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Evaluating Long-Term-Care Policy Options, Taking the Family Seriously

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We supplement the empirical facts on long-term care (LTC) from the main text, such as, providing the estimates of all covariates of the linear probability model for informal care; complementing the analysis of caregiver compensation *across* families by a *within* family analysis; showing nursing-home expenditures by Medicaid coverage; providing statistics on the medical expenditure categories from the HRS with and without the introduction of Medicare Part D; and comparing pertinent characteristics of medical, nursing home, and total expenditures generated by the model with the data. We then provide a substantial amount of theory which is behind our model. Most importantly, we show how to solve the instantaneous game which makes up the agents' problem. We provide all proofs from the Propositions and the Corollary and provide a further Proposition which is a general characterization of the IC decision. Finally, we provide the computational algorithm, additional details about our calibration, and the full tables for the robustness exercise of high opportunity costs.

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1 Data appendix

1.1 The Health and Retirement Study

1.1.1 Survey design

The Health and Retirement Study (HRS) is a panel study of bi-yearly frequency conducted by the University of Michigan. It began in 1992, and became representative of the US population of ages 50 and above as of 1998. By 2010, the HRS is comprised of 6 cohorts: the original HRS cohort (born between 1931 and 1941), the AHEAD cohort (born before 1924), the Children of the Depression (CODA) cohort, born between 1924 and 1930, the War Baby (WB) cohort, born between 1942 and 1947, the Early Baby Boomer (EBB) cohort, born between 1948 and 1953, and the Mid Baby Boomer (MBB) cohort born 1954 to 1959 and first interviewed in 2010.

The sampling proceeds as follows. Housing units are randomly chosen (household screening). From these housing units, households are identified (not every housing unit is a household). A household is a valid member for the survey if at least one household member's age is cohort-eligible. Interviews are conducted with the cohort-eligible individual and also with his/her spouse or partner regardless of year of birth. A cohort initially sampled consists of only non-institutionalized individuals and thus excludes the nursing-home population. However, respondents who subsequently move to nursing homes are retained in the study and interviewed whenever possible, often through a proxy respondent. In order to make the nursing-home sample representative of the population the HRS provides sampling weights.[1]

Since the HRS is a longitudinal survey, there is attrition due to mortality and respondents' withdrawal. Attrition other than due to mortality does not appear to be a major concern. Re-interview response rates are in the low to mid-90% range. If a household is in the sample and refuses to participate in a particular wave it is kept in the sample and is contacted again; the household is dropped from the sample only when the household insists on not to be contacted again.

The HRS obtains detailed information about care obtained from others due to functional limitations with regards to activities of daily living (ADLs: dressing, bathing, going to bed, eating, walking across a room) and instrumental activities of daily living (IADLs: shop for groceries, prepare meals, take medication, manage money, use phone). The study first probes whether an individual has physical issues, such as, difficulties with running, walking, or stoop-

[1] Since October 2015 these weights are available for the 2000-2010 waves. Prior to that date, nursing-home weights were available for only the 2000 and 2002 waves.

ing. If no physical issues are reported, questions regarding (I)ADLs are skipped. Otherwise the survey continues by asking the respondent about all possible (I)ADL limitations. Once all functional limitations are coded, the interviewer asks the respondent about the helpers with the various (I)ADLs declared, and how many hours each helper provides. Respondents may have a helper only for certain functional limitations, various helpers for different limitations, or no helper at all. There is one caveat, the HRS does not collect hours of care provided for individuals who reside in a LTC institution. For these individuals we impute care hours by regressing known care hours from non-LTC-institution residents on a variety of pertinent characteristics, such as, age, indicators of frailty, etc. and use the estimated coefficients to predict hours of care for institutionalized individuals. The idea behind this imputation is to find out how many care hours an institutionalized individual would require if she were at home.

1.1.2 HRS and RAND

For the empirical analysis we use waves 2000-2010. Using earlier waves is undesirable since, according to the HRS, these are not yet representative of the nursing-home population. Whenever possible we use the cleaned-up data versions provided by the RAND Corporation. Specifically, we use their longitudinal respondent level data set (RAND HRS Data File v.O) and their family level data set (RAND HRS Family Data File v.C). Importantly, however, the RAND family file does not include information on helpers other than children. Thus, to find out about the importance of, for example, the spouse in providing informal care we need to make use of the original HRS. Also, RAND does not incorporate exit interviews, which contain information about deceased individuals a few months prior to death, provided by the HRS and so we use them directly. Finally, because RAND does currently not provide family data for 2012, we opted to stop with wave 2010.

1.1.3 Care sample

Table 1 provides a bird's-eye view of the *care sample* introduced in the main text. About 15% of the entire HRS sample (individuals aged 50 and above) has a helper(s) with functional limitations and enters the care sample. Unsurprisingly, older cohorts (AHEAD and CODA) are over-represented. The average age is 73 years. Older cohorts are increasingly comprised of women, and in especially the oldest cohort many are widowed. A typical respondent in the care sample reports to have four functional limitations (out of 10) and almost 16% claim to have been diagnosed with a memory-related issue. Frailty, as measured by the number of functional limitations and indications of dementia, increases substantially for the older cohorts. Around 14% of respondents in the care sample reside in a nursing home, whereas, 86% reside at home. The incidence of nursing-home residency strongly increases with the aging of the sample. Nonetheless it is remarkable that even in the oldest age group (AHEAD) more than two-thirds of individuals continue to reside at home.

Table 1: Care sample 2000-2010

Cohort	N	Of individuals aged 50+	Age	Female	Widow(er), single	(I)ADLs	Memory issues	Nursing home
AHEAD	6,100	38.2%	87	71.1%	71.8%	4.8	21.3%	26.5%
CODA	3,119	19.0%	78	62.2%	49.7%	4.1	17.6%	14.5%
HRS	4,759	11.3%	69	58.7%	41.9%	3.7	11.5%	10.0%
WB	1,472	8.8%	60	58.9%	36.7%	3.3	7.5%	3.3%
EBB	1,274	8.6%	56	55.9%	37.7%	3.2	10.9%	1.6%
MBB	504	6.9%	54	59.7%	34.9%	3.6	0.0%	0.0%
Total	17,228	15.2%	73	63.0%	51.1%	4.0	15.5%	13.7%

HRS 2000-2010, bi-yearly. Individuals born: AHEAD <1924; CODA 1924-30; HRS 1931-41; WB 1942-47; EEB 1948-53; MBB 1954-59. The care sample consists of individuals with at least one functional limitation and at least one helper. *Age* is average age and *(I)ADLs* are average number of functional limitations. Statistics are weighted using respondent-level weights.

1.2 Caregivers and care recipients

As in the main text, we define informal helpers of retirement-age as *old* (most often spouses), those of working-age as *young* (typically children of the elderly), and create a residual informal-caregiver category *other* for helpers who are relatives or friends, but for whom we do not know their age. Formal care is either provided at home through formal home care (FHC) or in a nursing home (NH).

1.2.1 Primary caregivers

We now consider a sensible alternative classification to the helper-intensities (light, medium, and heavy). We ask who among all helpers of a respondent is typically the *primary caregiver*; that is, the caregiver who provides the most hours of care among all helpers of the respondent. The picture which arises under this classification is fundamentally the same as in the main text, except that care is less concentrated on these helpers since a primary caregiver can also provide few hours of care (which is why we prefer the helper-intensity categories used in the main text).

Primary caregivers provide the vast majority of all care hours (88.6%) and make up 57.4% of the total helper population; recall, heavy helpers make up 32.1% of the helper population and provide 86.0% of all care hours.

Table 2: Case counts and hours of primary caregivers

	# Cases (out of all primary helpers)		Hours (out of all primary hours)	
Helper type	married/coupled	widow(er)/single	married/coupled	widow(er)/single
old	**78.0**%	3.6%	**71.0**%	2.0%
young	11.7%	**46.7**%	10.0%	**37.7**%
other	2.0%	13.0%	1.0%	6.3%
informal	**91.7**%	**63.3**%	**82.0**%	**46.0**%
FHC	3.1%	16.2%	4.0%	12.3%
NH	5.2%	**20.5**%	14.0%	**41.7**%
formal	8.3%	36.7%	18.0%	54.0%

The primary helper is defined as the caregiver who provides the most hours of care to the individual among all caregivers the individual has. # Cases: Fractions out of all primary caregivers. Hours: Fraction of hours out of all primary caregiver hours. Respondent-level weights are used.

Table 2 shows that whether the respondent is married/coupled or widow(er)/single, informal caregivers comprise the majority of primary caregivers. For married/coupled individuals the old most commonly take on the role of primary caregiver; for widow(er)/single respondents the young are most common. The right-hand side shows that informal primary caregivers provide substantial amounts of care hours. Among married couples, the lion's share of primary hours stem from the old. Among widow(er)/single individuals the young and NH provide hours of care roughly in the same ballpark.

1.2.2 Widow(er)s/singles' characteristics

We now document characteristics about widow(er)s/singles differentiated by primary-caregiver category.

Table 3 shows that widow(er)/single individuals are typically women. Women are over-represented when their primary caregiver is young and slightly under-represented when FHC is the main provider of care. Individuals with primary caregiver from the categories old and other share some similarities. They are more likely male, younger, less frail in terms of average numbers of (I)ADLs and fewer show signs of dementia. They are much more likely to be childless and tend to have fewer children. Individuals with NH are older and much more frail as measured by their average number of functional limitations and the fact that a much higher fraction has indications of dementia than the average respondent. Respondents who receive the

Table 3: Widow(er)/single characteristics

Description	old	young	other	FHC	NH	Total
Care sample						
N	257	4,439	1,070	1,378	2,001	9,145
Female	49%	84%	64%	76%	78%	78%
Age	64	76	70	78	83	77
(I)ADLs	3.7	3.8	3.5	4.5	6.8	4.5
Memory	7.6%	11.8%	9.7%	14.8%	41.2%	17.3%
Children	1.5	3.7	1.9	2.6	2.5	3.0
Childless	45.6%	0.0%	33.9%	17.6%	16.5%	12.6%
LTC insurance	4.2%	5.1%	6.2%	7.2%	5.3%	5.6%
Median income	10.4K	12.0K	11.9K	12.2K	12.7K	12.0K
Total wealth:						
50pct	1.6K	25.4K	10.0K	20.0K	2.0K	15.0K
75pct	68.0K	107.3K	95.3K	157.6K	81.0K	105.0K
90pct	300.0K	308.0K	284.0K	522.0K	326.5K	341.0K
Housing wealth:						
50pct	0	0	0	0	0	0
75pct	30.0K	62.0K	50.0K	52.0K	0	50.0K
90pct	80.0K	150.0K	130.0K	150.0K	80.0K	135.0K
AHEAD						
N	43	**1,950**	366	731	**1,418**	4,508
Female	59%	84%	80%	83%	85%	83%
Age	88	87	87	88	89	88
(I)ADLs	5.2	4.0	3.7	4.8	7.0	5.0
Memory	16.8%	14.2%	13.6%	16.9%	41.9%	22.2
Children	0.5	3.4	1.2	2.5	2.3	2.7
Childless	75.0%	1.1%	51.0%	14.4%	16.4%	13.0%
LTC insurance	5.6%	5.1%	8.2%	8.0%	5.0%	5.8%
Median income	15.2K	12.9K	13.6K	13.5K	13.0K	13.0K
Total wealth:						
50th pct	58.0K	**50.0K**	60.0K	60.6K	**3.0K**	36.9K
75th pct	310.0K	**168.0K**	170.4K	252.0K	**100.9K**	160.5K
90th pct	378.0K	**432.0K**	403.0K	775.6K	**354.5K**	443.0K
Housing wealth:						
50th pct	0	**0**	1k	0	**0**	0
75th pct	20.0K	**80.0K**	80.0K	80.0K	**0**	60.0K
90th pct	80.0K	**174.0K**	150.0K	220.0K	**75.0K**	150.0K

Characteristics of single respondents by type of respondents' primary caregiver. The upper part includes all single respondents and the lower part only those born before 1924. Income reported is the median and includes all sources of income. *Age* and *Children* are averages. Respondent-level weights are used. Nominal values are measured in constant 2000 dollars.

majority of care through FHC are slightly older and somewhat more frail than individuals who are being cared for by the young; on the other hand, those with FHC have fewer alternative caregivers as they tend to have fewer children and are more likely to have no children at all than those who are cared for by young helpers; they are also more likely to be covered by LTC insurance which may help to pay for FHC. Individuals with a primary caregiver from the young category have the highest average number of children and are least likely to be childless, suggesting that having children, and rather more than less, makes IC more likely. In terms of median income there are no stark differences. Differences in terms of wealth are more pronounced. We first note that many widow(er)/single individuals in the sample are fairly wealth-poor with median wealth being only around \$15K. The 90th percentile is, however, substantially richer (\$341K) and especially the top 10% of FHC recipients is comparatively wealthy (\$522K).

The second part of the table shows the same statistics for the oldest-old individuals, that is, those born before 1924 (AHEAD cohort). There are few men and the number of respondents with old helpers becomes negligible. A similar pattern in terms fragility, number of children, and LTC insurance emerges as in the care sample. Individuals living at home are more frail than before while nursing-home residents display practically the same number of functional limitations and memory-related issues as in the larger sample. Differences in median income are again negligible. FHC recipients are the wealthiest, and, generally, community residents are wealthier than individuals living in a LTC facility. The median respondent's wealth position when obtaining care from a young caregiver is substantially larger than that of a nursing-home resident (\$50K versus \$3K), and a fairly large difference also persists at the 75th and the 90th percentiles. Housing wealth for institutionalized individuals vanishes for the vast majority. The fraction of housing wealth out of total wealth for respondents with young caregivers is still substantial but smaller than in the larger sample, and, especially so at the 90th percentile.

1.2.3 Caregiving children's characteristics

We now document characteristics of caregiving children differentiating by the three care-intensity categories that we also use in the paper: weekly hours of care of <7.5 is *light*, 7.5-19 weekly hours is *medium*, and *heavy* stands for at least 20 weekly hours (equivalent to a part-time job or more). Table 4 paints a picture of characteristics of caregiving children by care intensity and puts these into contrast with non-caregiver children (care intensity *zero*).

Caregiving children are slightly older, more likely to be female, less likely to be married/partnered, and somewhat more likely to be childless, attributes which are indicative that

Table 4: Children's characteristics by care intensity

Description	Light	Medium	Heavy	Zero	Total
Care sample					
Age	47	47	48	45	45
Female	62%	69%	74%	48%	51%
Married	65%	56%	49%	69%	68%
Children	1.9	1.8	1.9	2.0	1.9
Childless	23.2%	25.6%	27.7%	22.1%	22.5%
Own home	46.4%	37.8%	28.4%	44.2%	43.8%
Co-residence	24.0%	38.6%	59.6%	6.0%	10.3%
Own Ps home	2.2%	4.6%	10.0%	0.0%	0.0%
On life insurance	58.3%	60.6%	61.8%	23.3%	28.7%
On will	85.1%	84.6%	84.3%	74.2%	76.1%
Transfer	14.6%	12.6%	10.5%	10.3%	10.8%
No HS diploma	9.4%	14.7%	16.0%	14.6%	14.1%
HS diploma	37.2%	37.6%	41.7%	41.3%	40.8%
Some college	25.6%	25.7%	24.4%	20.1%	21.4%
College degree	27.7%	22.0%	17.9%	23.9%	24.1%
Not working	29.4%	38.9%	50.4%	25.4%	27.0%
Part-time work	10.2%	11.3%	11.2%	7.9%	8.4%
Full-time work	60.4%	49.8%	38.4%	66.7%	64.6%
AHEAD					
Age	58	58	58	58	58
Female	59%	69%	75%	46%	51%
Married	78%	65%	51%	73%	73%
Children	2.3	2.1	2.2	2.4	2.4
Childless	15.0%	20.2%	23.1%	15.2%	15.9%
Own home	65.3%	57.8%	42.1%	61.1%	60.6%
Co-residence	11.9%	29.3%	59.6%	3.4%	9.2%
Own Ps home	3.4%	7.4%	16.7%	0.0%	2.4%
On life insurance	74.4%	77.4%	74.2%	42.3%	51.9%
On will	91.2%	88.0%	87.5%	77.8%	81.5%
Transfer	13.3%	11.2%	10.0%	6.4%	8.0%
No HS diploma	4.4%	9.1%	10.5%	13.5%	11.5%
HS diploma	36.4%	37.0%	40.3%	41.6%	40.4%
Some college	22.9%	23.8%	23.7%	16.2%	18.1%
College degree	36.4%	30.1%	25.5%	28.8%	30.0%
Not working	36.0%	42.0%	57.2%	39.1%	39.8%
Part-time work	11.5%	11.7%	11.1%	8.5%	9.4%
Full-time work	52.5%	46.4%	31.7%	52.4%	50.9%

Characteristics of children by helper-intensity status. Upper part of the table includes all parent cohorts and the lower part only widow(er)/single parents from the AHEAD cohort. *Age* and *Children* are averages. *Own Ps home* means that kid obtained home from parent while parent is still alive. *Transfer* refers to financial gift.

non-helpers have more competing demands on their time than children who provide care. Home-ownership among caregiving children is less common, instead co-residency of helping children with the parent is dramatically higher when compared to non-caregivers. Heavy-helping kids are much more likely to own the home of the parent (*own Ps home*: parent transferred home to child) than non-helping kids. Furthermore, helping kids are much more likely to be a life-insurance beneficiary of the parent and somewhat more likely to be named on the parent's will. Direct financial transfers do not appear to play a central role. Kids who provide heavy help tend to be somewhat less educated. A larger fraction among them has no high school diploma and a smaller fraction has a college degree. Considering that heavy-helping kids provide substantial amounts of care, it is perhaps unsurprising that much fewer work full-time. Kid-helpers are also more likely to be part-time employed than kids who do not help.

Part (b) of Table 4 provides the same comparison for children with a widow(er)/single parent from the oldest cohort. Qualitatively, a similar pattern arises as before. The home-ownership rate rises and more of the non-helper children are a beneficiary of the parent's life insurance than before. Fewer children work since the average age among them is higher.

1.3 Determinants of informal care

1.3.1 Linear probability model for IC

Table 5 shows the full set of covariates and their estimated coefficients for the linear probability model of informal care presented in the main text of the paper (Table 3).

1.3.2 Is IC really a choice for all elderly?

One may think that some elderly are in such bad condition that there is no choice but to institutionalize them. However, this is not what our data say. For example, 64% of respondents who currently have a memory-related condition reside in the community. The following Table shows the percentage of nursing-home residents by the number of (I)ADL limitations they have. It is true that the percentage of nursing-home residents increases significantly with disability. However, even among the most frail (10 IADL conditions and memory problems) about 30% of respondents are at home. So it seems that there is always a choice to be made for or against nursing-home care.

This is not surprising if we think about the nature of the (I)ADL limitations; they do not require sophisticated technology to be taken care of but rather large amounts of low-skilled

Table 5: Linear probability model for informal care

	Care sample		Single sample		Disabled single sample	
	all	disabled	all	disabled	MA eligible	MA ineligible
Covariate	(N=11,501)	(N=5,197)	(N=5,756)	(N=2,818)	(N=1,566)	(N=1,252)
married/partnered	0.165***	0.229***				
	(0.00949)	(0.0160)				
siblings	0.00215	0.000539	0.00481	0.000869	0.00270	-0.00287
	(0.00160)	(0.00285)	(0.00304)	(0.00478)	(0.00593)	(0.00822)
# kids	0.00675***	0.0114***	0.0100***	0.0137***	0.0115*	0.0190*
	(0.00163)	(0.00276)	(0.00278)	(0.00411)	(0.00492)	(0.00746)
grandkids	-0.000244	-0.00596	-0.00308	-0.0116	-0.00860	-0.0121
	(0.00366)	(0.00548)	(0.00535)	(0.00704)	(0.00813)	(0.0134)
# (I)ADLs	-0.0412***	-0.0414***	-0.0465***	-0.0414***	-0.0441***	-0.0383***
	(0.00164)	(0.00241)	(0.00250)	(0.00362)	(0.00485)	(0.00557)
dementia	-0.104***	-0.125***	-0.123***	-0.126***	-0.120***	-0.134***
	(0.0103)	(0.0143)	(0.0161)	(0.0202)	(0.0277)	(0.0301)
low wealth	0.0898***	0.102***	0.112***	0.103***	0.0962**	0.0665
	(0.0102)	(0.0159)	(0.0152)	(0.0229)	(0.0323)	(0.0439)
medium wealth	0.110***	0.145***	0.130***	0.129***	0.193***	0.0802
	(0.0118)	(0.0192)	(0.0189)	(0.0274)	(0.0485)	(0.0451)
high wealth	0.0972***	0.0897***	0.122***	0.146***	0.172	0.117*
	(0.0149)	(0.0242)	(0.0242)	(0.0332)	(0.106)	(0.0458)
log income	0.0275	0.0569	0.105*	0.247***	0.136	0.293**
	(0.0269)	(0.0563)	(0.0435)	(0.0533)	(0.0743)	(0.0989)
(log income)^2	-0.00191	-0.00280	-0.00677**	-0.0146***	-0.00678	-0.0179***
	(0.00140)	(0.00294)	(0.00249)	(0.00311)	(0.00523)	(0.00514)
some college (kid)	-0.0145	-0.0283*	-0.0350*	-0.0565**	-0.0387	-0.0774*
	(0.00829)	(0.0140)	(0.0147)	(0.0217)	(0.0284)	(0.0333)
college (kid)	-0.0818***	-0.110***	-0.142***	-0.184***	-0.165***	-0.200***
	(0.0129)	(0.0199)	(0.0209)	(0.0273)	(0.0406)	(0.0386)

Table 3 from main text. Results continue on next page.

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	Care sample		Single sample		Disabled single sample	
	all	disabled	all	disabled	MA eligible	MA ineligible
caucasian	-0.0694***	-0.116***	-0.0994***	-0.171***	-0.186***	-0.151***
	(0.00901)	(0.0150)	(0.0155)	(0.0234)	(0.0281)	(0.0448)
age	-0.00346***	-0.00285**	-0.00452***	-0.00227	-0.00184	-0.00311
	(0.000698)	(0.00108)	(0.00125)	(0.00182)	(0.00226)	(0.00303)
hospital	-0.0416***	-0.0609***	-0.0590***	-0.0620***	-0.0861***	-0.0327
	(0.00716)	(0.0122)	(0.0125)	(0.0187)	(0.0238)	(0.0299)
out-patient	0.0200*	0.0126	0.0354*	0.0432	0.0230	0.0676
	(0.00859)	(0.0150)	(0.0162)	(0.0248)	(0.0319)	(0.0374)
ltc insurance	-0.0143	-0.0162	-0.0483	-0.0202	0.0284	-0.0465
	(0.0145)	(0.0253)	(0.0308)	(0.0405)	(0.0660)	(0.0512)
some college	-0.00364	-0.0241	0.0262	0.0132	-0.0417	0.0466
	(0.00989)	(0.0175)	(0.0180)	(0.0272)	(0.0394)	(0.0366)
college	-0.0412**	-0.0419	-0.0683**	-0.0588	-0.114	-0.0140
	(0.0140)	(0.0230)	(0.0264)	(0.0347)	(0.0580)	(0.0430)
gender (kid)	0.0225**	0.0410***	0.0429***	0.0551**	0.00745	0.109***
	(0.00725)	(0.0122)	(0.0127)	(0.0182)	(0.0242)	(0.0280)
own home (kid)	-0.00736	-0.0408**	-0.0331*	-0.0986***	-0.0935**	-0.111**
	(0.00857)	(0.0144)	(0.0150)	(0.0224)	(0.0295)	(0.0354)
age (kid)	-0.000590	-0.00180	0.000844	-0.000756	-0.00162	0.0000722
	(0.000750)	(0.00111)	(0.00125)	(0.00178)	(0.00231)	(0.00275)
married (kid)	-0.0164	-0.0379*	-0.0203	-0.0474	-0.0369	-0.0656
	(0.0100)	(0.0163)	(0.0165)	(0.0242)	(0.0300)	(0.0402)
constant	1.092***	0.920***	0.854***	0.166	0.592*	0.0201
	(0.131)	(0.276)	(0.201)	(0.248)	(0.275)	(0.517)

Linear probability model with dependent variable IC. Standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Three samples: (1) the care sample (see text), (2) widower/singles from the care sample, and (3) disabled widower/singles from the care sample. All: regression uses all individuals in sample. Disabled: regression restricted to individuals receiving at least 90 hours of monthly care. Medicaid (MA) eligible: non-housing wealth < $2,000 and income < $20,500. For care sample, which includes couples and singles, low wealth is $7.5k-$135k, medium wealth is $135k-$405k, and high wealth is >$405k; the omitted category is wealth below $7.5k. For regression using singles, low wealth is $5k-$90k, medium wealth is $90k-$270k, and high wealth is >$270k; the omitted category is wealth below $5k. Income includes social security, and all other sources of income. Some college (kid): average years of children's education is between 13-16 years. College (kid): 16 years and more; the omitted category is that average schooling is below 13 years.

Table 6: Nursing-home residency by degree of disability

Description	number of IADLs 6	7	8	9	10	N
all respondents	18.0	26.7	37.0	47.6	60.3	4,900
respondents with memory problems	35.5	37.4	48.8	61.2	69.4	1,364

Percentage of nursing-home residents by number of (I)ADL limitations. Number of observations given in last column.

labor. Being frail does not mean that a respondent will be in such bad health that she has to be in a hospital. Recall, a nursing facility is also not designed to handle severe medical conditions. If individuals are in need of medical care, the HRS categorizes these cases as hospital stays. In the model, these stays (who are typically of much shorter duration than nursing-home stays) are part of the medical-cost shock process.

Consistent with this, we see that care recipients living in the community indeed report that they receive high amounts of care. Table 7 shows that among community residents with 6 or more (I)ADL issues, 50% receive more than 192 care hours per month (6 hours per day), 25% receive more than 480 monthly hours (16 daily hours), and 10% of them even report monthly hours of 621 (20.7 per day). When the elderly is additionally afflicted by a memory-related disease these numbers become substantially higher especially at the median (recall that elderly in need of care may have more than one caregiver which is why the daily care hours may become very large).

Table 7: Total monthly hours of care at home for frail elderly

Description	percentile 50 pct	75 pct	90 pct	N
all respondents	192	480	621	3,060
respondents with memory problems	310	510	713	622

Total monthly hours of care provided at home for individuals with 6 or more I(ADL) limitations.

1.3.3 Compensation of caregivers *within* families

We now complement the analysis in the main text of informal-caregiver compensation across *child-caregiver families* (families with heavy-helper children and disabled widow(er)/single parents who receive the majority of care hours informally; recall that in these cases there is

Table 8: Within-family transfers

(i) Financial transfer					
# receive transfer	two	three	four	five	Total
none	17.4%	23.9%	22.5%	21.6%	85.4%
one	2.5%	3.1%	2.0%	2.5%	10.2%
two	0.9%	0.7%	1.2%	0.4%	3.0%
three and more		*negligible ...*			...
(ii) Co-residence					
# co-residing	two	three	four	five	Total
none	6.1%	8.2%	7.2%	7.4%	28.9%
one	13.8%	16.5%	16.1%	13.3%	59.7%
two	0.9%	2.8%	2.3%	3.6%	9.6%
three		0.2%	0.7%	0.4%	1.3%
four and more		*negligible ...*			...
(iii) Home transfer					
# owning	two	three	four	five	Total
none	17.1%	23.4%	22.5%	21.6%	84.6%
one	3.9%	4.3%	3.8%	3.2%	15.3%
two and more		*negligible ...*			...
(iv) Will					
# on will	two	three	four	five	Total
none	2.2%	3.8%	3.7%	2.5%	12.3%
one	1.7%	4.1%	3.1%	2.1%	10.9%
two	19.8%	1.5%	0.7%	0.9%	22.9%
three		22.9%	0.3%	0.4%	23.6%
four			17.6%	0.4%	18.0%
five				12.3%	12.3%
(v) Life insurance					
# on life insurance	two	three	four	five	Total
none	2.7%	4.0%	2.9%	2.4%	12.0%
one	6.7%	12.4%	15.9%	12.3%	47.2%
two	10.5%	1.2%	3.2%	2.0%	16.8%
three		11.0%	0.2%	0.4%	11.7%
four			7.9%	0.0%	7.9%
five			7.9%	0.0%	7.9%

Joint distribution of number of children in child-caregiver families with two to five children and number of children (none, one, etc.) which benefit from various types of transfers.

typically one heavy-helper kid) by also studying transfer arrangements *within* these families.[2] In line with the across-family evidence, we find that a heavy-helper kid is much more likely to benefit from rent-free living with the parent, is almost always the recipient of the home transfer, and is more frequently a beneficiary of the parent's life insurance than her non-heavy-helping siblings.

Table 8 provides an overview of within-family transfers for child-caregiver families with two to five children. Part (i) shows how often financial gifts in families take place to no child, exactly one, et cetera. In about 14% of these families gifts to at least one child occurs. If they do occur, there is typically one child recipient, which tends to be the heavy-helper child (62%); in this case, the median transfer is $2,885 for a heavy-helper kid, and $1,828 to a non-heavy-helper kid. Part (ii) shows a key characteristic of these families: the incidence of co-residence is very high. More than two-thirds of parent and children live together, and most commonly it is exactly one child which lives with the parent. If there is exactly one child living with the parent, in 96% of cases it is the heavy-helper child (recall, co-residence is typically a transfer from parent to child). Part (iii) shows how often a parent transfers her home to children. This happens in about 15% of families and is practically always directed at one child which is almost always the heavy-helper kid (98.5%). Part (iv) of the table shows that the norm is that all children in the family are named on the will. But, in 11% of cases there is only one child, which is the usually the heavy-helper child (92.5%). Finally, part (v) of the table shows the frequency at which children are named as beneficiaries of the parent's life insurance. In the vast majority, if the parent has a life insurance, at least one child is a beneficiary. In contrast to the will, for which we find that the norm is to include all kids, here it is more often the case that only one child is named as beneficiary of life insurance; in 80.9% of these cases, it is the heavy-helping kid.

1.4 Medical and nursing home expenditures

1.4.1 Nursing home

Table 9 provides information on out-of-pocket (OOP) expenditures by nursing home respondents depending on Medicaid coverage. We condition on nursing home stays of at least 100

[2] It might also be the case that siblings compensate each other for taking on the role of caregiver in which case there is a transfer from siblings to the heavy-helper child. This case is irrelevant for our model since we model the entire kid generation as one agent. If the kid generation as a whole does not receive a transfer from the parent then we interpret care as altruistically motivated. Transfers within the kid generation are hard-wired in our model in the sense that children's income is pooled and so among them there is full risk-sharing.

days in order to exclude Medicare recipients. In the discussion surrounding the care sample in the main text we report that among nursing-home respondents 62.5% are MA supported. We obtain this number by taking Medicaid-recipients who are fully, mostly, and partially covered, but exclude individuals with expenditures that are above the median of those without coverage (≈$28,000). In the same way we obtain the reported MA-recipiency rate of 58.5% for the AHEAD widow(er)/single sample. For completeness we also show these expenditures for the widow(er)/single sample.

Table 9: Nursing-home expenditure by Medicaid coverage

Care sample									
coverage	**N**	**mean**	**p10**	**p25**	**p50**	**p75**	**p90**	**p95**	**p99**
full	751	0	0	0	0	0	0	0	0
mostly	199	6,758	298	900	3,824	9,130	15,185	27,204	60,002
partial	169	13,351	572	2,696	6,723	16,407	28,942	46,413	131,396
none	628	31,263	23	11,498	27,581	46,032	64,299	75,525	105,323
Total	1,747	15,764	0	0	3,879	24,822	49,307	60,729	95,243

AHEAD widow(er)/single sample									
coverage	**N**	**mean**	**p10**	**p25**	**p50**	**p75**	**p90**	**p95**	**p99**
full	467	0	0	0	0	0	0	0	0
mostly	94	7,371	343	954	5,245	10,713	16,080	27,204	34,168
partial	90	14,333	448	2,877	8,140	17,554	35,552	47,043	131,396
none	416	29,455	2,132	10,527	25,222	41,458	60,839	76,345	102,029
Total	1,067	16,022	0	0	4,681	25,881	45,592	60,839	92,883

Widow(er)/single sample									
coverage	**N**	**mean**	**p10**	**p25**	**p50**	**p75**	**p90**	**p95**	**p99**
full	643	0	0	0	0	0	0	0	0
mostly	145	6,715	346	1,049	5,040	9,500	15,529	18,873	34,168
partial	127	12,821	382	2,219	6,811	16,651	35,552	46,414	76,724
none	518	30,357	2,206	10,942	25,881	43,085	60,638	76,345	105,323
Total	1,433	15,186	0	0	3,673	24,762	46,151	57,711	95,244

Data source: HRS 2000-2010 (includes exit interviews). Annualized OOP nursing home expenditures for nursing home stays of at least 100 days at time of interview (to exclude Medicare cases) depending on Medicaid coverage. Full coverage: Medicaid-recipient with full coverage. Mostly/partial coverage: Medicaid-recipient with some coverage. None: no Medicaid coverage. Weights adjusted by authors to account for missing values by assigning a higher weight to non-missing observations. Dollar figures converted into year 2000 values.

1.4.2 Medical

Table 10 shows pure medical OOP expenditures for all individuals of age 65 and above. Note that these expenditures are reported for the duration between interviews and not annually as a are nursing home expenses. The most important categories are the following: Hospital visits with overnight stays, outpatient surgery, doctor visits, prescription drugs, and home-health services (this does not mean formal home care). The upper part includes waves prior to the impact of Medicare Part D (the reason we start with year 2002 is that OOP expenditures are available for each of these categories only from 2002 on). This piece of legislation, signed into law as part of the Medicare Prescription Drug Modernization Act in 2003, became effective in 2006 to alleviate OOP prescription drug costs. The impact of this policy on OOP prescription drug costs is clearly visible in the HRS data. Nonetheless, OOP expenditure on prescription drugs continue to remain to be the largest expenditure category. In our calibration of the medical expenditure process we use the data starting with the year 2006 in order to capture the situation current elderly face more closely.

1.4.3 Expenditures by age

We now show that the model is successful in producing medical, nursing home, and total expenditures by age in line with the data. This is important since it allows us to better understand why there are not enough wealthy elderly in the model. If these expenditures in the model do not share the same risk features as in the data then fewer rich individuals might be the result. If, however, these risks are adequately captured, than our claim that the discretionary aspect is responsible for the retirement-savings puzzle is strengthened.

We first compare model-generate medical and nursing home expenditure distributions with those from the data. Here it is especially crucial to generate a fat right tail as this introduces riskiness which has been argued to be a key driver of savings. Table 11 shows these distributions. Unsurprisingly, pure medical expenditures in the model are very similar to those in the data; this expenditure process is directly calibrated. More interesting are nursing home expenditures since they are endogenous in the model. If anything, the model generates nursing home expenditures which are more "risky", in the sense that if those were observed in the data, and the researcher assumes them be a shock, riskiness would be large due to the large numbers in the 95th and 99th percentile. The model effortlessly creates the fact that expenditures, especially nursing home expenditures, strongly increase with age. Finally, in both data and model nursing home expenditures are substantially larger than medical expenditures. When considering the

Table 10: Medical expenditure categories

		Years: 2002-2010			
statistic	**hospital**	**outpatient**	**doctor**	**drugs**	**home health**
mean	178	49	258	1,568	53
p50	0	0	0	536	0
p75	0	0	159	1,538	0
p90	91	0	574	3,728	0
p95	794	131	1,191	5,641	0
p99	4,138	914	3,969	16,572	192
max	74,855	129,465	68,979	201,407	84,423

		Years: 2006-2010			
statistic	**hospital**	**outpatient**	**doctor**	**drugs**	**home health**
mean	186	58	265	1,218	57
p50	0	0	0	493	0
p75	0	0	166	1,306	0
p90	159	0	574	2,835	0
p95	828	159	1,429	4,563	0
p99	4,138	1,242	3,969	11,132	334
max	74,855	129,465	68,979	93,207	84,423

Data source: HRS (includes exit interviews). Out-of-pocket medical expenditures over time interval between interviews (core interviews: ≈ 1.5-3 years and exit interviews: ≈ 0.5-3 years) by age categories. Weights adjusted by authors to account for missing values by assigning a higher weight to non-missing observations. Dollar figures converted into year 2000 values.

combined expenditure process we see that the model produce a riskier picture than is the case in the data.

Additionally, it is also useful to consider the persistence of the total expenditure process as higher persistence implies a higher inherent degree of risk. Table 12 shows transition matrices of total expenditures for both data and model. Persistence of the highest expenditure category in the model is much stronger than in the data. In the lowest category model and data counterpart coincide. Since in the data there are also many short nursing home stays persistence in categories two and three is higher in the data than in the model.

Table 11: Medical and nursing home expenditures

	Data					Model				
	Medical					Medical				
Age	50pct	75pct	90pct	95pct	99pct	50pct	75pct	90pct	95pct	99pct
(65y,75y]	0.7	1.7	3.5	5.4	12.3	1.1	1.1	2.5	5.4	20.1
(75y,85y]	0.7	1.9	3.9	5.7	15.2	1.1	1.1	2.6	5.8	21.2
(85y,95y]	0.7	1.9	4.0	6.5	22.3	1.1	1.1	3.0	6.5	21.4
	Nursing home					Nursing home				
Age	50pct	75pct	90pct	95pct	99pct	50pct	75pct	90pct	95pct	99pct
(65y,75y]	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	41.1
(75y,85y]	0.0	0.0	0.0	1.6	54.6	0.0	0.0	0.0	17.4	108.9
(85y,95y]	0.0	0.0	9.9	33.1	89.5	0.0	0.0	21.6	53.7	111.8
	Total					Total				
Age	50pct	75pct	90pct	95pct	99pct	50pct	75pct	90pct	95pct	99pct
(65y,75y]	0.7	1.7	3.6	5.6	13.3	1.1	1.1	3.0	7.4	57.5
(75y,85y]	0.7	2.0	4.8	7.6	39.7	1.1	1.1	6.2	27.6	114.2
(85y,95y]	0.8	2.4	8.6	27.5	81.3	1.1	1.1	26.4	58.4	116.5

Data source: HRS waves 2006-2010. Data and model-generated percentiles of out-of-pocket expenditures over time interval between interviews (core interviews: ≈ 1.5-3 years and exit interviews: ≈ 0.5-3 years) by age categories.

2 Theory appendix

2.1 Solving the instantaneous game: Stages 2-4

We take as given the value functions $\{V^p, V^k\}$ and their derivatives and proceed by backward induction to characterize the equilibrium of the instantaneous game.

2.1.1 Consumption choice

Consumption choice Since $u^i_{cc}(\cdot) < 0$ for $i \in \{k, p\}$, the optimal consumption choice in the final stage of the game can be backed out from the first-order condition $u^i_c(c^i, \cdot) = V^i_{a^i}$ as in Barczyk

Table 12: Transitions in total medical expenditures

	Data					Model					
From	e_0	e_1	e_2	e_3	e_4	From	e_0	e_1	e_2	e_3	e_4
e_0	85.0	10.8	3.3	0.7	0.2	e_0	86.1	6.3	4.9	1.7	1.0
e_1	53.6	33.2	11.8	1.0	0.5	e_1	82.3	7.8	5.8	2.5	1.6
e_2	45.2	27.4	23.8	2.1	1.6	e_2	73.8	7.8	8.0	5.1	5.3
e_3	46.9	20.6	14.5	8.8	9.3	e_3	45.0	6.5	12.5	16.4	19.6
e_4	34.8	11.2	22.7	7.7	23.6	e_4	11.6	3.0	9.5	17.3	58.6
Total	77.8	15.0	5.8	0.9	0.5	Total	82.8	6.4	5.3	2.6	2.9

Data source: HRS waves 2006-2010 (including exit waves). Transitions matrix for total medical expenditures. Expenditures categories are constructed as follows: $e_0 < \$2,000$, $e_1 \in [\$2,000, \$5,000)$, $e_2 \in [\$5,000, \$20,000)$, $e_3 \in [\$20,000, \$50,000)$, $e_4 \geq \$50,000$.

Table 13: Transitions in FC time share

	Data					Model					
From	d_0	d_1	d_2	d_3	d_4	From	d_0	d_1	d_2	d_3	d_4
d_0	93.0	3.8	1.9	0.8	0.5	d_0	95.5	0.7	2.4	1.2	0.3
d_1	63.3	15.6	6.8	3.7	10.6	d_1	19.3	2.5	21.3	17.2	39.6
d_2	25.1	8.0	10.0	7.6	49.4	d_2	23.0	2.4	22.2	15.1	47.2
d_3	11.5	1.7	9.0	5.8	72.0	d_3	6.8	1.3	12.4	13.1	66.4
d_4	11.0	3.5	3.9	5.5	76.2	d_4	0.5	0.5	2.7	4.5	91.8
Total	89.2	4.2	2.3	1.1	3.2	Total	89.1	0.7	3.1	1.9	5.2

Data source: HRS waves 2000-2010 (including exit waves). Transitions matrix for time spend in a nursing home. Time spend in nursing home as fraction of time between interviews: $d_0 = 0$, $d_1 = (0, 10\%]$, $d_2 = (10, 50\%]$, $d_3 = (50, 90\%]$, $d_4 = (90, 100\%]$. HRS weights are used.

& Kredler (2014):

$$c^i(z, V_a; y_4, h, m) = \begin{cases} c^i_{unc} & \text{if } a^i > 0, \\ C_{ma} & \text{if } i = p \text{ and } m = 1, \\ \min\left\{c^i_{unc}, y_{i,4}\right\} & \text{otherwise.} \end{cases} \quad (1)$$

$$\text{where} \quad c^i_{unc} = \left(\frac{n^i(z)(1+\nu)^{\mathbb{I}\{i=k\}}}{\phi(n^i(z))^{1-\gamma} V^i_{a^i}}\right)^{\frac{1}{\gamma}} + \mathbb{I}\{i = p\} s(1-h) C_f$$

The parent is constrained to consume C_{ma} in case she is in MA. When having zero wealth, each agent may be constrained to consume their income-on-hand, $y_{i,4}$. Finally, note that when the parent is in PP, $s(1-h)(1-m) = 1$, then the parent needs C_f units of consumption more to obtain the same marginal utility as in IC.

MA choice

2.1.2 Medicaid (MA) decision

We now go back to the parent's MA choice in Stage 3. We first note that the child will choose the same consumption level, c^k, in the final stage, no matter what the parent's MA choice is. We can easily see this to be true from (4) since the child's income-on-hand, $y_{k,4}$, is the same irrespective of the parent's MA decision. Taking together (6) and (5), a broke parent in formal care thus chooses MA for in Stage 3 if and only if

$$u^p(C_{ma}, h = 0; z) > \underbrace{u^p(c_{pp}, h = 0; z) + [y_{p,3} - p_{bc} + s_{pp} - c_{pp}] V^p_{a^p}}_{=G(y_{p,3})}, \quad (2)$$

$$\text{where} \qquad c_{pp} = c^p(z, V_a; [y_{k,3}, y_{p,3} - p_{bc} + s_{pp}], h = 0, m = 0).$$

Note that if the parent is constrained in PP, she chooses PP iff the consumption level she can afford in PP, $c_{pp} = y_{p,3} - p_{bc} + s_{pp}$, exceeds C_{ma}. In general, the function $G(\cdot)$ defined on the right-hand side of (2) is strictly increasing in $y_{p,3}$. We can thus implicitly define a threshold income level y^p_{thr} that characterizes the optimal MA choice as

$$m(z, V_a; y_3, h) = s(1-h)\mathbb{I}\{a^p = 0\}\mathbb{I}\{y_{p,3} < y^p_{thr}\}, \qquad \text{where } y^p_{thr} \text{ solves}$$
$$G(y^p_{thr}) = u^p(C_{ma}, h = 0; z).$$

2.1.3 Gift choice

Healthy or informal care: $s = 0$ *or* $h = 1$.

We first state the optimal transfer choice for the case in which the parent is healthy or informal care was chosen in Stage 1. The solution is exactly as in Barczyk & Kredler (2014). Following them, we first define the "dictator solutions" that player i would choose if she could impose her preferred allocation on the other. Player i's dicator transfer (which may be positive or negative) is implicitly defined by

$$V^i_{a^i} = \alpha^i u^j_c(y_{j,2} + g^i_{dict}, \cdot).$$

In order to find equilibrium gifts in the situation where players are constrained, we will also make use of the dictator transfer that player i would choose in a static setting in which no savings take place. The static dictator transfer is implicitly defined by

$$u^i_c(y_{i,2} - g^i_{stat,dict}, \cdot) = \alpha^i u^j_c(y_{j,2} + g^i_{stat,dict}, \cdot).$$

Finally, let us define the consumption level that player i would choose if unconstrained, c^i_{unc}, implicitly as

$$u^i_c(c^i_{unc}, \cdot) = V^i_{a^i}.$$

With this notation in hand, the optimal gift choices unconstrained and a constrained player are as in Barczyk & Kredler (2014):

$$\begin{aligned} g^i_{unc} &\equiv \max\left\{0, \min\{g^i_{dict}, c^j_{unc} - y_{j,2}\}\right\}, \\ g^i_{constr} &\equiv \max\left\{0, \min\{g^i_{stat,dict}, c^j_{unc} - y_{j,2}\}\right\}, \end{aligned}$$

We can then write the optimal gift-giving strategy when the parent is healthy as

$$\text{If } s = 0 \text{ or } h = 1: \quad g^i(z, V_a; y_2, h) = \begin{cases} 0 & \text{if } a^j > 0, \\ g^i_{unc} & \text{if } a^j = 0 \text{ and } a^i > 0, \\ g^i_{unc} & \text{if } a^j = a^i = 0 \text{ and } c^i_{unc} + g^i_{unc} \leq y_{i,2}, \\ g^i_{constr} & \text{otherwise.} \end{cases} \tag{3}$$

The intuition is as follows. Player i does not provide gifts to player j as long as player j still has positive assets. Instead, she would wait until player j has spent down her wealth in order to be able to control the consumption of player j. When player j is broke, then player i will aim to implement her preferred solution, setting agent j's marginal utility, weighted by the altruism parameter α^i, equal to her own marginal utility. If player i's income is high, the marginal utility of gift-giving at $g^i = 0$ may be negative, thus resulting in the corner solution of zero transfers. Once both agents are broke, the same reasoning holds, but the solution may be constrained by the family's total income stream.

Formal care: $s = 1$ and $h = 0$. We now analyze the gift choice under formal care, distinguishing the cases where the child is constrained and where it is not.

To make the parent choose PP, the child has to lift the parent's Stage-3 income above y^p_{thr}, see (2). Since $y_{p,3} = y_{p,2} + g^k$, this means that the smallest transfer that achieves PP is $g^k_{thr} \equiv \max\{0, y^p_{thr} - y_{p,2}\}$. Any gift below this threshold is wasted, and it thus follows that the optimal gift on the interval $g^k \in [0, g^k_{thr})$ is $g^k = 0$.[3] On the interval $g^k \in [g^k_{thr}, \infty)$, we denote the optimal gift by g^k_{noMA}. Finally, the kid compares which out of $g^k \in \{0, g^k_{noMA}\}$ is better for her. We now go over two different cases, the unconstrained child and then the constrained child.

Case 1: child unconstrained ($a^k > 0$). Consider the situation when the child gives a transfer $g^k \geq g^k_{thr}$ that makes the parent choose PP. The kid's payoff function on this range, H^k_{noMA}, is then as in a setting without a consumption floor (see Barczyk & Kredler, 2014). We define the Hamiltonian for this case (where there is no Medicaid) as

$$H^k_{noMA}(g^k) \equiv \alpha^k u^p\big(\min\{c^p_{unc}, y_{p,2}+g^k-p_{bc}+s_{pp}\}, h = 0, z\big)+[y_{p,2}+g^k-p_{bc}+s_{pp}-c^p_{unc}]^+ V^k_{a^p} - g^k V^k_{a^k},$$

where $[x]^+ \equiv \max\{x, 0\}$. As shown in Barczyk & Kredler (2014), the function H^k_{noMA} is strictly increasing for $g^k < \tilde{g}^k$, and strictly decreasing for $g^k > \tilde{g}^k$, where

$$\tilde{g}^k = \max\big\{0, \min\{g^k_{dict}, c^p_{unc} + p_{bc} - s_{pp} - y_{p,2}\}\big\}.$$

The kid's payoff is increasing until the point where either g^k_{dict} is reached (which implements the kid's favored consumption allocation at this point in time) or the parent starts to save the

[3] The interval $[0, g^k_{thr})$ is empty if $g_{thr} = 0$, in which case the parent chooses private care for any gift. In this case, only the interval $g^k \in [g^k_{thr}, \infty)$ is of interest.

gift. Thus, on the range $g^k \geq g^k_{thr}$, the optimal transfer is

$$g^k_{noMA} \equiv \arg \max_{g^k \geq g^k_{thr}} H^k_{noMA}(g^k) = \max\{g^k_{thr}, \tilde{g}^k\}.$$

Finally, we have to compare how the kid values the outcome under the best gift choice on the range $g^k \geq g^k_{thr}$ versus a transfer of zero. This gives us the kid's optimal transfer when the kid is unconstrained:

$$g^k_{f,unc} = \begin{cases} 0 & \text{if } \alpha^k u^p(C_{ma}, 0; z) \geq \alpha^k u^p(y_{p,2} - p_{bc} + s_{pp} + g^k_{noMA}, 0; z) - g^k_{noMA} V^k_{a^k}, \\ g^k_{noMA} & \text{otherwise.} \end{cases} \quad (4)$$

Note that in the case that the parent goes to MA when receiving no gift from the kid, this equation obviously gives the correct solution. If the parent does not go to MA given $g^k = 0$, then $g^k_{thr} = 0$. Thus $H^k_{noMA}(g^k_{noMA}) \geq H^k_{noMA}(0) \geq \alpha^k u^p(C_{ma}, 0; z)$, since the child will also prefer PP to MA if the parent chooses so herself in Stage 3 for $g^k = 0$. Thus the equation also gives the correct solution in this case.

Case 2: child constrained ($a^k = 0$). When the kid is also broke, we have to consider the possibility that the child is constrained. If the unconstrained-optimal gift from (4) is feasible, then $(c^k_{unc}, g^k_{f,unc})$ is obviously also the solution to the problem with the additional constraint. If the unconstrained-optimal policy is not feasible, the child will choose a transfer such that the constraint $c^k + g^k = y_{k,2}$ binds since the payoff is strictly concave (again, see Barczyk & Kredler, 2014). To find the optimal transfer that fulfills $c^k + g^k = y_{k,2}$, consider the kid's payoff when the parent does not receive MA and the child is constrained:

$$\hat{H}^k_{noMA}(g^k) = \alpha^k u^p\big(\min\{c^p_{unc}, y_{p,2}+g^k-p_{bc}+s_{pp}\}, 0; z\big)+[y_{p,2}+g^k-p_{bc}+s_{pp}-c^p_{unc}]^+ V^k_{a^p}+u^k(y_{k,2}-g^k).$$

As Barczyk & Kredler (2014) show, $\hat{H}^k_{noMA}(g^k)$ is strictly increasing for $g^k < \tilde{g}^k_{constr}$ and strictly decreasing for $g^k > g^k_{constr}$, where

$$\tilde{g}^k_{constr} \equiv \max\big\{0, \min\{g^k_{stat,dict}, c^p_{unc} + p_{bc} - s_{pp} - y_{p,2}\}\big\}.$$

Thus, the kid's optimal transfer among those that make the parent choose private care is

$$\hat{g}^k_{noMA} \equiv \arg \max_{g^k \geq g^k_{thr}} \hat{H}^k_{noMA}(g^k) = \max\{g^k_{thr}, \tilde{g}^k_{constr}\}.$$

We still have to consider an exception: It is not feasible for the child to give a transfer $g^k \geq g^k_{thr}$ if $y_{k,2} < g^k_{thr}$. In this case, any transfer from the child is wasted, thus $g^k = 0$ is optimal. If it is feasible for the child to pay g^k_{thr}, then she should again compare the payoff of giving $\hat{g}^k_{noMA}$ to that of zero transfers. To summarize, the child's optimal transfer when constrained is

$$g^k_{f,constr} = \begin{cases} 0 & \text{if } y_{k,2} < g^k_{thr}, \\ 0 & \text{if } y_{k,2} \geq g^k_{thr} \text{ and } \alpha^k u^p(C_{ma}, 0; z) + u^k(y_{k,2}) \geq \\ & \qquad \alpha^k u^p(y_{p,2} - p_{bc} + s_{pp} + \hat{g}^k_{noMA}, 0; z) + u^k(y_{k,2} - \hat{g}^k_{noMA}), \\ \hat{g}^k_{noMA} & \text{otherwise.} \end{cases} \tag{5}$$

Summary: child's optimal gift in formal care. Summarizing all cases, the child's optimal gift under formal care is

$$g^k(z : s = 1, y_2, h = 0) = \begin{cases} 0 & \text{if } a^p > 0, \\ g^k_{f,unc} & \text{if } a^p = 0 \text{ and } a^k > 0, \\ g^k_{f,unc} & \text{if } a^p = a^k = 0 \text{ and } c^k_{unc} + g^k_{f,unc} \leq y_{k,2}, \\ g^k_{f,constr} & \text{otherwise.} \end{cases}$$

The intuition is similar to the situation in which the parent is healthy. Kids do not give transfers to parents who still own wealth since they want to exert control over the parent's spending. When the parent is broke, kids compare two situations: A first situation in which they do not give gifts and the parent may take up MA, and a second in which they give an (optimally-chosen) gift to parents that enables the parent to afford PP care. Note that the first situation (MA) may not arise if parents have high income and can afford PP themselves. The second situation (PP) may not be feasible, on the other hand, if the child is broke and has such low income that PP is not affordable for the larger family. Kids then choose the better of the two scenarios by either giving zero or positive gifts. Again, the optimal-gift-giving formula has to be adjusted for the case in which the child is broke and the family is constrained by total family income.

Parent's gift in formal care. Parents' optimal gifts are as in the case without formal care if $a^p > 0$, see Equation (3). If $a^p = 0$, then the parent cannot give gifts by assumption.

2.2 IC decision: Neither agent broke

Proof for Proposition 3.1: We start by writing down the surplus functions $S^p(Q)$ and $S^k(Q)$. Since we assumed $V^p_{a^p} > V^p_{a^k}$ and $V^k_{a^k} > V^k_{a^p}$, gifts in Stage 2 will be zero and the parent will not choose MA. Then we can write the laws of motion for wealth, (1) and (2), as functions of Q and h:[4]

$$\dot{a}^p(Q,h) = ra^p + y_p(\epsilon^p) - hQ - (1-h)(p_{bc} - s_{pp}) - c^p(\cdot, h, m=0),$$
$$\dot{a}^k(Q,h) = ra^k + h(Q + y_{k,ic} + s_{ic}) + (1-h)y_{k,fc} - c^k(\cdot, h, m=0).$$

Since $a^k > 0$, the optimal consumption rule (1) tells us that kid consumes the same in both scenarios in Stage 4, i.e. $c^k(\cdot, h=0) = c^k(\cdot, h=1)$. Thus also the kid's felicity $u^k(c^k(\cdot,h))$ is the same in both scenarios. For the parent, however, (1) tells us that she consumes C_f more in PP, i.e. $c^p(\cdot, h=0) - c^p(\cdot, h=1) = C_f$. But again, the parent's felicity is the same for $h=0$ and for $h=1$: Since the parent chooses consumption to set marginal felicity equal to $V^p_{a^p}$ in both cases, also the level of felicity must be the same due to the functional form of $u^p(\cdot)$.

Now, take the difference of the laws of motion between the two scenarios:

$$\dot{a}^p(Q,h=1) - \dot{a}^p(Q,h=0) = p_{bc} - s_{pp} - C_f - Q,$$
$$\dot{a}^k(Q,h=1) - \dot{a}^k(Q,h=0) = y_{k,ic} - y_{k,fc} + s_{ic} + Q.$$

Using these equations and the facts that the felicity is the same in the two scenarios for both agents, we find that the surplus functions from (11) become

$$S^i(Q) = [p_{bc} - s_{pp} + C_f - Q]V^i_{a^p} + [s_{ic} - \underbrace{(y_{k,fc} - y_{i,fc})}_{=\Delta y_{ic}} + Q]V^i_{a^k} \qquad \text{for } i \in \{k,p\}. \tag{6}$$

Since we assumed $V^p_{a^p} > V^p_{a^k}$, $S^p(Q)$ is linearly decreasing in Q. Also, $S^k(Q)$ is linearly increasing in Q since we assumed $V^k_{a^k} > V^k_{a^k}$. Setting $S^p(Q)=0$ and $S^k(Q)=0$ then yields the thresholds $\bar{Q}^p$ and $\underline{Q}^k$ claimed in the proposition. ■

Proof for Proposition 3.2. We first show that Eq. (18) must hold. Define the private cost of PP as $C_{pp} \equiv C_f + p_{bc} - s_{pp}$ and the private cost of IC as $C_{ic} \equiv \Delta y_{ic} - s_{ic}$. First, consider the case $C_{pp} \geq C_{ic}$. Pick an arbitrary $\tilde{Q} \in [C_{ic}, C_{pp}]$. We then see from the surplus functions in (11)

[4] Formally, use the laws of motion in H^k_4 in (4), and then recursively substitute into H^k_3, then into H^k_2, and finally into (11).

that $S^k(\tilde{Q}) \geq 0$ and $S^p(\tilde{Q}) \geq 0$; after all, both agents are better off under this transfer, and they value each other's well-being positively. Thus we have found a transfer $\tilde{Q} > 0$ that makes both better off, and thus $h = 1$. Second, consider the opposite case: $C_{pp} < C_{ic}$. Pick an arbitrary $\hat{Q} \in (C_{pp}, C_{ic})$. Again from (11), it is easy to see that $S^k(\hat{Q}) < 0$ and $S^p(\hat{Q}) < 0$. Since S^p is decreasing in Q, $S^p(Q) < 0$ for all $Q \geq \hat{Q}$, i.e. the parent will not accept any transfer that is higher. Neither will the kid accept any transfer that is lower: Since S^k is increasing in Q, $S^k(Q) < 0$ for all $Q \leq \hat{Q}$. Thus there is no Q that makes both better off, which implies $h = 0$. Taking together the two cases implies (18).

To show Eq. (19), note that the surplus functions are linear. As is well-known, the equilibrium transfer Q^* is then given by the convex combination of the threat points using the bargaining weight ω. Formally, the results may be derived by maximizing the Nash criterion in (12).

Finally, we have to show that $h(z)$ represents the same decision rule that a family planner would choose who maximizes a weighted sum of utilities of the family members. By way of contradiction, consider an allocation A (a contingent, feasible plan for consumption, assets, and the care decision for the dynasty) that violates Eq. (18) at some t, in some state of nature. We will now show that a planner could increase flow felicity of both the parent and the kid in this state of the world. There are two cases to consider: (i) If allocation A prescribes $h_t = 1$ but we have $C_{pp} = C_f + p_{bc} - s_{pp} < \Delta y_{ic} - s_{ic} = C_{ic}$, then the alternative plan of choosing $\tilde{h}_t = 0$ leads to a change in the family's income flow by $\tilde{\Delta} = \Delta y_{ic} - s_{ic} - (p_{bc} - s_{pp}) > C_f$. The planner can now allocate C_f units of the gain $\tilde{\Delta}$ to the parent and $\tilde{\Delta} - C_f$ units to the kid, thus maintaining the parent's flow felicity constant while increasing the kid's flow felicity. This is a Pareto improvement and A cannot be optimal. (ii) If $h_t = 0$ but $C_{pp} > C_{ic}$, then a switch to IC yields an income change $\tilde{\Delta} = p_{bc} - s_{pp} - (\Delta y_{ic} - s_{ic} > -C_f$. Under IC, the planner could reduce the parent's consumption by C_f units, maintaining her felicity constant, while increasing the kid's consumption by $C_f + \tilde{\Delta} > 0$ units. This again yields a Pareto improvement. Taking cases (i) and (ii) together implies that any allocation that is optimal for a family planner satisfies Eq. (18), which is equivalent to the claim in the proposition. ■

Proof for Corollary 3.1. The statements on the comparative statics with respect to to C_f, $p_{bc} - s_{pp}$, and $\Delta y_{ic} - s_{ic}$ follow directly from Eq. (18) in Proposition 3.2. The two claims in the last sentence of the corollary can be shown by first taking the following derivatives in

Equations (17) and (16):

$$\partial \underline{Q}^k / \partial V^k_{a^p} = -V^k_{a^k} B_{ic} / (V^k_{a^k} - V^k_{a^p})^2, \qquad \frac{\partial \bar{Q}^p}{\partial V^p_{a^p}} = V^p_{a^k} B_{ic} / (V^p_{a^p} - V^p_{a^k})^2,$$

where we define $B_{ic} \equiv C_f + p_{bc} - s_{pp} - (\Delta y_{ic} - s_{ic})$ as the (utility-adjusted) benefit that the entire family derives from IC. Since $h = 1$ if and only if $B_{ic} \geq 0$ by Proposition 3.2, it follows that $\partial \underline{Q}^k / \partial V^k_{a^p} \leq 0$ and $\partial \bar{Q}^p / \partial V^p_{a^p} > 0$. By Proposition 3.2, it then directly follows that Q^* is weakly decreasing in $V^k_{a^p}$ and weakly increasing in $V^p_{a^p}$, as claimed. ■

2.3 IC decision: General case

The following discussion of informal-care bargaining encompasses all cases, i.e. also vectors (a^p, a^k) where one or both players have zero wealth.

We will first analyze which transfers Q are too low in the sense that the parent would choose to top up the transfer Q with a gift $g^p > 0$ in Stage 2. It is useful to define the "dictator transfer" for the parent, $Q^*_p \in \overline{\mathbb{R}}$, which we back out from the (potentially negative) transfer that the parent would choose in IC if she had all family flow income in her pocket in Stage 2:

$$Q^*_p \equiv \begin{cases} g^p(z, V_a; [y_{p,2} = y_{p,1} + y_{k,ic}, 0], 1) - y_{k,ic} & \text{if } a^k = 0, \\ -\infty & \text{otherwise.} \end{cases} \tag{7}$$

When the kid has positive wealth, the parent always wants to receive an unbounded negative transfer flow since she prefers wealth to be in her pockets, $V^p_{a^p} > V^p_{a^k}$, and we define the desired transfer to be $-\infty$. Now, observe that for any transfer falling short of the optimum in Stage 1, $Q < Q^*_p$, the parent will give a gift $g^p = Q^*_p - Q$ in Stage 2 to attain her preferred allocation. This is true since all outcomes available after a transfer $Q < Q^*_p$ are also available to the parent when owning the family's entire flow income, which is how we constructed Q^*_p in the first place. In the transfer stage, we have thus shown that the parent's optimal strategy is

$$g^p = \max\{Q^*_p - Q, 0\}.$$

In a similar fashion, we now define an upper bound on transfers. Some transfers are so high that the kid would give back part of them as a gift. We define the dictator transfer for the child, $Q^*_k \in \overline{\mathbb{R}}$, from the gift the kid would give to the parent if the kid owned all of the family's flow income at the gift-giving stage:

$$Q_k^* \equiv \begin{cases} y_{p,1} - g^k(z, V_a; [0, y_{p,2} = y_{p,1} + y_{k,ic}], 1) & \text{if } a^p = 0, \\ \infty & \text{otherwise.} \end{cases} \tag{8}$$

Note that Q_k^* may be negative if $a^p = 0$. If the child has lots of resources, she may not want a transfer Q in exchange for IC but give a gift himself to prop up the parent's consumption. On the other hand, whenever the parent has positive wealth, the kid would like to receive an unbounded transfer flow since $V_{a^k}^k > V_{a^p}^k$.

We now show that $Q_k^* > Q_p^*$. If at least one of the players has positive wealth, this statement is obvious. For the case $a^p = a^k = 0$, imperfect altruism ($\alpha^k \alpha^p < 1$) implies that each player would choose the other to consume less than herself if she commanded all family flow income, resulting in the ideal transfer being larger for the kid than for the parent.

We now show that we only have to consider transfers $Q \in [Q_p^*, Q_k^*]$ to find the bargaining solution for informal care. First, we need not consider $Q < Q_p^*$, since the parent would react to such a low transfer by a gift in the gift-giving stage, lifting up the total amount given to the young to $Q + g^p = Q_p^*$. Thus any transfer $Q < Q_p^*$ will lead to the same consumption-savings allocation in Stage 4, and to the same bargaining surplus, as $Q = Q_p^*$. We thus may consider these transfers as equivalent and restrict the analysis to $Q \geq Q_p^*$. Second, any transfer $Q > Q_k^*$ would be "undone" by a gift from the children, leading to the same allocation and surplus as $Q = Q_k^*$.

We thus restrict the analysis to the interval $Q \in [Q_p^*, Q_k^*]$. On this interval, both S^k and S^p are monotone functions: the parent strictly prefers lower transfers and children prefer higher transfers, the bounds of the interval being their respective bliss points (if this was not the case, there would be gifts in the gift-giving stage). Now taking into account the non-negativity constraint on Q, we define the following bounds on the equilibrium transfer:

$$Q_{lb} = \max\{0, Q_p^*\}, \qquad Q_{ub} = \max\{0, Q_k^*\}. \tag{9}$$

If $Q_p^* < 0$, the ideal transfer for the parent is zero since we restrict Q to be non-negative. If, on the other hand, $Q_k^* < 0$, the child is so well off that she would give gifts to the parent in Stage 2 even if she receives no transfer for giving informal care. In this situation, the child will always implement her preferred allocation in Stage 2 and acts as a family dictator.

The following proposition is a full characterization of the informal-care decision.

Proposition 2.1 (general characterization of informal-care decision) ***Proposition*** *(*general characterization of informal-care decision*): Let Q_p^* and Q_k^* be defined as in* (7) *and* (8)*, and let Q_{lb} and Q_{ub} be defined as in* (9)*. Then $Q_p^* < Q_k^*$, $S^p(Q)$ is a decreasing function for $Q \in [Q_p^*, Q_k^*]$, and $S^p(q)$ is an increasing function for $Q \in [Q_p^*, Q_k^*]$. In equilibrium the following cases can be distinguished:*

1. *(one bliss point undesirable) If $S^p(Q_{lb}) < 0$ or $S^k(Q_{ub}) < 0$, then $h = 0$.*
2. *(bliss points are desirable) If $S^p(Q_{lb}) \geq 0$ and $S^k(Q_{ub}) \geq 0$, then there exist thresholds $\underline{Q}^k \in [Q_{lb}, Q_{ub}]$ and $\bar{Q}^p \in [Q_{lb}, Q_{ub}]$ such that $S^k(Q) \geq 0$ iff $Q \geq \underline{Q}^k$ and $S^p(Q) \geq 0$ iff $Q \leq \bar{Q}^p$.*
   (a) *(excessive reservation transfer) If $\underline{Q}^k > \bar{Q}^p$, then $h = 0$.*
   (b) *(bargaining solution) If $\underline{Q}^k \leq \bar{Q}^p$, then $h = 1$ and*

$$Q^* = \arg \max_{Q \in [\underline{Q}^k, \bar{Q}^p]} \{S^k(Q)^{\omega} S^p(Q)^{1-\omega}\}.$$

Also, the parent will give no gifts in the ensuing stage of the game: $g^p = 0$. For the child, the following holds: if $Q_k^* \geq 0$ then $g^k = 0$, otherwise $g^k = -Q_k^* > 0$ and $Q^* = 0$.

Proof: $Q_p^* < Q_k^*$ and monotonicity of the functions S^p and S^k on the interval $[Q_p^*, Q_k^*]$ has been proved before. We now go over the different cases covered by the proposition, giving some explanations on the way.

1. If the parent is not willing to accept informal care even for the lowest-possible transfer, i.e. $S^p(Q_{lb}) < 0$, then $S^p(Q) < 0$ for all $Q \geq 0$ by monotonicity of the surplus function and thus no informal care takes place. Similarly, if the child is not willing to provide care for the highest-possible transfer, i.e. $S^k(Q_{ub}) < 0$, then no informal care takes place.
2. Consider now the case in which some transfer exists for each player under which they prefer IC. By increasingness of S^k, we can find the child's reservation transfer $\underline{Q}^k \in [Q_{lb}, Q_{ub}]$ at which S^k turns positive. Note that this reservation transfer is equal to Q_{lb} if $S^k(Q_{lb}) \geq 0$, and it equals zero if in addition $Q_{lb} = 0$. Similarly, by increasingness of S^p we can find $\bar{Q}^p \in [Q_{lb}, Q_{ub}]$, the parent's willingness to pay, above which S^p turns

negative. This willingness to pay equals Q_{ub} if $S^p(Q_{ub}) \geq 0$. We can distinguish the following two cases according to the ordering of $\underline{Q}^k$ and $\bar{Q}^p$:

(a) $\underline{Q}^k > \bar{Q}^p$: There is no Q such that both agents have a positive surplus and thus $h = 0$.

(b) $\underline{Q}^k \leq \bar{Q}^p$: The surplus is positive for both agents on $Q \in [\underline{Q}^k, \bar{Q}^p]$, thus $h = 1$. We can find the Nash-bargaining solution Q^* evaluating the derivative of the Nash criterion in (12) with respect to Q. This derivative is easily shown to be a decreasing function on on $Q \in [\underline{Q}^k, \bar{Q}^p]$. Since $\bar{Q}^p \geq Q_{lb} \geq Q_p^*$, the parent will not give gifts in Stage 2. The following sub-cases can arise:

   i. $Q_{lb} = Q_{ub} = 0$: This case arises when the kid is not willing to accept a transfer $Q > 0$ from the parent, $Q_k^* \leq 0$, i.e. the kid would undo such a transfer by an altruistic gift. In this case we only have to check if both agents prefer IC to PP for $Q = 0$. Iff both prefer IC, then $h = 1$ and the child gives an altruistic gift in Stage 2.

   ii. $Q_{lb} = 0 < Q_{ub}$: The parent's bliss point is such that she would prefer not to give any transfer, i.e. $Q_p^* = 0$. In this case a corner solution $Q^* = 0$ may arise, which is characterized by the derivative of the Nash criterion being negative at $Q = 0$.

   iii. $0 < Q_{lb} < Q_{ub}$: In this case, there is an interior solution, which is identified by finding the zero of the derivative of the Nash criterion on (Q_{lb}, Q_{ub}).

Finally, we note that the case in which both players have positive wealth (which is discussed in the main text), is included in Point 2(b). In this case, $Q_p^* = -\infty < Q_{lb} = 0 < Q_{ub} = Q_k^*$, and the Nash-bargaining solution can be found in closed form. ■

3 Calibration appendix

3.1 Health, mortality and medical-spending risks

Health and mortality. We first estimate stocks of LTC individuals $\lambda(j, ed)$ as a function of higher-order variables in age and interaction of age with education. We use a log-likelihood ratio test to pin down a desirable specification (among combinations of age, age-squared, education, and education interacted with age). Figure 1 shows the stocks of LTC individuals in the data by gender and educational attainment. Lower educated individuals have the lowest life expectancy and tend to require LTC at earlier ages. Additionally, their expected duration of LTC is longest.[5]

We then estimate transition probabilities for mortality by gender, health status, and educational attainment, shown in panels two and three of Figure 2. The preferred model for mortality hazards over a two-year interval for healthy individuals includes again age, age-squared, education, and education interacted with age, $\pi^{s=0}_{j+2}(j, ed)$. For LTC individuals, various statistical tests suggest that a model specification with only age and age-squared suffices, $\pi^{s=1}_{j+2}(j)$. To recover transition probabilities for LTC we make use of $\lambda(j, ed)$, $\pi^{s=0}_{j+2}(j, ed)$, and $\pi^{s=1}_{j+2}(j)$. Denote the stock of LTC individuals at age j and education level ed by $S(j, ed)$ and those who are healthy by $H(j, ed)$. By assumption, all individuals at age 65 are healthy. The pool of individuals alive A (the sum of healthy and disabled) after a two-year period is

$$A(j + 2, ed) = [1 - \pi^{s=0}_{j+2}(j, ed)]H(j, ed) + [1 - \pi^{s=1}_{j+2}(j)]S(j, ed).$$

The number of LTC individuals after two years is $S(j + 2, ed) = \lambda(j + 2, ed)A(j + 2, ed)$. We can solve for the LTC transition probability $\phi(j, ed)$ from the law of motion of LTC individuals

$$S(j + 2, ed) = (1 - \pi^{s=1}_{j+2}(j, ed))S(j, ed) + \phi(j, ed)H(j, ed).$$

Finally, we also need to update the stock of healthy individuals

$$H(j + 2, ed) = (1 - \pi^{s=0}_{j+2}(j, ed))H(j, ed).$$

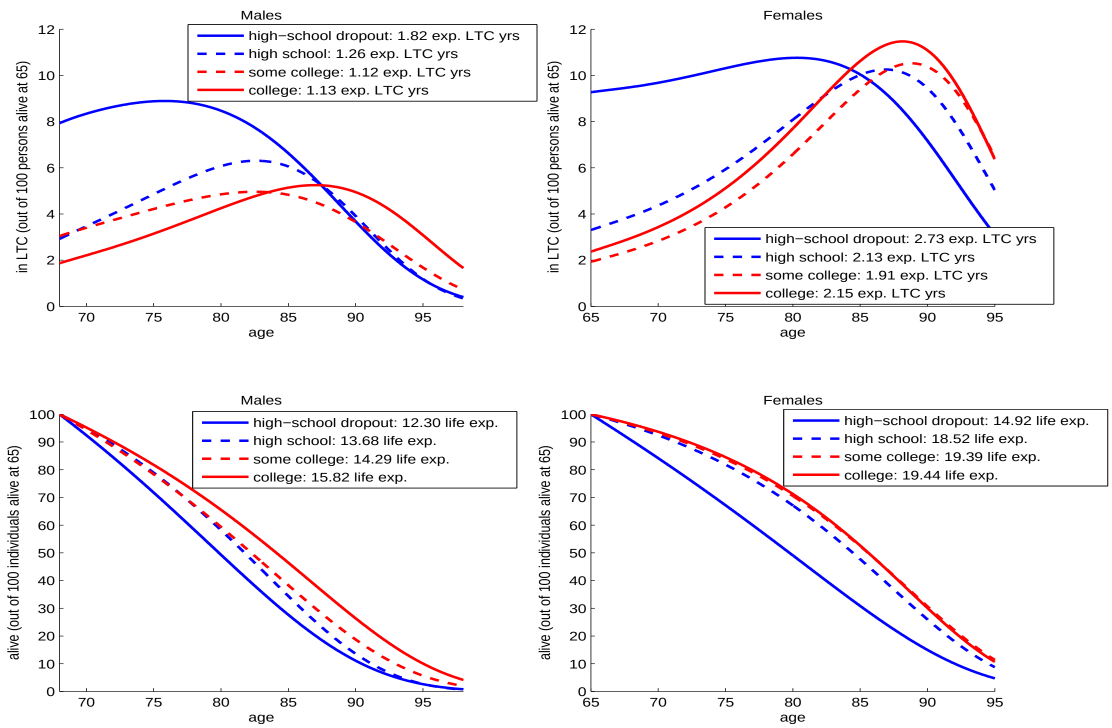
This estimation procedure yields conditional probabilities over a two-year time period. We need to convert these into yearly hazard rates, which we do by taking the matrix-logarithm of the estimated conditional probabilities. The top panel in Figure 2 shows the resulting LTC-risk profile.

In the model all individuals of age 65 are assumed to be healthy. Thus, when we estimate LTC and mortality hazards beginning with a pool of healthy individuals at age 65 we obtain a life expectancy which is somewhat higher and an expected duration of LTC slightly lower than is the case for all individuals in the data; Table 14 shows this comparison.

Medical spending. Medicare is a government health-insurance program that covers all individ-

[5] Cross-sectionally we also find that low-education individuals have more disability. We find that high-school dropouts above 65 years of age are roughly three times as likely to be disabled (according to our classification) than a college graduate above 65.

Figure 1: Empirical stocks of LTC individuals

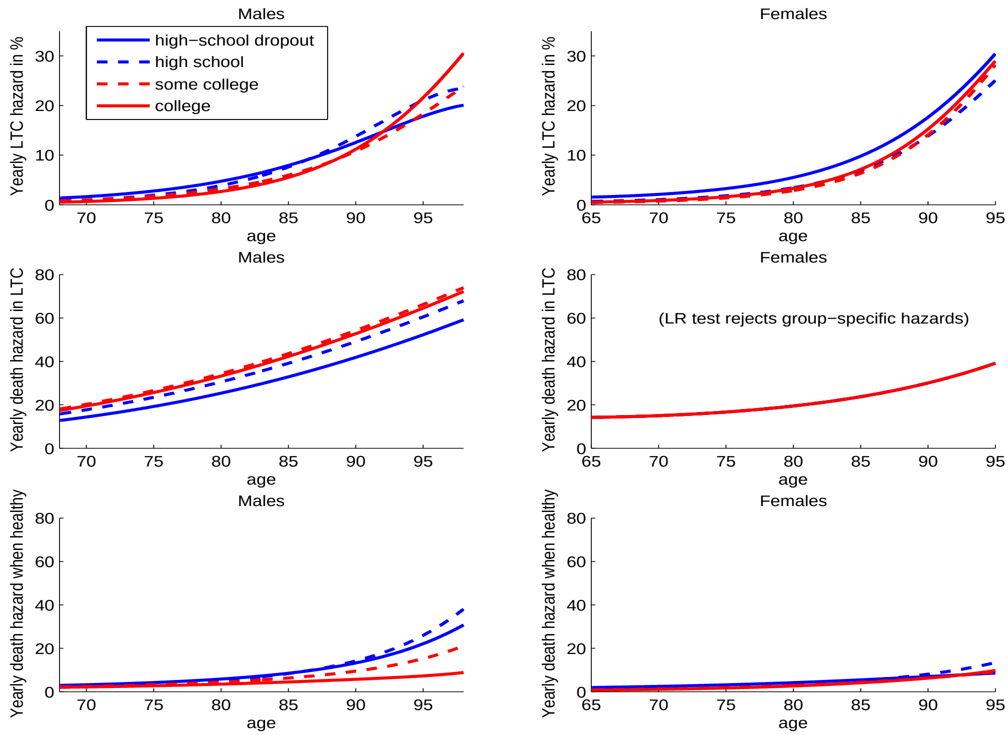


Data source: HRS waves 2000-2010.

uals of age 65+ irrespective of income and wealth. Since we assume that medical shocks are exogenous and the Medicare policy remains invariant across the counterfactual experiments, we take this part out of the estimation of the shock process. Medicaid is a means-tested program that helps elderly individuals pay for expenditures that Medicare does not cover. Due to the means test, Medicaid costs to the government change endogenously when individuals change their savings behavior in response to policies. Thus we use pre-Medicaid costs in our estimation.

To estimate the pre-Medicaid medical expenditure process we follow Kopecky & Koreshkova (2014) and use observations that pertain to household heads in the top permanent-income quintile; permanent income is approximated by the sum of social-security benefits, employer pension plans and annuities. The assumption is that OOP medical-expenditures are invariant across permanent income categories when conditioning on age. We study the following 5 categories from the HRS (including the exit interviews): hospital visits with overnight

Figure 2: Empirical and model hazards



Data source: HRS waves 2000-2010.

stays, outpatient surgery, doctor visits, prescription drugs, and home-health services (this does not include formal home care) for individuals of ages 65 and above. For the purposes of the medical expenditure process we opt to use waves starting from 2006 on to get an estimation that is more in line with the situation current retirees face; see Table 10.

One point where we have to go beyond Kopecky & Koreshkova (2014) is the following. Note that to generate a fat-tailed distribution, as has been documented in the literature, in continuous time we cannot have individuals draw from a medical-shock distribution at each point in time as these shocks would average out by the law of large numbers.[6] Instead, to obtain a fat-tailed distribution, we need to assume that medical expenditures are lumpy (which also seems more realistic). In continuous time lumpiness is modelled through a jump process which is characterized by two objects: the hazard rate that a medical event occurs, and the distribution

[6]In principal one could use Brownian disturbances to wealth to model medical shocks but such a process does not deliver fat tails even though it might occasionally generate very large expenditures.

Table 14: Life expectancy and expected LTC duration

Source	< high school	high school	some college	college
Data	14.92	18.52	19.39	19.44
Model	15.79	18.94	19.64	19.76

Data source: HRS waves 2000-2010. Females: life expectancy at age 65 by educational attainment.

Source	< high school	high school	some college	college
Data	2.73	2.13	1.91	2.15
Model	2.35	1.98	1.83	2.05

Data source: HRS waves 2000-2010. Females: expected duration of LTC, conditional on LTC, by educational attainment.

Source	< high school	high school	some college	college
Data	12.30	13.68	14.29	15.82
Model	12.86	13.94	14.60	16.03

Data source: HRS waves 2000-2010. Males: life expectancy at age 65 by educational attainment.

Source	< high school	high school	some college	college
Data	1.82	1.28	1.12	1.13
Model	1.48	1.15	1.01	1.07

Data source: HRS waves 2000-2010. Males: expected duration of LTC, conditional on LTC, by educational attainment.

of medical costs conditional on the event occurring. To separately identify these two objects we proceed in the following way.

Hazard rate of medical event. We define a medical event to be a medical procedure which triggers a potentially large OOP expenditure. We find that a reasonable classification of a medical procedure to constitute as an event is if either a hospital visit with costs above an expenditure threshold occurs (which we set to \$1,000), or if there is no hospital visit, there are excess expenditure stemming from other procedures (again above \$1,000 which typically accrue due to prescription drugs). We then count the number of events, n, that are observed during the interview interval length d, i.e. the duration since the last interview or 2 years if the last wave is lacking, for each individual. We find that a Poisson arrival model of rare events is an adequate description. Denote the (yearly) hazard rate of an event by $\zeta(j,g,s)$ which depends on age j, gender g and LTC status s (recall, we do this for the top permanent-income quintile). The hazard of events is assumed to be constant over the interval length d. Under the assumption of independence of events, n follows a Poisson distribution. It is characterized by the single Poisson parameter $\phi = \zeta(j,g,s)\cdot d$. The expected number of events is then given by

$$\mathbb{E}(n|j,g,s;d) = \zeta(j,g,s)\cdot d \quad \Rightarrow \quad \frac{n}{d} = \zeta(j,g,s) + \epsilon,$$

and so to obtain estimated hazard rates we regress n/d (the number of events per year over the interview interval) on age, gender and our LTC indicator (we also include higher order terms for age). We find that a simple specification that only includes our measure of LTC, s, suffices (of course, this measure strongly correlates with age and somewhat less with gender).

OOP medical-cost distribution conditional on medical event. The second step is to estimate the distribution of post-Medicare pre-Medicaid OOP expenditures conditional on an event occurring. For this we use all observations with $n = 1$ (these constitute the majority of observations conditional on an event taking place) of individuals in the top permanent-income quintile. We find that, conditional on an event, the log-normal distribution gives a good fit and does so even for the upper tail.[7] Table 11 shows how the model-generated expenditures compare to the data and Table 12 compares the transition matrix of total expenditure categories (LTC + medical).

Finally, we also include fixed medical spending for people above 65 years of age which we find to be \$535 per year.

3.2 Taxes

We model progressive income taxation using the functional form of Gouvieia & Strauss (1994). Total income taxes paid are

$$\tau(y) = b\left[1 - (sy + 1)^{-1/p}\right],$$

where y is the taxable income of a household. We take the values for the parameters from estimates by Guner et al. (2014), who find $b = 0.264$, $s = 0.013$, and $p = 0.964$.

We take the Social Security benefit schedule from Kopecky & Koreshkova (2014):

$$S(\bar{E}_\epsilon) = \begin{cases} 0.9\bar{E}_\epsilon, & \text{if } \bar{E}_\epsilon < 0.2\bar{E}, \\ 0.9(0.2\bar{E}) + 0.33(\bar{E}_\epsilon - 0.2\bar{E}), & \text{if } 0.2\bar{E} \le \bar{E}_\epsilon \le 1.25\bar{E}, \\ 0.9(0.2\bar{E}) + 0.33(1.25\bar{E} - 0.2\bar{E}) + 0.15(\bar{E}_\epsilon - 1.25\bar{E}), & \text{if } 1.25\bar{E} \le \bar{E}_\epsilon \le 2.46\bar{E}, \\ 0.9(0.2\bar{E}) + 0.33(1.25\bar{E} - 0.2\bar{E}) + 0.15(2.46\bar{E} - 1.25\bar{E}), & \text{if } \bar{E}_\epsilon > 2.46\bar{E}, \end{cases}$$

where $\bar{E}_\epsilon$ is average lifetime labor earnings, and $\bar{E}$ is the average economy-wide labor earnings. The Social Security tax rate is $\tau^{SS} = 0.124$.

[7] Note that this is consistent with the existing literature that has documented even fatter tails than those generated by a log-normal distribution because individuals can draw multiple events over a two-year period, a time period which is used by, for example, De Nardi (2010).

4 Solution algorithm

As a starting point for our algorithm, define the value function of new parents entering retirement as $V^{ret}(a,\epsilon) \equiv V^p(0,a,0,\epsilon,\epsilon,0)$ – recall that these parents were just matched to a kid with the same productivity and with zero wealth. We will now make a guess for V^{ret} and then backward-iterate on age j^k until the value functions converge. We obtain the starting guess, V_0^{ret}, by solving our model for the retirement period of a parents household that faces the environment of our model but has no kids. Given the guess V_0^{ret}, the algorithm is:

1. From V_n^{ret}, we obtain the value functions $V^p(\cdot, j_{ret})$, $V^k(\cdot, j_{ret})$, and $W(\cdot, j^{ret})$ for $j^k = j^{ret}$, i.e. the last instant of interaction between kids and parents, from the boundary conditions (23) and (24).

2. Obtain value functions V_n^k, V_n^p, Z_n by backward-solving the HJBs (3) and (22) for ages $j^k \in [0, j^{ret}]$.

3. Obtain a new guess $V_{n+1}^{ret}(a,\epsilon) = V_n^p(0,a,0,\epsilon,\epsilon,0)$. Check if $V_n^{ret} \simeq V_{n-1}^{ret}$. Quit the loop if the convergence criterion is met, continue with step 1 if not.

Grid issues. We discretize the wealth variables a^k and a^p on a discrete grid. The discretization steps for age, Δj^k, are then endogenously chosen as the highest number that maintains all transition probabilities in the Markov-chain approximation within the bounds $[0,1]$ (this is equivalent to the stability criterion for finite-difference PDE methods). When parents die and leave large bequests, the kid's wealth jumps out of the state space. We extrapolate the value function Z outside the wealth grid in this case based on the assumption that consumption functions are linear.

Exchange-motivated transfers. In our computations, we impose an upper bound $Q_{max} < \infty$ on Q_k^* on the transfer Q. When the parent is wealth-rich but faces only a short time to live, children can essentially count on possessing all dynasty wealth within little time, and players become indifferent toward the timing of transfers. In such situations, players are essentially pooling their wealth, and the terms $V_{a^j}^i - V_{a^i}^i$ approach zero. This can lead equilibrium transfers to reach very high levels, see Equation (16), which has no implications on the allocation of care and consumption but slows down our algorithm considerably.

Altruistic gifts. Within step 2, we follow Barczyk & Kredler's (2014) strategy. We guess that in equilibrium altruistic gifts only flow when the recipient has zero wealth, which requires that $V_{a^k}^k(z) \geq V_{a^p}^k(z)$ and $V_{a^p}^p \geq V_{a^k}^p(z)$ for all z. We ignore violations of these inequalities for all iterations $n < N$, where N is the final step in which convergence is reached. A challenge we face here is that by construction, we have $V^i_{a^i} = V^i_{a^j}$ for both agents at $j^p = j_{dth}$ when the parent dies for sure. A dollar in the parent's pocket has the same value as in the kid's pocket if it is bequeathed in the near future. Due to this, we find small violations to the transfer motives close to $j^p = j_{dth}$, which are probably due to numerical issues related to the discrete choices in our model.

Following Barczyk & Kredler (2014), we have attempted to introduce Brownian noise into the laws of motion for a^k and a^p. However, introducing such noise did not help much to solve problems with the transfer motives, indicating that the main problem lies with the certain time of death. We have thus opted to leave out noise in order to have a simpler model.

We do not think that these issues pose a challenge to our computational strategy for the following reasons. First, the violations die off as we move away from $j^p = j_{dth}$, thus indicating that they are caused by the restriction that parents die for sure at j_{dth}. Second, the violations are infrequent and occur in places in the state space with almost zero measure of families.

5 Scenario: Higher opportunity costs

Table 15 presents all the results of the various policy experiments in the alternative world of a higher opportunity costs discussed in the main paper. We consider a scenario where we lower β from 0.66 to 0.57 but maintain all other parameters as they are in the baseline calibration. Taking this as the new status quo, we then carry out the same counterfactuals as for the baseline in the rows below (using the same changes to the subsidy and MA parameters as before). Table 16 shows the welfare implications on current generations.

Table 15: Policy experiments with high opportunity cost

	Care type (%)			**Costs (as $\Delta\tau$)**				**Wealth** ($000, age 70-75)			**Ex-ante CEV**	
LTC policy	IC	MA	PP	$\Delta\tau$ =	$\Delta\tau_s$ +	$\Delta\tau_{ma}$ +	$\Delta\tau_{inc}$	p25	p50	p75	short run	long run
status quo	34.7%	37.0%	28.3%					$52K	$186K	$399K		
$s_{ic}\uparrow$	47.3	29.0	23.6	0.12	0.22	-0.16	0.06	45	174	387	**0.33**	**0.18**
$s_{ic}^k\uparrow$	47.5	28.8	23.7	-0.00	0.11	-0.16	0.05	48	178	390	0.24	0.15
$s_{pp}\uparrow$	15.7	31.7	52.5	0.21	0.36	-0.10	-0.05	49	170	373	0.14	0.00
both↑	31.8	24.7	43.5	0.25	0.50	-0.24	0.00	41	160	365	**0.50**	**0.22**
MA↑	31.1	42.5	26.4	0.20		0.18	0.02	41	176	393	0.08	-0.07
MA↓	37.4	32.0	30.6	-0.18		-0.15	-0.02	67	196	404	-0.17	-0.00
MA↓,both↑	32.8	21.3	45.1	0.15	0.51	-0.34	-0.01	49	165	368	**0.38**	**0.20**

Policies: $s_{ic}\uparrow$: informal-care subsidy of $4,375 (per year). $s_{pp}\uparrow$: private-payer subsidy of $11,460 (per year). $MA\uparrow$: 20% increase to both y_{ma} and C_{ma}. $MA\downarrow$:20% reduction in both y_{ma} and C_{ma}. $s_{ic}\uparrow$ + $s_{pp}\uparrow$: both informal- and formal-care subsidy, amounts as in $s_{ic}\uparrow$ and $s_{pp}\uparrow$. $MA\downarrow$ + $s_{ic}\uparrow$: combination of $MA\downarrow$ and $s_{ic}\uparrow$. **Care arrangements**: IC: informal-care prevalence, MA: Medicaid prevalence, and PP: private-payer prevalence. **Costs**: $\Delta\tau$: change to the income tax rate required to finance LTC policy. Changes to tax rate due to: payout of subsidy $\Delta\tau_s$, changes in MA ($\Delta\tau_{ma}$), and change to income taxes ($\Delta\tau_{inc}$). Changes to government spending on medical shocks are negligible. **Wealth**: quantiles of wealth distribution ages 70-75. **CEV**: consumption equivalent of new-born under veil of ignorance. Short run: at time of reform (weighting with baseline measure over families), long run: after convergence (weighting with ergodic measure in counterfactual).

	IC transfers			**FC Financing**			**IC by kid educ**			**IC by parent pension**				
LTC policy	Exchg	Beqst	Altrsm	$g^k > 0$	$g^k = 0$	MA	HS	HS+	Collg	Q1	Q2	Q3	Q4	Q5
status quo	88.9%	11.1%	0.0%	1.6%	41.8%	56.6%	57.9%	20.4%	0.0%	19.7%	37.2%	47.5%	42.8%	32.3%
$s_{ic}\uparrow$	77.9	22.0	0.1	2.1	42.8	55.2	75.1	33.0	0.0	42.1	48.6	56.9	51.6	40.2
$s_{ic}^k\uparrow$	77.8	22.1	0.1	2.1	43.1	54.9	75.3	33.0	42.5	48.9	56.8	51.6	40.1	
$s_{pp}\uparrow$	87.7	12.2	0.1	4.3	58.1	37.6	32.8	0.0	0.0	12.9	21.1	21.3	15.6	9.4
both↑	91.5	8.3	0.2	5.6	58.2	36.2	66.1	0.1	0.0	37.9	37.6	36.0	28.2	18.3
MA↑	88.8	11.2	0.0	0.8	37.5	61.6	51.0	19.3	0.0	16.8	27.7	42.6	41.8	32.2
MA↓	88.3	11.7	0.0	3.0	45.9	51.1	62.6	21.5	0.0	24.1	41.9	50.3	43.7	32.4
MA↓, both↑	91.2	8.7	0.0	7.6	60.6	31.8	68.3	0.1	0.0	39.9	39.4	37.2	28.2	18.3

IC Transfer: *Exchg*: IC with $g^k > 0$. *Beqst*: IC with $g^k = 0$, $a^p > 0$. *Altrsm*: IC with $g^k = a^p = 0$. **FC Financing**: PP care with $g^k > 0$, PP care with $g^k = 0$, MA care. **IC by kid educ**: IC among education groups; HS is high school; HS+ is more than high school and less than college. **IC by parent pension**: IC by parent pension quintile.

Table 16: Welfare of currently alive generations with higher opportunity cost

LTC policy	all	parent	kid	parent ($\underline{\epsilon}$)	parent ($\overline{\epsilon}$)	kid ($\underline{\epsilon}$)	kid ($\overline{\epsilon}$)
both↑	1.49	2.62	1.05	2.79	2.48	1.22	0.88
MA↓, both↑	1.14	1.98	0.81	1.56	2.36	0.83	0.79
s_{pp} ↑	0.78	1.45	0.52	1.05	1.81	0.48	0.56
s_{ic} ↑	0.76	1.32	0.55	1.85	0.84	0.76	0.34
s_{ic}^{k} ↑	0.50	0.85	0.36	1.19	0.53	0.49	0.24
MA↑	0.42	0.85	0.26	1.43	0.28	0.43	0.09
MA↓	-0.58	-1.07	-0.39	-1.88	-0.35	-0.61	-0.16

Consumption equivalent variations ranked by overall desirability by current families (all). Parent and kid generations are further divided into two productivity groups: $\underline{\epsilon}$ is the low productivity and $\overline{\epsilon}$ is the high productivity group. For each group, CEVs are weighted by the density of households in the baseline model.

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