in S}\theta^s_{ss'}V^{1,j}(\cdot,s')}_{\text{shock to health}} + \underbrace{\sum_{y'\in Y}\theta^y_{yy'}V^{1,j}(\cdot,y')}_{\text{shock to income}} + \\ & +\theta^m_t(s)\underbrace{\int_0^{\bar{m}}\left(V^{1,p}(\cdot,[\max\{a^p-m,0\},a^k]) - V^{1,p}(\cdot,[a^p,a^k])\right)dM(m)}_{E[V^{1,p}(\cdot,m)-V^{1,p}|\text{medical event}]} + \\ & + \underbrace{\theta^d(s)[W^j(t,y^k,a^k+T(a^p,h)) - V^{2,j}]}_{\text{death}}, \end{aligned}$$

where W^j is the continuation value of the kid household upon the death of the parent household which is given in the appendix. Note that while the parent is alive this term enters in her HJB as $\alpha^p W^k$ which can be interpreted as a *bequest motive.*

Stage 1 In the first stage of the decision protocol a homeowner decides whether to sell her home. This is done by using the stage-2 value function to compare lifetime utility with and without the home:

$$x = \mathbb{I}\{V^{2,p}(t,0,s,y,[a^p+h,a^k]) > V^{2,p}(t,h,s,y,a)\}.$$

If the home is sold, the household becomes a renter (and can never acquire a home again), $h=0$, and has additional liquid wealth equal to the value of the home h. The value function for a homeowner becomes

$$V^{1,p} = xV^{2,p}(t,0,s,y,[a^p+h,a^k]) + (1-x)V^{2,p}(t,h,s,y,a).$$

3.4 Equilibrium dynamics

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

Once entering retirement, parents start to dissave. However, they do so at a slow pace while healthy. They maintain a buffer stock of savings for both precautionary reasons and to leave a bequest. Once the disability shock or a large medical-expenditure shocks hit, the parent may receive transfers from the child in terms of money or time (informal care) or opt for government-provided Medicaid care. When hit by the disability shock, the model predicts that parents often sell their house in order to have liquid wealth available and pay for nursing-home and medical expenses. This is less often the case, however, when the child provides informal care.

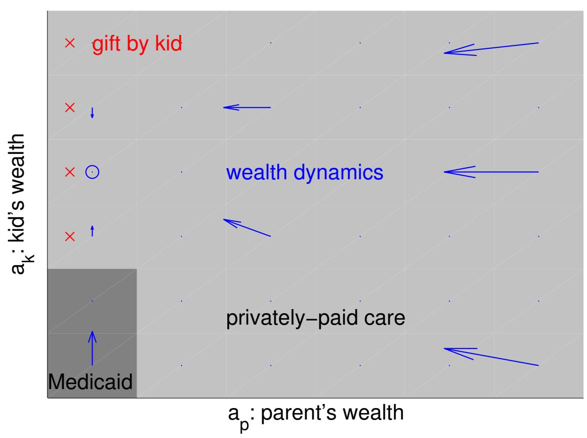


Figure 6: Equlibrium dynamics: Disabled parent with high-wage kid

We now discuss the dynamics in the long-term-care situation, which are of special importance. Figure 6 depicts the situation of a family with a disabled parent and a child with high labor productivity. The figure shows, for each level of parent's and child's wealth, which care arrangement occurs (indicated by the shading of the areas), what the wealth dynamics are (the arrows), and if transfers flow or not. Since 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 fast on nursing-home care. Once the parent has spent down all wealth, the child gives transfers to the parent which enable the parent to stay in a privately-paid nursing home; these transfers are altruistically motivated. If the child has low wealth too, however, he withholds transfers and the parent is forced to opt for Medicaid-financed care.

Figure 7 shows the analogous graph for family with a low-productivity child. Since the child has low opportunity costs of caregiving, he opts for informal caregiving in most situations. This makes the parent avoid the cost of a nursing home, compensating the child with a larger bequest. In our model, home owners also hold on to their houses longer when given informal care, which is in line with the data. However, the child's caregiving behavior is not motivated solely by the expected bequest. This may be seen from the situation in which the parent spends down all wealth. In this situation, the child still gives informal care in many situations, which is motivated exclusively by altruism. However, once both the parent and the child have low wealth, the child does not give informal care any more and the parent has to opt for either Medicaid or privately-paid care.

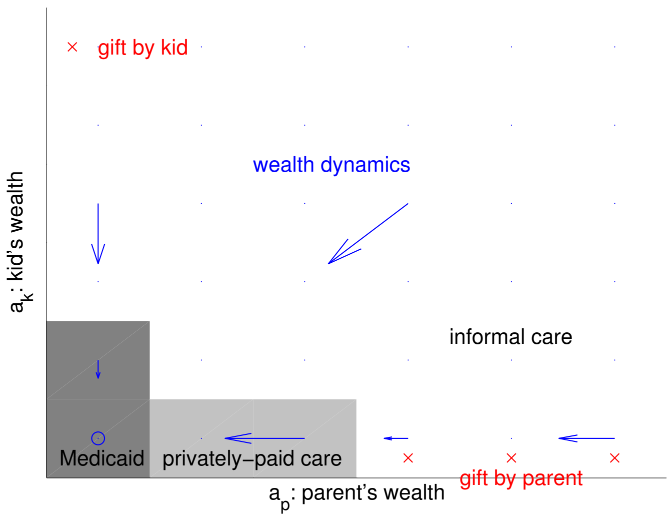


Figure 7: Equlibrium dynamics: Disabled parent with low-wage kid

4 Calibration

Table 6 shows selected parameters of our (still preliminary) calibration. We assume standard values for the real interest rate, the discount rate, and the parameters governing the income process, see the bottom panel of the table. All parameters that are related to altruism and long-term care are taken from Barczyk & Kredler (2017). All housing-related parameters and the process for medical-expenditure shocks are based on Nakajima & Telyukova (2016).

Model fit. Table 7 shows how the calibrated model matches up with the observed distribution of bequests in the data. We see that the model does very well in capturing the fact that about a third of singles do not leave any bequests. However, the model has trouble

Parameter	Value	Description	Source
q	16,750	nursing-home cost	
c_f	1,240	consumption floor	care/altruism-related:
θ^s, θ^d	...	health transitions	Barczyk & Kredler (2017)
α^p	0.090	parent's altruism	($\hat{\alpha}^p = 0.39$)
α^k	0.030	child's altruism	($\hat{\alpha}^k = 0.26$)
γ	2.93	risk aversion/IS	
ξ	0.81	consumption weight	housing-related:
ω	2.52	owning premium	Nakajima & Telyukova (2016)
δ	0.017	house depreciation	
θ_m, F_m	...	medical costs	based on Nakajima & Telyukova (2016)
r	0.020	real interest rate	
ρ	0.040	discount rate	standard
θ_y	...	income process	

Table 6: Calibration parameters

to match the upper tail of the distribution. This indicates to us that more housing categories will be needed (so far we only have one).

Total estates	Model	Data
none	32%	35%
Q50	90K	2K
Q75	158K	120K
Q90	281K	450K

Table 7: Model fit for bequests

The preliminary calibration produces a decent fit for savings behavior in old age. The top panel of Figure 8 shows the homeownership rates in the model are not too far from the data, although they decrease somewhat too fast. In the bottom panel, we see that also dissaving in liquid savings occurs somewhat too fast for the wealthy elderly.

Finally, Table 8 shows that the current calibration has trouble to capture the care arrangements that are observed in the data. The model understates by about half the number

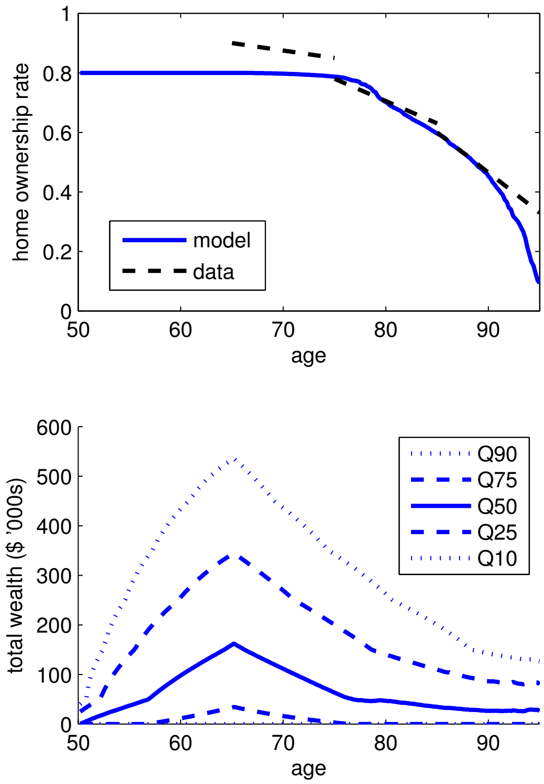


Figure 8: Home-ownership and assets over the life cycle

of people who receive informal care when they die. Also, the number of Medicaid recipients is way too low in the calibration. Barczyk & Kredler (2017) report in their Table 8 that among the disabled who receive formal care, about 55% receive Medicaid-financed care and only about 45% pay privately. However, in the calibration here private payers outnumber Medicaid recipients at death hugely. This tells us that the consumption floor c_f in Medicaid has to be increased when bringing it into the preferences from Nakajima & Telyukova (2016), which have more curvature than those used by Barczyk & Kredler (2017).

Type of care	Model	Data
informal	23%	40%
private	69%	
Medicaid	8%	

Table 8: Care arrangement at death

5 Counterfactual experiments

In order to find out which motives matter most for bequests, we study the following counterfactuals:

1. **No altruism**: Set $\alpha^p = 0$ (or $\alpha^k = 0$).

2. **No medical-expense risk**: Individuals are given free access to care ($p_{bc} = 0$); this is financed by a constant insurance premium paid by all retirees.

3. **No informal care**: We remove the possibility of informal caregiving, i.e. we set $i = 0$ $\Rightarrow$ for all families. exchange

4. **No LTC risk**: Households pay a constant insurance premium and get their nursing home paid.

5. **Liquid housing**: We make everybody rent and give home owners their initial housing wealth in cash.

6. **No longevity risk**: We set $\delta^d = 0$ and set the time of death to life expectancy.

Table 9 shows the results from these counterfactuals. Wee see that in the scenarios with a certain lifespan and with liquid housing, almost one fifth of the population ceases to leave bequests. Also the 50th and 75th percentile of the bequest distribution decrease substantially. When viewed in isolation, two other motives that are often mentioned in the literature seem to matter less: parental altruism and exchange. Shutting down the parent's altruism and removing the possibility of exchange relatively weak effects on bequests. We thus conclude that longevity risk and the illiquidity of housing are the most important bequest motives when seen in isolation.

It is also interesting what occurs when old-age risks are shut down. Removing LTC risk decreases the need for precautionary savings, leading to a large reduction in bequests, especially among the rich. This effect is also present, for the scenario (non-LTC) medical-expenditure risk is shut down. However, the effects are a lot weaker in the latter case. This is due to the fact that nursing-home expenditures are a lot larger than other medical expenditures, which are relatively well-insured by Medicare.

Interestingly, shutting down the child's altruism has effects that are a lot larger than shutting down the parent's altruism (in absolute value). This is remarkable, since it is the *parent's* altruism that has been in the center of attention of the literature on bequests. In our model, however, having an altruistic child provides an important safety net. Children

Scenario	% no bequest	Q50 beq. (K$)	Q75 beq.	Q90 beq.	% house beq.	% i at death
Data	35	2	120	450	36	40
Baseline	32	90	158	281	45	23
$\alpha^p = 0$	+1	-2	-5		-1	
$\alpha^k = 0$	-17	**+42**	+82		+11	-12
no med.	-2	+3	+7		-2	+1
no LTC	+9	**-22**	-34		-7	–
no i	-2	+3	+8		+2	–
liq. house	+18	**-72**	-48		–	+0
T certain	+18	**-65**	-83		-33	+16

Table 9: Results from counterfactuals

help parents out in two situations: First, they may give informal care to them when disabled. Second, they give financial transfer to them in times of need. Both kinds of help reduce the parent's need for precautionary savings and thus reduce bequests. We note that this mechanism would not be present in a model in which old-age risks are absent or fully insurable. This shows that it is important to take into account interactions between different bequest motives and other channels. Our contribution here is that the dynamic model puts these interactions on the table and shows that they are quantitatively important.

6 Conclusions

This paper has quantitatively studied the motives that govern bequest behavior. Our preliminary results indicate that there is no single bequest motive. When trying to isolate a single motive, longevity risk and illiquid housing seem to be the most important factors to be taken into account. However, there are important interactions between the different motives: altruism and an the opportunity to exchange care against bequests may actually decrease observed bequests because they provide the elderly with better insurance against risks and thus lower their need for precautionary savings. Finally, strategic interactions in our model can rationalize that most old-age transfers flow as bequests and not as inter-vivos transfers.

A limitation of this paper is that it does not provide a good model for the bequest motives for the richest 1-2% of Americans. To capture the behavior of these individuals, who are often entrepreneurs, it may be necessary to include an empire-building motive into the model, i.e. a taste for maintaining the family company on top of the corporate ladder or to ensure that the family keeps its status among the wealthy. Such a synthesis of models may be necessary especially when studying estate taxation since the super-rich are paying the lion's share of estate taxes in most countries.

References

Ameriks, J., Caplin, A., Laufer, S. & Nieuwerburgh, S. V. (2011), 'The joy of giving or assisted living', *Journal of Finance* **66 (2)**, 519:561.

Barczyk, D. (2016), 'Ricardian equivalence revisited: Deficits, gifts, and bequests', *Journal of Economic Dynamics and Control* (63), 1–24.

Barczyk, D. & Kredler, M. (2014*a*), 'Altruistically-motivated transfers under uncertainty', *Quantitative Economics* **5**, 705–749.

Barczyk, D. & Kredler, M. (2014*b*), 'A dynamic model of altruistically-motivated transfers', *Review of Economic Dynamics* **17**(2), 303–328.

Barczyk, D. & Kredler, M. (2017), 'Evaluating long-term-care policy options, taking the family seriously*', *The Review of Economic Studies* p. rdx036.
URL: *+ http://dx.doi.org/10.1093/restud/rdx036*

Brown, M. (2007), 'End-of-life transfers and the decision to care for a parent', *University of Wisconsin-Madison, Mimeo* .

Clauset, A., Shalizi, C. R. & Newman, M. E. (2009), 'Power-law distributions in empirical data', *SIAM review* **51**(4), 661–703.

De Nardi, M. (2004), 'Wealth inequality and intergenerational links', *The Review of Economic Studies* **71**(3), 743–768.
URL: *+ http://dx.doi.org/10.1111/j.1467-937X.2004.00302.x*

De Nardi, M., French, E. & Jones, J. B. (2016), 'Savings after retirement: a survey', *Annual Review of Economics* **8**, 177–204.

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

DeNardi, M., French, E. & Jones, J. B. (2013), 'Medicaid insurance in old age', *NBER Working Paper (No. 19151)* .

Dynan, K. E., Skinner, J. & Zeldes, S. P. (2004), 'Do the rich save more?', *Journal of political economy* **112**(2), 397–444.

Fahle, S. (2015), 'Informal care, actual bequests, and housing assets', *Working paper* .

Francesconi, M., Pollak, R. A. & Tabasso, D. (2015), 'Unequal bequests', *Working paper* .

Gale, W. G. & Scholz, J. K. (1994), 'Intergenerational transfers and the accumulation of wealth', *Journal of Economic Perspectives* **8**(145-160).

Groneck, M. (2016), 'Bequests and informal long-term care: Evidence from hrs exit interviews', *Journal of Human Resources* .

Hurd, M. D., Meijer, E., Moldoff, M. B. & Rohwedder, S. (2016), 'Improved wealth measures in the health and retirement study: asset reconciliation and cross-wave imputation'.

Joint Committee on Taxation (2015), 'History, present law, and analysis of the federal wealth transfer tax system'.

Klass, O. S., Biham, O., Levy, M., Malcai, O. & Solomon, S. (2006), 'The forbes 400 and the pareto wealth distribution', *Economics Letters* **90**(2), 290–295.

Kopczuk, W. (2007), 'Bequest and tax planning: Evidence from estate tax returns', *The Quarterly Journal of Economics* **122**(4), 1801–1854.

Kopczuk, W. (2013), 'Taxation of transfers and wealth', *Handbook of Public Economics* **5**.

Kopczuk, W. & Lupton, J. P. (2007), 'To leave or not to leave: The distribution of bequest motives', *The Review of Economic Studies* **74**(1), 207–235.

Kopecky, K. A. & Koreshkova, T. (2014), 'The impact of medical and nursing home expenses on savings', *American Economic Journal: Macroeconomics* **6**, 29–72.

Kotlikoff, L. J. & Summers, L. H. (1981), 'The role of intergenerational transfers in aggregate capital accumulation', *Journal of Political Economy* **89**(4), 706–732.

Laitner, J. & Ohlsson, H. (2001), 'Bequest motives: a comparison of sweden and the united states', *Journal of Public Economics* **79**(1), 205–236.

Lockwood, L. M. (2012), 'Bequest motives and the annuity puzzle', *Review of economic dynamics* **15**(2), 226–243.

Lockwood, L. M. (2017), 'Incidental bequests: Bequest motives and the choice to self-insure late-life risks', *Working paper* .

Love, D. A., Palumbo, M. G. & Smith, P. A. (2009), 'The trajectory of wealth in retirement', *Journal of Public Economics* **93**(1), 191–208.

McGarry, K. (1999), 'Inter vivos transfers and intended bequests', *Journal of Public Economics* **73**(3), 321–351.

Modigliani, F. (1988), 'The role of intergenerational transfers and life cycle saving in the accumulation of wealth', *The Journal of Economic Perspectives* **2**(2), 15–40.

Nakajima, M. & Telyukova, I. A. (2016), 'Reverse mortgage loans: A quantitative analysis', *The Journal of Finance* .

Palumbo, M. G. (1999), 'Uncertain medical expenses and precautionary saving near the end of the life cycle', *Review of Economic Studies* **66 (2)**, 395–421.

Venti, S. F. & Wise, D. A. (2004), *Aging and Housing Equity: Another Look: in D.A. Wise, ed., Perspectives on the Economics of Aging*, University of Chicago Press, Chicago.

Yaari, M. E. (1965), 'Uncertain lifetime, life insurance, and the theory of the consumer', *The Review of Economic Studies* **32**(2), 137–150.
URL: *http://www.jstor.org/stable/2296058*

A Power-law distribution estimation

The density of the Pareto distribution is given by:

$$\mathbb{P}\left(X = x\right) = \frac{\alpha}{x_{min}}\left(\frac{x}{x_{min}}\right)^{-\alpha}$$

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. That is, 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:

$$\mathbb{P}\left(X \geq x\right) \quad = \quad \int_{x}^{\infty} p\left(X\right) dX = \left(\frac{x}{x_{min}}\right)^{-\alpha+1}$$

Taking logs reveals the linear relationship we see in Figure 9 between the log anti-CDF and the log of the data:

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

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:

$$D = \max_{x \geq x_{min}} \left|S(x) - P(x)\right|$$

where $S(x)$ is the empirical CDF and $P(x)$ is a Pareto CDF with α equal to the ML estimator. The bottom left panel of Figure 9 shows how D varies with x_{min}. The bottom right panel 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 $\widehat{x_{min}}$.

B Details of the estate value imputation procedure

In this section, we first document the extent and varieties of missing data in our sample. We then describe the imputation procedure in detail. Finally, we discuss an added wrinkle to our imputation procedure which concerns whether the reported estate value includes (and *should* include) the primary residence or not.

Table 10 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.

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. Home ownership 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 11.

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 11. 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.

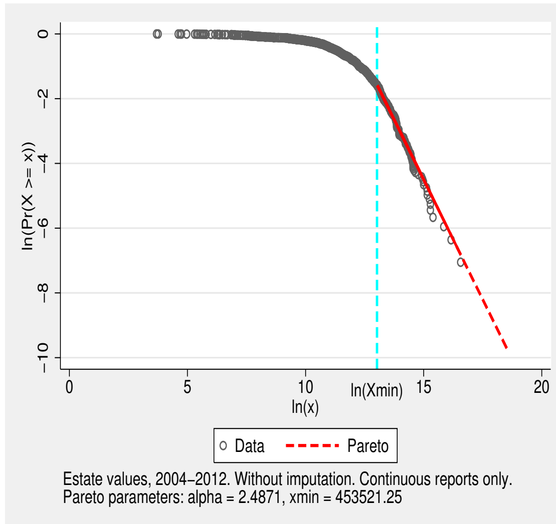
The final step of the main imputation procedure is a nearest neighbor matching assignment of continuous estate values. The data for this step include all individuals who left bequests and whose proxies reported non-missing dollar amounts. The procedure differs depending on whether the observation to 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 11. 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 fact is immaterial.

Apart from the main imputation procedure, one additional step that is unique to our imputation procedure requires mention. 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 (33 in our final sample) 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.

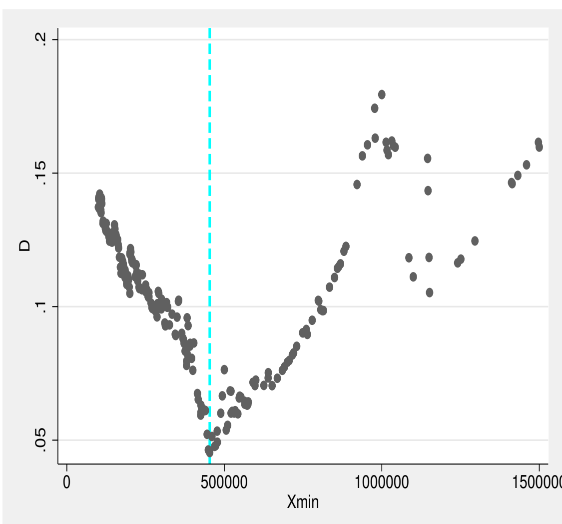
To remedy this issue, we took the value of the primary residence from the most recent non-missing core interview data and added it to the estate value. (Although data on home values are recorded in the exit interview, the core interview housing value data have been more carefully vetted.) For individuals 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.[8] Given that relatively few observations were affected, we did not see much value in deviating from RAND's well-established procedure.

[8]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.

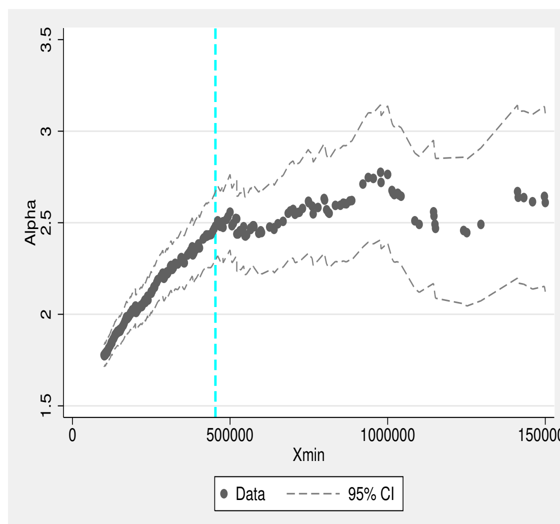
Figure 9: The Pareto tail of the estate value distribution



(a) Pareto tail



(b) With and without kids



(c) With and without kids

Top: This panel duplicates Figure . The gray circles represent data on reported estate values from the 2004-2012 exit interviews 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 $\alpha = 2.481711440718236$ and $x_{min} = 453521.25$. 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. *Bottom left:* 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. *Bottom right:* This figure plots the ML estimates for α at each possible value of x_{min}.

Table 10: Types and frequencies of estate value reports

	N	Percent
No asset	1,168	38.68
Continuous report	1,096	36.29
Complete brackets, closed	280	9.27
Incomplete brackets, closed	45	1.49
Incomplete brackets, open top	180	5.96
No bracket information	235	7.78
Don't know ownership	16	0.53
N	3020	

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.

C Theory appendix

C.1 Indirect utility functions and optimal expenditure choice (Stage 4)

The FOCs for a renter with respect to consumption and home size yield

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

i.e. the renter spends a fixed fraction ξ of his budget on consumption regardless of what the relative price is. 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

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

where we multiply the expression by ξ/ξ.

Upon substituting optimal expenditure we obtain the indirect felicity function

$$\tilde{u}(e;n,h) = \begin{cases} A(n,0)\frac{e^{1-\gamma}}{1-\gamma} & \text{if } h=0 \text{ (renter)}, \\ A(n,h)\frac{\tilde{e}^{\xi(1-\gamma)}}{\xi(1-\gamma)} & \text{if } h>0 \text{ (owner)}, \end{cases} \tag{2}$$

Table 11: Imputation models

	(1) Any Estate	(2) Bracket	(3) IHS(Value)
Net Worth IHS (most recent)	0.0786***	0.156***	0.213***
	(0.00961)	(0.0174)	(0.0219)
Female	0.254**	-0.0440	-0.130
	(0.105)	(0.108)	(0.186)
HS Educ or GED	0.250**	0.242*	0.411*
	(0.109)	(0.127)	(0.217)
Some College	0.260*	0.435***	0.631**
	(0.142)	(0.147)	(0.253)
College+	0.690***	0.986***	0.865***
	(0.199)	(0.173)	(0.288)
Age (exit)	0.0754	0.00796	0.225*
	(0.0564)	(0.0710)	(0.127)
Age Squared	-0.000290	0.000154	-0.00117
	(0.000352)	(0.000437)	(0.000778)
Non-white	-0.405***	0.0377	0.247
	(0.110)	(0.152)	(0.263)
Owned Home 0/1 (preload)	0.756***	0.802***	1.174***
	(0.113)	(0.117)	(0.196)
Medicaid Coverage (most recent)	-0.904***	-1.046***	-1.589***
	(0.0991)	(0.138)	(0.226)
Intended Bequest 10k+ (most recent)	0.00545***	0.00338**	0.00411
	(0.00134)	(0.00152)	(0.00263)
Intended Bequest 100k+ (most recent)	0.00870***	0.0166***	0.00894***
	(0.00178)	(0.00156)	(0.00253)
N	3146	1467	1161
R^2			0.366
adj. R^2			0.357
pseudo R^2	0.287	0.178	

Standard errors in parentheses. * p<.1, ** p<.05, *** p<.01

Specifications also include the full set of interview wave indicator variables. 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. Home ownership is from the preloaded information for the exit interview.

where the felicity shifter $A(\cdot)$ is defined above. Note that owners' indirect felicity has a different curvature in expenditure e than renters'. The coefficients of relative risk aversion with respect to expenditure, which we denote by $\theta(h)$, is given by

$$\theta(h) = \begin{cases} \theta^r \equiv \gamma & \text{if } h = 0 \text{ (renter)}, \\ \theta^h \equiv 1 + \xi(\gamma - 1) & \text{if } h > 0 \text{ (owner)}. \end{cases}$$

For a renter, the coefficient of relative risk aversion of the indirect felicity function is the same as the one with respect to the Cobb-Douglas aggregate, namely γ. Comparing the size of the coefficient of relative risk aversion for owners to renters we can see that

$$\begin{cases} \theta^h < \theta^r & \text{if} \quad \gamma > 1, \\ \theta^h = \theta^r & \text{if} \quad \gamma = 1, \\ \theta^h > \theta^r & \text{if} \quad \gamma < 1. \end{cases}$$

Thus, for the relevant case of $\gamma > 1$ renters coefficient of relative risk aversion of the indirect utility function exceeds those of owners. This is despite the fact that the Cobb-Douglas aggregate for a renter is linear in e, while it is diminishing for the owner. We would have thought that a concave transformation of a linear function leads to a "less" concave function than when applying this operation to an already concave function. Instead, however, it is the linear function which becomes "more" concave than the already concave function.

Consider function z with $z > 0, z' > 0$ and $z'' \leq 0$ and function u with $u' > 0$ and $u'' < 0$. Next, define the composite function $w(c) = u(z(c))$ and take its first and second derivative

$$\begin{aligned} w'(c) &= u'(z(c))z'(c) \\ w''(c) &= u''(z(c))z'(c)z'(c) + u'(z(c))z''(c). \end{aligned}$$

The coefficient of absolute risk aversion of w is given by

$$\begin{aligned} \alpha^w(c) &= -\frac{w''(c)}{w'(c)} = \frac{-u''(z(c))z'(c)z'(c) - u'(z(c))z''(c)}{u'(z(c))z'(c)} = -\frac{u''(z(c))}{u'(z(c))}z'(c) - \frac{z''(c)}{z'(c)} \\ &= \alpha^u(z(c))z'(c) + \alpha^z(c) \end{aligned}$$

In our case we have that

$$z^h(e) = (\omega h)^{1-\xi} e^{\xi}, \quad z^r(e) = \xi^{\xi} \left(\frac{1-\xi}{r+\delta} \right)^{1-\xi} e,$$

and

$$w^h(e) \equiv u^h(z^h(e)) = \frac{(z^h(e))^{1-\gamma}}{1-\gamma}, \quad w^r(e) \equiv u^r(z^r(e)) = \frac{(z^r(e))^{1-\gamma}}{1-\gamma}.$$

Thus,

$$-\frac{w_h''(e)}{w_h'(e)} = \gamma\frac{z_h'(e)}{z_h(e)} - \frac{z_h''(e)}{z_h'(e)} = \frac{\xi\gamma}{e} + \frac{1-\xi}{e} = \frac{1+\xi(\gamma-1)}{e},$$
$$-\frac{w_r''(e)}{w_r'(e)} = \gamma\frac{z_r'(e)}{z_r(e)} - \frac{z_r''(e)}{z_r'(e)} = \frac{\gamma}{e} + 0 = \frac{\gamma}{e}.$$

The contribution to the absolute risk aversion of the Cobb-Douglas aggregate for the owner is a constant $(1-\xi)/e > 0$ while it contributes 0 for the renter. The contribution coming from the power utility transformation depends on the size of γ. For $\gamma > 1$ the constant contribution becomes irrelevant for comparing risk aversion between owners and renters and we see that for owners only a fraction, ξ, of γ matters. Individuals are risk averse only over the portion of discretionary expenditures. For the renter these are consumption and housing and for the owner it is only consumption since housing is predetermined (for owners, the depreciation cost δh is already netted out).

From the FOC (1) it follows that unconstrained optimal expenditure is

$$e(n,h) = \begin{cases} \left(\frac{A(n,0)}{V_a}\right)^{\frac{1}{\gamma}} & \text{if } h = 0 \text{ (renter)}, \\ \left(\frac{A(n,h)}{V_a}\right)^{\frac{1}{1+\xi(\gamma-1)}} & \text{if } h > 0 \text{ (owner)}. \end{cases}$$

Optimal expenditure is decreasing in V_a and increasing in the marginal-utility shifter $A(n,h)$. For a homeowner, the marginal-utility shifter depends on the level of housing wealth. Furthermore, whether $A(n,h)$ is increasing or decreasing in housing depends on the size of γ. For $\gamma > 1$, it decreases in h and so does consumption. The reason for this is the desire to smooth the Cobb-Douglas aggregate over time. A high level of housing wealth is made up with low consumption expenditure, and, vice versa. When $\gamma < 1$, consumption is, however, increasing in housing wealth. Now the intra-temporal complementarity of h and c dominates the inter-temporal smoothing motive.

For a homeowner, unconstrained consumption is $c = e - \delta h$; the size of the home is predetermined. For a renter, unconstrained consumption is $c = \xi e$ and housing services are $x = (1-\xi)\frac{e}{r+\delta}$.

C.2 Optimal gift choice in Stage 3

Above we saw that the indirect utility function for renters and homeowners differ in their degrees of relative risk aversion. Thus we need to study transfer choices when the donor and the recipient have different degrees of risk aversion. Within the CRRA class, we can write the felicity function for agent $j \in \{p, k\}$, as

$$u(e_j) = A^j \frac{e_j^{1-\theta^j}}{1-\theta^j},$$

where A^j is j's felicity shifter, θ^j is j's risk aversion over expenditure, and e_j is j's flow expenditure. Note that we may have $\theta^p \neq \theta^k$. Consider the problem of an unconstrained kid donor who chooses own expenditure and (dictates) parent's expenditure (assume for now that the parent does not save any of the transfer):

$$\max_{e_k \geq 0, g^k \in (-\infty,\infty)} \left\{ A^k \frac{e_k^{1-\theta^k}}{1-\theta^k} + \alpha^k A^p \frac{(\overbrace{y^p + g^k}^{=e_p})^{1-\theta^p}}{1-\theta^p} - (e^k + g^k)V^k_{a^k} + \dots \right\},$$

where y^p is the parent's flow income. Note that we study a dictator problem in which the child can also choose negative gifts in order to find the kid's preferred allocation. The FOC with respect to own (unconstrained) optimal expenditure is as above

$$A^k e_k^{-\theta^k} - V^k_{a^k} = 0 \qquad \Rightarrow \qquad e_k = \left(\frac{A^k}{V^k_{a^k}}\right)^{\frac{1}{\theta^k}}.$$

The FOC of the kid with respect to gifts to the parent (which effectively pins down parent's expenditure since we assume for now that the parent does not save in this situation) is

$$\alpha^k A^p e_p^{-\theta^p} - V^k_{a^k} = 0 \qquad \Rightarrow \qquad e_p^* = \left(\frac{\alpha^k A^p}{V^k_{a^k}}\right)^{\frac{1}{\theta^p}},$$

where e_p^* denotes expenditures the donor desires the recipient to make. The child's optimal transfer is then

$$g^k_{dict} = e_p^* - y^p = \left(\frac{\alpha^k A^p}{V^k_{a^k}}\right)^{\frac{1}{\theta^p}} - y^p,$$

where the subscript *dict* reminds us that this is the (potentially negative) gift the kid would choose if it could dictate flow expenditure. As in BK2014b, the optimal transfer is then

$$g^k_{unc} = \max\left\{0, \min\{g^k_{dict}, e_0^p - y^p\}\right\},$$

where e_0^p is the parent's unconstrained-optimal expenditure level. The subscript *unc* indicates that this transfer is the solution for the case where the kid is unconstrained. The min-operator ensures that the transfer does not go into saving, whereas the max-operator ensures that transfers are not negative. The solution from BK2014b applies because the felicity functionals are strictly concave in e^k and e^p and since $V^k_{a^p} < V^k_{a^k}$.

The kid's ratio of desired expenditure for the parent household relative to own optimal household expenditure is given by

$$\hat{e}^k \equiv \frac{e_p^*}{e_k} = \alpha_k^{\frac{1}{\theta^p}} \frac{A_p^{\frac{1}{\theta^p}}}{A_k^{\frac{1}{\theta^k}}} (V^k_{a^k})^{\frac{1}{\theta^k} - \frac{1}{\theta^p}}.$$

We are now interested in characterizing how the ratio $\hat{e}^k$ varies with changes in the donors' wealth, a_k. Note that this crucially depends on the relative size of the coefficients of relative risk aversion, θ^k and θ^p. We have:

$$\begin{cases} \theta^k < \theta^p \Rightarrow \frac{1}{\theta^k} - \frac{1}{\theta^p} > 0 \Rightarrow \hat{e}^k \downarrow & \text{if} \quad a^k \uparrow \Leftrightarrow V^k_{a^k} \downarrow, \\ \theta^k = \theta^p \Rightarrow \frac{1}{\theta^k} - \frac{1}{\theta^p} = 0 \Rightarrow \ \hat{e}^k \text{ constant}, & \\ \theta^k > \theta^p \Rightarrow \frac{1}{\theta^k} - \frac{1}{\theta^p} < 0 \Rightarrow \hat{e}^k \uparrow & \text{if} \quad a^k \uparrow \Leftrightarrow V^k_{a^k} \downarrow. \end{cases}$$

For us the relevant case is when the kid is a homeowner, $\theta^h = \theta^k = (1-\xi) + \xi\gamma$, the parent is a renter, $\theta^r = \theta^p = \gamma$, and $\gamma > 1$. Then $\theta^p > \theta^k$, and the kid's ratio of desired expenditure for the parent household relative to own optimal household expenditure, $\hat{e}^k$, is decreasing in the kid's wealth. Intuitively, the kid's utility function displays less curvature than that of the parent so that the parent household's marginal utility decreases at a faster rate than the kid household's.

Next, we consider the problem of a **constrained kid donor** (which arises in the case $a^k = a^p = 0$ when the unconstrained-optimal gift g^k_{unc} is not feasible):

$$\max_{g^k \in [-y^p, y^k]} \left\{ \frac{A^k (y^k - g^k)^{1-\theta^k}}{1-\theta^k} + \alpha^k \frac{A^p (y^p + g^k)^{1-\theta^p}}{1-\theta^p} \right\}$$

where y^j is agent j's flow income. As before, the parent's expenditure is the sum of income and the gift, i.e. $e^p = y^p + g^k$. The FOC for the child's gift is given by

$$\underbrace{-A^k (y^k - g^k_{stat,dict})^{-\theta^k} + \alpha^k A^p (y^p + g^k_{stat,dict})^{-\theta^p}}_{\equiv F^k(g^k)} = 0.$$

The subscript *stat,dict* suggests that $g^k_{stat,dict}$ is the (potentially negative) transfer that the kid would dictate in a static setting. When $\theta^k = \theta^p$ we have that

$$g^k_{stat,dict} = (y^k + y^p)\frac{\hat{e}^k}{1+\hat{e}^k} - y^p, \quad \text{where} \quad \hat{e}^k = \left(\frac{\alpha^k A^p}{A^k}\right)^{\frac{1}{\theta}}.$$

When $\theta^k \neq \theta^p$, there is no analytic solution. Since $F^k(\cdot)$ is strictly decreasing and

$$\lim_{g^k \to -y^p} F^k(g^k) = \infty, \qquad \lim_{g^k \to y^k} F^k(g^k) = -\infty,$$

$F^k(\cdot)$ has a unique root on the interval $(-y^p, y^k)$, which can be easily found numerically. Since the Hamiltonian satisfies the same conditions as in BK2014b (concavity of the felicity functional and $V^k_{a^p} < V^k_{a^k}$), the solution for the child's constrained transfer is

$$g^k_{constr} = \max\left\{0, \min\{g^k_{stat,dict}, c^p_0 - y^p\}\right\},$$

where c^p_0 is the parent's unconstrained consumption choice. The min-operator ensures that the child's transfers do not go into savings, and the max-operator ensures positivity of the transfer.

Medicaid option for parent. When the parent is in need of LTC and the child has opted against informal care, then we also have to take into account that the parent may choose the consumption floor c_{ma}. The kid household can use gifts to influence the parent's choice regarding whether to pay privately for a nursing home or to rely on Medicaid. Taking the choice of gifts from the children as given, the parent decides whether to opt for Medicaid or to pay privately for a nursing home. Since the Hamiltonian is concave in e^k and e^j and since $V^k_{a^p} < V^k_{a^k}$, the analysis from BK2015, appendix A3, applies.

We only have to define the minimal gift by the kid that makes the parent choose privately-paid care in stage 4. The parent chooses privately-paid care if

$$\tilde{u}(e^p; 1, h^p) = A(n^p, h^p)\frac{(e^p)^{1-\theta^p}}{1-\theta^p} \geq \tilde{u}(c_{ma}; 1, 0),$$

where c_{ma} is the MA consumption floor. The parent is indifferent between privately-paid care and Medicaid at the expenditure threshold

$$e^p_{thr} = \left(\frac{(1-\theta^p)\tilde{u}(c_{ma}; 1, 0)}{A(n^p, h^p)}\right)^{\frac{1}{1-\theta^p}}$$

If the parent is renting, we have $e^p_{thr} = c_{ma}$ (as in BK2015). Then the minimal gift from the child that makes the parent stay out of Medicaid is

$$g^k_{thr} \equiv \max\{0, e^p_{thr} - y^{3,p}\},$$

where the max-operator is necessary since gifts cannot be negative. Note that $y^{3,p} = y^p - q$ is stage-3 income, the parent's pension minus the nursing-home cost q. Given the threshold g^k_{thr}, the solutions from BK2015 then apply unchanged when substituting their felicity functional $u(\cdot)$ by the indirect felicity functional $\tilde{u}(\cdot)$ from equation (2).

C.3 Long-term care

An individual's health state s follows a random process and is exogenously determined. It is described as either being healthy ($s = 0$), requiring LTC ($s = 1$), or being dead ($s = 2$). Both, requiring LTC and being dead are absorbing states. The hazards of requiring LTC and death depend on an individual's age and are summarized by the Poisson hazard matrix θ^s_t. The hazard of death also depends on whether the individual requires LTC.

A household requiring LTC has to obtain care from one of three sources. A member of the kid household may provide informal care. This form of care incurs no direct financial costs to the elderly household but the kid household loses a fraction of its income. On the plus side for the kid, providing informal care protects the assets of the parent household.

If a child is unwilling to provide informal care, the parent has the option to pay privately for a nursing home or to rely on means-tested Medicaid (the kid can, however, subsidize the parent's nursing-home expenditures through gifts out of purely altruistic reasons). A privately-financed nursing home provides the individual with LTC. Furthermore, the individual is free to choose how much room and board, amenities etc. to consume. In contrast, when the nursing home is financed through Medicaid, the individual has no choice over her standard of living and instead has to live within the means provided by the government through a consumption floor. The means-test for Medicaid stipulates that a person must have no financial assets; also, social security payments are garnished by the Medicaid authority.

The following term enters the HJB due to shocks to the health state

$$\sum_{s' \in S} \theta^s_{ss'} V^{1,j}(, s'),$$

where $V^{1,j}$ is the stage-1 value function of a j household and $\theta^s_{ss'}$ is the hazard of transitioning from current health state s to health state s'.

C.4 Medical expenditures

We follow the bulk of the literature and assume that medical expenditures follow an exogenous stochastic process. It is important to stress, however, that in contrast to this literature we separate these medical expenditures, which are non-discretionary in nature (e.g. for surgery, hospital stays etc.) from the LTC expenditures which in our model are at least partially discretionary (i.e. a person can always choose Medicaid at the cost of this being a rather unpleasant state). Also, insurance against LTC expenditures is very effective in our model through savings and the family. In contrast, medical expenditures can be extremely large (but there is also a consumption floor so one can always get around it).

The hazard rate of a medical event depends on an individual's age and health status, $\theta_t^m(s)$. Conditional on experiencing a medical event, lump-sum out-of-pocket (OOP) medical expenditures m are drawn from distribution M. A household pays these expenditures lump-sum but is protected by government insurance if the OOP costs exceed the household's liquid financial assets a (so there is a homestead exemption which protects the house).

Suppose the support of M consists of $n > 1$ discrete OOP levels. Denote the probability of incurring OOP expenditure i, conditional on experiencing a medical event, by π_i. The following term enters the HJB due to medical expenditure risk

$$\cdot s + \theta_t^m(s) \underbrace{\sum_{i=1}^{n} \pi_i \left(V^{1,p}(\cdot, [\max\{a^p - m_i, 0\}, a^k]) - V^{1,p}(\cdot, [a^p, a^k]) \right)}_{E[V^{1,p}(\cdot, m_i) - V^{1,p} | \text{medical event}]} + \cdots$$

where $V^{1,p}$ is the stage-1 value function of the parent household. If distribution M is continuous this term becomes

$$\cdots + \theta_t^m(s) \underbrace{\int_0^{\bar{m}} \left(V^{1,p}(\cdot, [\max\{a^p - m, 0\}, a^k]) - V^{1,p}(\cdot, [a^p, a^k]) \right) dM(m)}_{E[V^{1,p}(\cdot, m) - V^{1,p} | \text{medical event}]} + \cdots$$

C.5 Death and bequests

Denote the value function of the child household after the parent's death by W. State variables are now given by age t, income of the kid household y^k, and health status s^k. The child household has no companion generation after the death of the parent generation. Care can thus only be obtained from formal sources, i.e., either paying privately for a nursing home or relying on Medicaid. This value function satisfies the following HJB

$$\begin{aligned}
-W_t + (\rho+\theta^d)W = &\max_{f\in\{0,1\},c^k} \left\{ fu(c_f,h_f) + (1-f)[u(c^k,h^k) + \dot{a}^k W_a] \right\} + \\
&+ \sum_{s'\in S} \theta^s_{ss'} W(\cdot,s') + \sum_{y'\in Y} \theta^y_{yy'} W(\cdot,y') + \theta^m \int_0^{\bar{m}} [W(\cdot,\max\{a^k-m,0\}) - W(\cdot,a^k)]\mathrm{d}M(m), \\
\text{s.t.} \quad & \dot{a}^k = (1-f)[ra^k + y^k - c^k - e(h^k) - s^k q] \\
& a^k \geq 0,
\end{aligned}$$

where $s^k \in \{0,1\}$ is the child's health state, h^k is the housing state, $e(h^k)$ are housing expenditures, and f is the child's choice over whether to make use of the consumption floor c_f or pay privately for care when in need of care.

The term that enters the kids' HJB that accounts for what happens after the death of the parent household is given by

$$\cdots + \theta^d[W(t,y^k,a^k+T(a^p,h)) - V^k] + \cdots$$

Conditional on the death event of the parent, the child household obtains after-tax bequests of size $T(a^p,h)$. While the parent household is alive this term also enters its HJB with the only difference that the continuation value of the child W is premultiplied by the parent's altruism parameter α^p and that the parent's value V^p is deducted

$$\cdots + \theta^d[\alpha^p W(t,y^k,a^k+T(a^p,h)) - V^p] + \cdots$$