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

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Abstract

We propose a dynamic non-cooperative model for long-term-care decisions of families. We first document the importance of informal caregiving and the economic circumstances of informal-care givers and recipients in the United States. We then build a heterogeneous-agents model with imperfectly-altruistic households to account for the patterns we find. There are two key innovations. First, both young and old households can save but lack the ability to commit to future transfers. Unlike models of commitment, the timing of inter-generational transfers and the dynamics of the intra-family wealth distribution are determinate. Second, in addition to purely-altruistic transfers we allow for financial transfers that flow in exchange for informal care. This gives rise to realistic predictions on a host of care arrangements and their financing. We calibrate the model, identifying the preference for different care arrangements by their prevalence in the data. We find that families' care decisions react strongly to economic incentives. Even relatively small subsidies to private payers of nursing homes and informal caregivers substantially reduce the use of Medicaid and are welfare-improving.

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1 Introduction

A 21^{st}-century challenge to governments is how to deal with a growing number of elderly in need of care. Traditionally, the family has played an important role in providing care at home. However, changing demographics, an increase in female labor-force participation, and rising medical expenditures are putting pressure on governments to take a more active role. In Germany and Japan, for example, the government has already stepped in; both countries have universal long-term-care insurance for the elderly.

In the U.S., the size of Medicaid – the program that is currently the primary government insurance mechanism for long-term care (LTC) – is a hotly debated topic.[1] While providing a consumption floor, means-tested Medicaid leaves LTC risks largely uninsured and so constitutes one of the major uninsured financial risks for elderly Americans (Brown & Finkelstein, 2007). Only 14% of the elderly in the U.S. have private LTC insurance (Brown & Finkelstein, 2011), and only 4% of all LTC expenditures are paid for by private insurance (CBO, 2004).[2] The discussion surrounding Medicaid will only intensify as the number of elderly requiring LTC as a fraction of the working-age population is projected to increase from 6.4% in 2010 to 7.4% in 2020, and up to 9.6% in 2030 (Johnson et al., 2007).

In this paper, we argue that the evaluation of LTC policy options has to take seriously the response of the family. For example, subsidies for nursing-home care may merely crowd out informal care, thus providing little additional insurance at a high cost to the government. On the other hand, subsidizing nursing homes may be less costly than its face value since it allows would-be family-caregivers to stay in the labor force and pay taxes. An alternative measure, subsidies to informal care, may be expensive if many informal caregivers leave their jobs, or simply ineffective if it goes primarily to infra-marginal families (e.g. retired spouses). On the positive side, encouraging informal care can help to keep Medicaid spending in check.

We first document the importance of family-provided care in the United States using the Health and Retirement Study (HRS). We find that at least two-thirds of all hours of care are

[1] The gerontological literature defines the need for LTC as becoming dependent on assistance from another person due to functional limitations, such as having difficulties with activities of daily living (e.g. getting in and out of bed, getting dressed, showering, and eating) or with instrumental activities of daily living (e.g. buying groceries, going to the doctor, and going for a walk).

[2] Reasons for the low take-up rates of private LTC insurance mentioned in the literature are market failure because of adverse selection, asymmetric information, and problems in the verification of care needs; see Brown & Finkelstein (2007) and Finkelstein & McGarry (2006). Brown & Finkelstein (2008) find that Medicaid substantially crowds out private LTC insurance. It has also been suggested that individuals shun market insurance because they rely on the family instead; see, for example, Ameriks et al. (2007).

provided by informal caregivers, particularly retired spouses and working-age daughters.[3] The vast majority of these caregiving hours stem from a fairly small fraction of helpers. We then zoom in on working-age children who provide an intensive level of care. Such children are less frequently full-time employed and tend to have less education and lower household income than children who provide fewer or no hours of care, suggesting that opportunity costs in the labor market play an important role in the observed care arrangement.[4] In addition to this, we find that care arrangements also depend on the care recipient's wealth: richer parents are more likely to receive care from a child, *ceteris paribus*. These facts suggests some form of intra-family bargaining in the care decision (see also Johnson & Sasso, 2006, who find evidence consistent with bargaining). Indeed, we find that caregiving children more often receive transfers in the form of co-residence in the parent's home, obtain higher inter-vivos transfers [5], and higher bequests than non-caregiving children[6].

In order to model the observed behavior of families, we extend the setting of Barczyk & Kredler (2014*a*), heterogeneous-agents life-cycle model with imperfectly-altruistic families. A key innovation with respect to their model is that, in addition to altruistically-motivated transfers (gifts), we also allow for exchange-motivated transfers. Parent and child bargain each period on the provision of informal care; if they agree on informal care, a financial transfer may flow in exchange for a time transfer (care). Because households are altruistic towards each other, they also consider the other's economic situation and preferences in the bargaining process. As a result, the model gives rise to a host of realistic care arrangements and their financing. The child may provide informal care (i) in exchange for immediate transfers, (ii) without immediate compensation but in anticipation of a higher bequest, or (iii) out of pure altruism (receiving neither transfers nor a bequest). Formal care may be (i) paid by the parent alone, (ii) subsidized by transfers from the child to varying degrees, or (iii) paid for by Medicaid. To the best of our knowledge, our model is the first fully-dynamic

[3]See also Stoller & Martin (2002); Wolff & Kasper (2006); etc. Another way of gauging the importance of informal care is imputing its economic value. Arno et al. (1999) provide an estimate of the economic value of informal caregiving of $196 billion in 1997; this is equivalent to approximately 18 percent of total national health-care spending ($1,092 billion) in 1997. A more recent estimate by the *Aging in Place* (2011) puts the economic value of informal care at $450 billion. In contrast, national spending on formal health care at home was only $32 billion and $83 billion for care in nursing homes.

[4]See Van Houtven et al. (2013) and Skira (2014) for studies focusing on the interactions between labor supply and caregiving decisions. Both papers find that opportunity costs of caregiving are important.

[5]Cox & Rank (1992) find evidence that parents exchange gifts for services from their children. Norton & Houtven (2006) find evidence for such an exchange specifically for caregiving.

[6]See also Bernheim et al. (1985), who argue that parents strategically withhold resources to "purchase" attention from their children with a larger bequest.

model that allows for both altruistically- and exchanged-motivated transfers, the two most commonly entertained transfer motives in the literature (see Cox, 1987 for a static model that allows for both motives).

We then calibrate the model to the U.S. economy. We take the parameters for demographics, wages, health, and the cost of care directly from the data and from the literature. The key parameters left to be identified are the strength of altruism of each generation, the utility gain from informal care, and utility from the Medicaid consumption floor. We pin down altruism from transfer data of households with healthy parents and identify the preference for care arrangements by the prevalence of these arrangements in the data. We find that, consistent with survey evidence and previous studies, the elderly prefer to stay at home and are strongly averse to Medicaid care (see, e.g., Ameriks et al., 2011).

We then evaluate several policy options in our framework. We find that a (non-means-tested) formal-care subsidy can be financed at essentially zero cost to taxpayers. Spending on the subsidy is made up for by savings on Medicaid and an increase in the labor force that boosts tax revenues. The second policy, an informal-care subsidy, is more expensive. It also saves on Medicaid spending, but shrinks the labor force because children give more care. We find that both generations prefer the formal-care subsidy to the status quo, but only the parent generation prefers the informal-care subsidy to the status quo. Between the two policies, parents prefer the informal-care subsidy and children prefer the formal-care subsidy. Our analysis suggests that offering a menu of informal- and formal-care subsidies might be a reasonable policy option. In terms of welfare, this combination of subsidies is particularly attractive to the elderly. Low-income families are those benefiting most from both kinds of subsidies.

This paper is part of a research agenda that extends heterogeneous-agents models to altruistic agents (without commitment). We build on the framework provided by Barczyk and Kredler (2014a, 2014b). This has several advantages, especially when doing *inter*-household analysis (e.g. parent and kid households), over the unitary or collective model, which are more plausible for analyzing *intra*-household issues (e.g. between spouses).

Firstly, the unitary and collective model imply indeterminacy in the timing of financial transfers and the dynamics of the wealth distribution within the family. This is due to the assumption that agents can fully commit to future actions. Commitment actually implies that *any* transfer scheme that makes the equilibrium allocation feasible is an equilibrium.[7]

[7]To illustrate this point, consider the following example. A college student is financed by her parents over

However, in the data we do see clear patterns in *when* financial transfers are given between households of a family, and who holds how much wealth at which point in time. Furthermore, since there is a strong relationship between care arrangements, wealth and transfers in the data, having a model with predictions on these variables is crucial for our research question. The non-cooperative approach to the family à la Barczyk and Kredler (2014a, 2014b) ensures such determinacy in transfers and the wealth distribution.[8] Furthermore, we argue that clear predictions on the elderly's wealth are essential when it comes to modeling LTC policy. Since there is a means test on the elderly's assets in order to qualify for Medicaid, any model that lacks predictions on the elderly's wealth cannot tell us when they qualify for Medicaid.

Secondly, some commitment models (such as the unitary model) imply that all members of a family agree on whether a given policy is desirable or not, since the family member that wins most can compensate the other members with transfers. It is not obvious that this kind of agreement, and less so this kind of compensation, actually occur in reality. Our calibrated model claims that disagreement is indeed a reality: most parents prefer a subsidy for informal care, whereas most children prefer a subsidy for formal care.

Thirdly, recent papers have rejected the commitment assumption in panel data sets and called for an exploration of no-commitment models (see, for example, Mazzocco, 2007). We see this paper as one step into this direction.

Another advantage of our modeling approach following Barczyk & Kredler (2014*a*) is that it allows *both* the parent and the child generation to save. Usually, this complication is circumvented in the literature because of the technical difficulties it entails.[9] However, we argue that it is crucial to allow savings for both generations when analyzing LTC. For the elderly, savings are a key source of insurance; also the Medicaid means test explicitly checks the elderly's wealth, as argued before. As for children, they tend to be in their prime saving

four years. The parents want the student to spend 1,000$ per month (assume that this is an efficient allocation). With commitment, both of the following transfer schemes lead to the same consumption allocation and are equilibria: (i) the parents give 1,000$ to the student every month for four years, which the student consumes, and (ii) parents give 48,000$ to the student before the freshman year and the student again consumes 1,000$ every month, making the necessary savings (assume a zero interest rate for simplicity). Scheme (ii) is an equilibrium because the parent can commit to never give transfers beyond the initial 48,000$, even if the child wasted her wealth and was starving. Believing in the parent's threat, the child behaves prudently and saves. Barczyk and Kredler's (2014b) model, however, selects (ii) as the unique equilibrium; it deems the parent's threat to withhold further transfers as not credible.

[8] Another problem with taking commitment models to the data is to select the point in time when the family commits to a plan—when the child is born?, when the child turns 18?, or when the family first appears in the data? This choice typically matters for predictions.

[9] See Barczyk & Kredler (2014*a*) for a literature review.

years when facing the decision if to give care to a frail parent or not. Thus their valuation of financial transfers or bequests will depend strongly on how much they have saved already, which cannot be addressed in a setting that rules out savings.

We now turn to a brief summary of the related literature. On the one hand, there is a macroeconomic literature that studies old-age risks. This literature was initially concerned with explaining why the elderly do not reduce their wealth as predicted by the standard life-cycle model (the *retirement savings puzzle*). It did so by recognizing the large financial risk that medical and LTC expenditures signify, especially in the U.S.[10] Recently, the focus of this literature has shifted towards analysis of policies relevant for such risks, such as Medicaid and Medicare. Attanasio et al. (2011), Braun et al. (2014), and DeNardi et al. (2013) are most closely related to ours in both questions and methods. However, these papers tend to focus less on the role of the family. On the other hand, there is an applied microeconomic literature that is explicitly concerned with the trade-offs faced by family caregivers. It shows that caregiving decreases labor supply and earnings, especially of female caregivers.[11] Our paper aims to combine elements from both literatures in order to obtain credible recommendations for LTC policy. Finally, it is interesting to compare the results from our model to results from the empirical literature. Goda et al. (2011) use the "social-security benefits notch" as a natural experiment that increased the permanent income of a cohort of Americans. The income effects they identify for the demand of different types of care seem large when compared to the behavioral response that our model predicts for different subsidies.[12]

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[10]Hubbard et al. (1995) study the interaction of means-tested social insurance programs and precautionary savings in the presence of uncertain earnings and out-of-pocket medical expenses. They show that a consumption floor is able to explain low wealth levels for households with low life-time earnings relative to the predictions of the life-cycle model. DeNardi et al. (2010) show that medical expenditures, particularly nursing-home expenditures, are an important explanation of the retirement savings puzzle and that lowering the government safety net not only influences the poor but also the rich because of the undesirability of the consumption floor. Ameriks et al. (2011) attack the question on why we see a lack of wealth decumulation and little annuitization in retirement head on by asking people. They find that respondents strongly fear the possibility of having to rely on public care (Medicaid) for LTC and are thus reluctant to convert liquid wealth into a fixed income stream. Kopecky & Koreshkova (2014) also study uncertain LTC expenditure and find that after earnings risk, nursing-home risk is the most important determinant of precautionary savings.

[11]Johnson & Sasso (2006) find that time help to parents strongly reduces female labor supply at midlife. Van Houtven et al. (2013) find that the provision of informal care has a negative and significant effect on the extensive and intensive margin of female labor-force participation. Skira (2014) finds that current care provided by a daughter also affects future labor-force participation and wages; she estimates the value of caregiving to be substantial.

[12]The "social-security benefits notch" refers to the fact that birth cohorts around 1915 received permanently higher social-security benefits than comparable workers born before and after due to legislation errors in the

2 Empirical facts

To motivate our modeling approach, we begin by studying the LTC population and their caregivers in the 2002 wave of the Health and Retirement Study (HRS). The HRS is a longitudinal survey that was established in 1992; as of 1998 it is representative of the U.S. population above 50.[13] There is a total of 18,166 survey participants in this wave.

2.1 *Elderly in need of care* Our sample is restricted to individuals (respondents) with functional limitations. We measure the need for care through a disability index that counts the number of functional limitations a respondent declares, ranging from 1-10.[14] Table 1 shows basic statistics for the sample. There are 2,788 individuals with some kind of limitation; 2,331 of these reside in the community (CR), and 457 in a nursing home (NHR). They are relatively old, are more likely to be female, and a majority of them is single. More than 90% have children, with an average of 3.2 children per household. Almost one-third have a high level of disability (defined as 6-10 functional limitations).

When comparing CR to NHR, we see that NHR are older, more likely to be female, and tend to be more frail. Also, NHR are more likely to be single and have fewer children, which indicates that the absence of family caregivers is an important determinant of nursing-home residency. The second part of the table shows the same statistics dividing the sample into single and married respondents. Once we restrict the sample to singles, we see that women are not over-represented among NHR any more. This suggests that there are more women in nursing homes than men since elderly women are more likely to be single. Women tend to outlive their spouses: they are younger than their husbands, and they have a higher life

1970s. Using the notch as an instrument, Goda et al. (2011) find that an exogenous increase in yearly (permanent) social-security income of 1,000$ (in 1993$) cuts nursing-home use of low-education Americans by one-third, or by 2pp (95% confidence interval: ≃0.7-2.7pp) of the entire age cohort, informal care rising by about the same magnitude. We find that a 1,000$ yearly subsidy for formal care (in 2002$) only increases nursing-home use from 58% to 62% among the single elderly with (strong) LTC needs. A 1,000$ yearly subsidy for informal care does the same in the opposite direction in our model. Other studies exploited cross-state and time variation in Medicaid benefits, putting the effects of policy changes from zero to substantial (see the literature review in Grabowski & Gruber, 2007). On the other hand, the policy variation inside the U.S. used in these studies is quite small compared to cross-*country* variation in LTC policies. Care arrangements are found to differ a lot by country, suggesting a large elasticity with respect to to policy.

[13] We use the 2002 wave because it is the last wave that has population weights for the nursing-home population; it is known to be representative not only of the population residing in the community, but also of the nursing-home population. It does not appear to suffer from selection on observables (Kapteyn et al., 2006).

[14] We count limitations with activities of daily living (ADL) and with instrumental activities of daily living (IADL) to construct the index. We found that this index correlates stronger with hours of care than the pure ADL index of Wallace & Herzog (1995).

Residency	Any ($N = 2,788$)	CR ($N = 2,331$)	NHR ($N = 457$)
Married or Single			
Median age	76	74	84
Female	64.3%	62.6%	72.6%
Single	55.4%	50%	80.5%
Childless	8.6%	6.8%	17.3%
Mean children	3.2	3.4	2.5
Disability ≥ 6	29.1%	21.5%	64.9%
Single			
Median age	80	78	85
Female	78.5%	78.8%	77.6%
Childless	12.5%	10.3%	18.9%
Mean children	2.9	3.1	2.3
Disability ≥ 6	34.6%	24.8%	63.4%
Married			
Median age	70	70	77
Female	46.8%	46.4%	52.0%
Childless	3.9%	3.4%	10.3%
Mean children	3.6	3.7	3.4
Disability ≥ 6	22.2%	18.2%	71.2%

Table 1: Basic respondents' statistics.

Single includes never married, divorced (and not re-married) and widowed. Respondent-level weights are used for both CR and NHR.

expectancy. Again, the childless are strongly over-represented among single NHR, pointing to the importance of informal caregivers.

Economic characteristics of CR and NHR residents (not shown in the table) are as follows. When restricting the sample of CR to ages 80 and above, to ensure a fairer comparison with NHR, we find that the educational attainment between these two groups is surprisingly alike. In line with this finding is the fact that Social Security income among them is similar, indicating that their lifetime incomes are similar. A stark difference, however, arises in terms of net wealth: the median net wealth of a CR is \$93,000, while that of a NHR is merely \$6,200. Also, NHR are more likely to have no assets at all. This is not surprising since entrance into Medicaid-funded nursing homes is means-tested. All this indicates that an unlucky history of medical shocks determines nursing-home residency to a larger degree than a person's economic conditions at retirement.

2.2 *Caregivers* Virtually all individuals in our sample obtain assistance from another person, whom we refer to as caregiver or helper. Who are these helpers? The HRS asks each elderly in need of care about all helpers from whom (s)he receives care, including how many hours and even which type of care each person provides.[15] We categorize the various caregivers into four groups. Nursing-home staff, formal helpers at home, and other organizational helpers are pooled into the category "Formal".[16] We sort informal caregivers into three categories: "Young" helpers are close family members who are of working age (mostly children, some children-in-law and grandchildren), who usually face opportunity costs from care; "Old" helpers are close family members above 65 (mostly spouses, also siblings); and the third category, "Other", is made up of friends, neighbors and other relatives.

Caregiver type	Young (N = 1,994)	Old (N = 1,169)	Other (N = 689)	Formal (N = 703)
Monthly care hours by category				
All respondents	**31.7%**	**28.8%**	12.2%	**27.3%**
Married respondents	14.1%	**66.6%**	5.9%	13.3%
Single respondents	**44.5%**	1.2%	16.8%	**37.4%**
Caregiver count by intensity of care				
Light	52.3%	20.4%	19.3%	8.0 %
Medium	45.3%	30.5%	14.0%	10.3%
Heavy	**29.0%**	**26.6%**	10.8%	**33.7%**

Table 2: Caregivers' importance

The table is based on all caregivers that are associated with the sample of 2,788 respondents. We assign one formal caregiver per nursing-home resident and impute hours by assigning one daily hour of care per (I)ADL limitation. The grouping of helpers into Young, Old, Other, and Formal and into intensity categories (Light, Medium, Heavy) is explained in the text. All statistics are weighted using respondent-level weights.

The first part of Table 2 shows the fractions the different helper types contribute to total hours of care. Informal caregivers provide the lion's share, with the immediate family (Young and Old) being the most significant contributor. For married individuals the Old, predominantly the spouse, are the central figures in providing care, whereas for singles the Young,

[15] An exception is that no information is collected on hours provided by nursing-home staff. We assign one formal caregiver per nursing-home resident and impute hours by assigning one daily hour of care per (I)ADL limitation. This relationship between hours of care and number of functional limitations roughly holds for our sample for which the caregiving hours are available, and it is also reasonable considering the descriptions of the (I)ADLs. We also find that care hours that nursing-home residents receive from family members and other non-nursing-home individuals are negligible.

[16] We found that there is surprisingly little care given by formal helpers at home – only 4% of all care hours come from such helpers –, so we pool them with nursing-home helpers.

primarily children, are most important. Also nursing-home caregivers play a substantial role for single individuals.

The second part of the table studies care hours from the point of view of the helper, asking how many hours of care a helper from each category gives. We divide helpers into the intensity categories Light (up to 7.5 weekly hours), Medium (7.5-20 hours per week) and Heavy (more than 20 weekly hours, i.e. equivalent to at least a part-time job). Almost all caregiving hours, 85.5% (not shown in table), are due to heavy helpers, who only represent about one third, 32.3% (not shown in table), of all helpers. This suggests that caregiving is the responsibility of primarily one designated caregiver. Indeed, we find that among elderly who have children and receive care from at least one child, 80% are helped by exactly one child. Roughly two thirds of heavy helpers are informal, most of them with close family ties. Only one-third are formal caregivers. Among them, working-age (Young) and retirement-age (Old) caregivers are of about equal importance.

2.3 *Children as caregivers* The previous tables show that married individuals rarely end up in a nursing home; they are usually taken care of by their spouse who is not working any more. But what determines if working-age children, who have higher opportunity costs, provide help to a parent? In order to find out, we now further restrict the sample to households with at least one child of age 18+ alive. There are 2,407 such households and 2,527 individuals, and so in almost all households there is only one elderly in need of care.

Table 3 shows that helping kids tend to be older and predominantly female. They are more likely to co-reside with their parent(s), less likely to be full-time employed, and tend to have low household income (<$35,000). These tendencies are magnified among heavy helpers. In terms of education, there are weaker patterns. The lower education types are somewhat over-represented among heavy helpers, presumably because they face lower opportunity costs of care in the labor market. However, they are slightly under-represented when looking at *all* helpers.

So far, our results were largely unconditional statistics. We now aim to find out which characteristics of the elderly and their children make nursing-home residency more or less likely, *ceteris paribus*. We run logistic regressions of the respondent's nursing-home status on various co-variates, including a measure of the parent's wealth and educational dummies for children to proxy their opportunity costs in the labor market.

Table 4 shows the estimated odds ratios for nursing-home residency. An odds ratio of 1 means that the co-variate is irrelevant in informing us about the likelihood of the nursing-

Helper status	Not helping $(N = 7,797)$	Any help $(N = 1,455)$	Heavy help $(N = 344)$
Kid's attributes			
Median age	45	49	49
Daughter	47.1%	67.5%	78.6%
Coresidence	5.0%	29.1%	59.2%
Employed	68.0%	53.4%	37.5%
Low income	43.4%	52.6%	71.3%
< High school	16.2%	12.0%	18.0%
High school	41.8%	47.4%	42.5%
> High school	42.0%	52.6%	39.5%

Table 3: Characteristics of helper kids compared to non-helpers.

All children of age 18+ associated with the 2,788 individuals are included. Not helping: child does not provide any help, Any help: child provides help of any intensity (light, medium or heavy), Heavy help as defined above. Employed is full time; Low income is household income less than $35,000. All statistics are calculated using respondent-level weights.

home status. Regression (1) is based on the main sample, while regression (2) is restricted to individuals with at least 6 functional limitations; regressions (3) and (4) are analogous to (1) and (2) except that the sample is restricted to singles.

As expected, being older and having a higher disability index make it more likely to reside in a nursing facility. Being married significantly decreases the chances of nursing-home residency, presumably because the spouse takes on the role of caregiver. On the other hand, neither the availability of siblings nor the number of children is informative about the respondent's nursing-home status, whether or not the elderly in need of care is single.

In order to capture the opportunity costs of children in the labor market, we create dummies for education of the child with the lowest educational attainment (which we interpret as the marginal caregiver). We see that having children with a college degree significantly increases the likelihood of nursing-home residency. This suggests that children's opportunity costs play an important role in the determination of care arrangements.

Turning to the resources of the parents, we see that wealth is statistically more significant than income (which is mainly social-security income for the elderly in our sample). This is not surprising when we take into account that for individuals with LTC needs life expectancy is rather low, meaning that the lifetime value of social-security payments is usually dwarfed by wealth (especially houses) and by medical expenditures. As for the elderly's wealth, we find that it is strongly negatively related to nursing-home residency. Respondents whose

Sample	(1) (N=2,527)	(2) (N=727)	(3) (N=1,283)	(4) (N=448)
Parents' attributes				
Age	1.051***	1.037**	1.050***	1.037**
	(5.00)	(2.89)	(4.70)	(2.69)
Disability	1.527***	1.586***	1.421***	1.381***
	(13.38)	(5.62)	(10.37)	(3.37)
Married	0.369***	0.448**		
	(-4.82)	(-2.98)		
Siblings	0.927	0.957	0.938	0.966
	(-1.76)	(-0.82)	(-1.33)	(-0.57)
# Kids	1.006	0.995	0.962	1.005
	(0.12)	(-0.09)	(-0.82)	(0.07)
Education (kids)				
High school	1.325	1.639	1.265	1.946
	(1.05)	(1.39)	(0.79)	(1.65)
Some College	1.197	1.319	1.083	1.375
	(0.51)	(0.63)	(0.22)	(0.65)
College	3.033***	4.411***	2.615**	4.817**
	(3.47)	(3.57)	(2.78)	(3.24)
Resources (parents)				
Income	1.365*	1.497*	1.404*	1.528*
	(2.45)	(2.37)	(2.31)	(2.07)
Wealth Q_2	0.464**	0.586	0.416***	0.596
	(-3.18)	(-1.70)	(-3.39)	(-1.43)
Wealth Q_3	0.288***	0.298***	0.325***	0.290**
	(-4.75)	(-3.75)	(-3.91)	(-3.30)
Wealth Q_4	0.320***	0.438*	0.245***	0.318**
	(-4.02)	(-2.34)	(-4.43)	(-2.75)

Table 4: Logistic regression for nursing-home status

* $p<0.05$, ** $p<0.01$, *** $p<0.001$. Educational attainment is of the kid in the family with the lowest years of education. Some college: 13-15 years of education; College: more than 15 years of education (odds ratio relative to 0-11 years of education). Wealth Q_j: jth wealth quartile (odds ratio relative to Q_1).

wealth is in the top two quartiles are more than three times less likely to be in a nursing home than those in the bottom quartile. Our model will interpret this as an intra-family bargaining story: the larger the economic clout of the elderly is, the more likely it is that the elderly is cared for at home. It is puzzling, however, that the coefficient for income points into the other direction: elderly with high income are, ceteris paribus, *more* likely to reside in a nursing home. This may be because the parent's income has predictive power for the caregiver's (potential) wage that goes beyond the caregiver's education.

Consistent with the bargaining interpretation, we find that caregiving children receive substantial compensation, and in various forms. Results from the HRS exit interviews 2004 show that helper children receive substantially higher bequests than non-helping children. The average inheritance (including houses, total assets, life insurance and inter-vivos transfer before death), to caregiving children is \$120,354 compared to \$16,511 for non-caregiving children.[17] Also, co-residence plays a big role; caregiving children are a lot more likely to coreside with the parent than non-helpers, see Table 3. In 66% of the coresiding parent-child pairs the parent owns or rents the home, meaning that co-residence most often constitutes a transfer from parent to child. Direct financial transfers at the time of caregiving play a smaller role: heavy helpers receive an average yearly transfer of 1,738\$, whereas the transfer to non-helpers is 932\$ (we restricted the sample to non-coresiding helpers with parents over 80 years to have a meaningful comparison). Although compensation is substantial for some helpers, there are also many cases where no or very little compensation is apparent in the data, hinting at altruism as another motive for care in addition to exchange.

3 The model

We now build a dynamic model that is motivated by the facts from the previous section. For expositional purposes we present a simplified version in this section that focuses on our key modeling innovation: the determination of care arrangements in a dynamic, non-cooperative setting. In the calibration, we will add a finer demographic structure, a proper life cycle, earnings risk, and age-varying LTC and mortality risks.

3.1 Setting

Time is continuous. Each family (or dynasty) consists of two infinitely-lived[18] generations: a parent (p) and a kid (k). The child is endowed with one unit of labor, which yields a wage rate w on the market. The parent receives a constant pension flow P. Parent and child can give monetary transfers to each other, but cannot write contracts on future transfers, i.e., there is no commitment. Each generation can save in a riskless asset with rate of return r, subject to a no-borrowing constraint. Other markets to insure against risk are absent.

[17] We are indebted to Max Groneck at the University of Cologne for providing these figures in a discussion.

[18] We do not make agents die to keep the Bellman equations as simple as possible. There are no qualitative changes when including a death hazard.

We model the need for care as a discrete variable s: the elderly is either healthy, $s = 0$, or sick, $s = 1$.[19] The parent is first healthy but transitions into the sick state at a constant hazard rate σ. The sick state is absorbing. A sick parent has to obtain care from one of two sources: (i) either informal care from the kid, in which case the child cannot work, or (ii) formal care. Formal care can either be bought on the market at flow cost q, or it is provided by the government through means-tested Medicaid care (MA). The means test works as follows: the parent has to hand in all remaining wealth and her pension to the government, and the government then provides a consumption floor c_{ma} to her. Formal care is subsidized by the government by a flow s_f, thus the net cost to the individual is $q_{net} \equiv q - s_f$.

When the parent is sick, in each instant of time t the care arrangement for a subsequent short interval $[t, t + \Delta t)$ is determined according to the timing protocol depicted in Figure 1. In the beginning of the interval, parent and child bargain if informal care, h_t, is provided. If the two parties decide that informal care is provided, $h_t = 1$, there is a non-negative flow transfer $Q_t \geq 0$ from the parent to the child; the size of the transfer is determined by symmetric Nash bargaining. Thus, in equilibrium informal care takes place if and only if there exists a transfer $Q_t \geq 0$ that makes both parties better off in informal care compared to the outside option of formal care. If the two parties agree on informal care, then the transfer flow, Q_t, is paid out immediately. The child also receives the informal-care subsidy flow, s_h, from the government in this case.

After bargaining on informal care, agents can give *altruistic gifts*, flows $g^p \geq 0$ and $g^k \geq 0$, to each other. We do not allow parents with zero wealth to give gifts once formal care has been chosen; we will explain why after describing the Medicaid decision.

In the case that the bargaining led to formal care, $h_t = 0$, the parent decides if to opt for Medicaid (MA) or for privately-financed care. MA is free but means-tested, i.e. the elderly has to relinquish the entire stock of wealth, a_t^p, the pension flow, P, and any gift flow, g^k, to the government if she chooses MA. If the parent chooses MA, $m_t = 1$, she receives a consumption floor c_{ma}; this value includes any negative utility from MA nursing homes, such as stigma effects and poor quality of care. Observe that the young cannot give transfers to the old to lift the old's consumption level above c_{ma} when in MA. The assumption is that the government only pays for basic care services, and that individuals have to accept this consumption floor—they cannot opt for better conditions (e.g. a single room) by paying a

[19]The sick state in the model corresponds to impairments that are serious enough so that care for the elderly amounts to at least a part-time job, i.e., care from the equivalent of one heavy helper in our data or a nursing home.

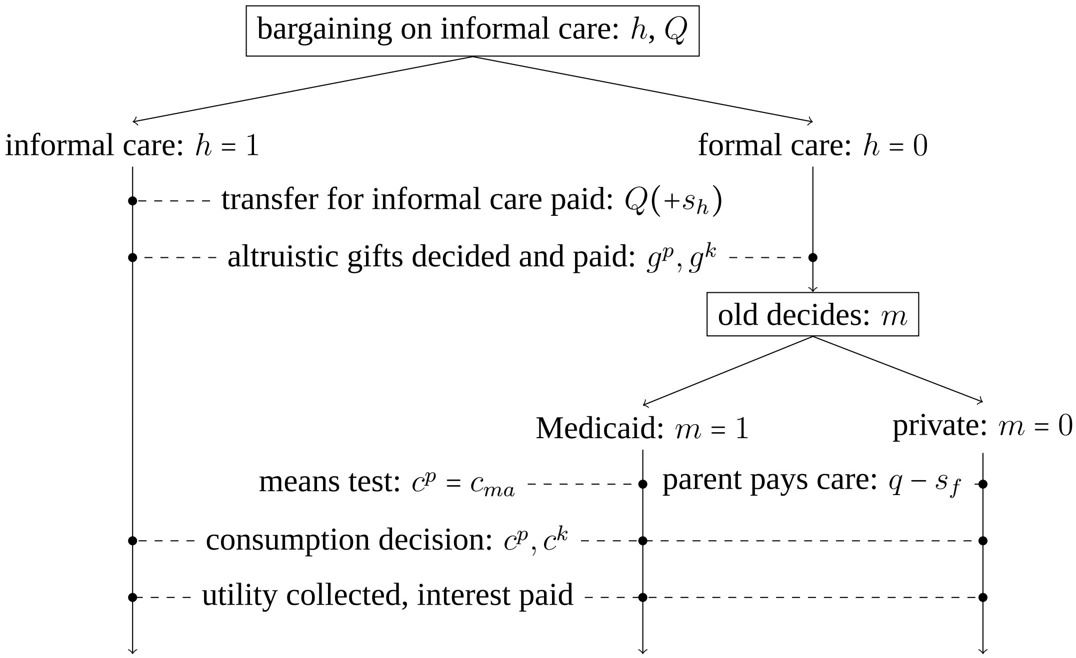

Figure 1: Timing protocol for decisions within an instant

higher price. If the parent decides to obtain private care, $m_t = 0$, she has to pay the flow cost of a private nursing home net of government subsidies, $q - s_f$. This is only feasible if the parent has positive assets, $a_t^p > 0$,[20] or if $P + g_k \geq q - s_f$, i.e. the pension plus gifts from the kid are sufficient to afford the nursing home.

We now discuss why we rule out gifts by parents once formal care has been chosen. If the parent goes to Medicaid, a real-world government certainly has the ability to withhold the parent's pension, making gifts to children impossible. Also, if the parent chooses private care, then gift-giving by a parent with zero wealth is quite unrealistic—private nursing-home expenses in the U.S. are very large, and usually exceed social-security benefits by far.[21]

In the last decision stage, both generations simultaneously choose their consumption, flows c_t^p and c_t^k, and pay for it. If the parent is in MA, then her consumption is restricted to be $c_t^p = c_{ma}$. In private care, the parent can decide her consumption level according to her budget constraint, which we interpret as the freedom to opt for a nursing home above the MA

[20] Note that if $a_t^p > 0$, there always exists Δt small enough so that $q\Delta t < a_t^p$, i.e. the parent can always afford formal care for a sufficiently short time interval if she has some wealth left.

[21] We could allow for gift-giving also by parents with zero wealth in formal care without changing our results, but at the cost of including g^p into the state at the point where MA is chosen.

standard. Note here that q has to be interpreted as the price of basic care services (assistance by nurses etc.), whereas c^p contains room and board, food, any higher-quality care that goes beyond basic care services, and all other amenities that a more expensive nursing home may offer.

Finally, both generations receive interest payments on their assets and collect utility. After this, the game moves on to the next interval. We assume that there are no costs of switching between the different care arrangements, thus the care choice is not a state variable.

Both generations are imperfectly altruistic. Generation i's flow utility from consumption is given by $u(c^i) + \alpha^i u(c^j)$, where $i, j \in \{p, k\}$ and $i \neq q$. Here, $\alpha^i \in [0, 1]$ is generation i's altruism parameter, and $u(\cdot)$ is a utility functional with the usual properties. When sick, the parent also derives flow utility ηh from care, where η measures the old's preference for informal care. From survey evidence, we expect η to be positive—the elderly typically say they prefer staying at home to going to a nursing home.[22] Since the child is altruistic, she also derives a utility flow $\alpha^k \eta h$ from care. [23] Both players discount the future at rate ρ.

3.2 Hamilton-Jacobi-Bellman equations

A family's state is given by the kid's wealth, $a^k \geq 0$, the parent's wealth, $a^p \geq 0$, and by whether the parent is sick or not, $s \in \{0, 1\}$. To make notation more compact, we introduce the vector $a \equiv (a^k, a^p)$. We first present the general Hamilton-Jacobi-Bellman equation (HJB), which takes into account all stages of the game depicted in Figure 1. We will then go over some important special cases to give more intuition.

We guess for now that the parent will only choose MA once she has zero assets. We will later verify that the parent's value function is increasing in a^p, which is sufficient for this choice to be optimal. To see this, note that the parent could always delay MA by an instant, buy private care instead, and choose consumption such that $c^p > c_{ma}$. This strategy obviously

[22] According to the survey *Aging in Place* (2011), 90% of seniors say they want to stay in their home as long as possible.

[23] We assume here that the child does not experience disutility from giving care, or, more precisely, that this disutility is not higher than that of working. When adding such a disutility parameter, the dynasty's informal-care choice depends on how strong the parents' preference for informal care is compared to kids' dislike of giving care. It is not easy to separately identify these two preference parameters, so for the sake of simplicity we model only the parent's preference for informal care. We take this road since there is strong survey evidence that the elderly prefer informal care, and since this specification (unlike a pure dislike-of-care specification) implies that richer parents are more likely to receive informal care ceteris paribus, which is what we find in the data.

yields a higher value than handing in a positive stock of wealth to the government.

Following Barczyk & Kredler (2014*a*), we introduce noise into the law of motion for a in order to ensure the existence of a unique equilibrium in the limit of a sequence of finite games. The HJBs are then

$$\begin{aligned} \rho V^i(a,s) = H_1^i(z,s) \; + \; (1-s)\sigma\big[V^i(a,1) - V^i(a,0)\big] \\ + \tfrac{1}{2}\epsilon^2\big[(a^i)^2 V^i_{a^i a^i}(a,s) + (a^j)^2 V^i_{a^j a^j}(a,s)\big] \qquad \text{for } i \in \{p,k\}, \end{aligned} \tag{1}$$

where $j \in \{p,k\}$, $j \neq i$, is the other agent and subscripts to V denote partial derivatives. The Hamiltonian functions $\{H_1^i(\cdot)\}_{i=p,k}$ are determined by backward induction on the stages of the instantaneous game and will be given below. Note that we have introduced the vector $z \equiv (a^p, a^k, V^p_{a^p}, V^p_{a^k}, V^k_{a^p}, V^k_{a^k})$ as an argument to H_1^i. The terms containing σ capture the risk of the parent becoming sick, and the terms in ϵ are the noise terms, ϵ being the standard deviation of the shock. We see that (1) is a second-order partial differential equation (PDE), where the first derivatives of V enter in H^i. We now derive the Hamiltonian functions $\{H_1^i(\cdot)\}_{i=p,k}$ by backward induction on the stages of the instantaneous game.

1. **Bargaining on informal care**:

$$\begin{aligned} H_1^p(z,s) &= h\eta + H_2^p\big(z, P-Q^*, (1-h)w + hs_h + Q^*, s(1-h)\big), \\ H_1^k(z,s) &= h\alpha^y\eta + H_2^k\big(z, P-Q^*, (1-h)w + hs_h + Q^*, s(1-h)\big), \end{aligned}$$

$$\text{where} \qquad h = \begin{cases} 1 & \text{if } s=1 \text{ and } \exists\, Q \geq 0 \text{ s.t. } S^p(Q) \geq 0 \text{ and } S^k(Q) \geq 0, \\ 0 & \text{otherwise,} \end{cases} \tag{2}$$

$$\begin{aligned} \text{where } S^p(Q) &= \eta + H_2^p\big(z, P-Q, s_h+Q, 1\big) - H_2^p\big(z,P,w,0\big), \\ S^k(Q) &= \alpha^k\eta + H_2^k\big(z, P-Q, s_h+Q, 1\big) - H_2^k\big(z,P,w,0\big), \end{aligned} \tag{3}$$

$$\text{and} \qquad Q^* = \begin{cases} \arg\max_{Q\geq 0} \left\{S^p(Q)^{1/2} S^k(Q)^{1/2}\right\} & \text{if } h=1, \\ 0 & \text{otherwise.} \end{cases} \tag{4}$$

informal care is provided to a sick parent if there exists a non-negative transfer Q such that both players' surplus is positive. The surplus is the utility flow from informal care, η or $\alpha^y\eta$, plus the difference between the Hamiltonians $\{H_2^i\}$ under the two scenarios in the ensuing stage of the game. Under informal care, the parent's flow income on hand (*income-on-hand*) in the next stage is $y_2^p = P - Q$, since she has to pay the transfer.[24] The child receives no wage but obtains the transfer plus the government subsidy instead, thus her income-on-hand is $y_2^k = s_h + Q$. The equilibrium transfer Q^* is then chosen to maximize the Nash criterion with equal bargaining weights given in (4).

2. **Gift-giving**:

$$H_2^p(z, y_2^p, y_2^k, f) = \max_{g^p \in \mathbb{G}^p} H_3^p\big(z, y_2^p - g^p + g^k, y_2^k + g^p - g^k, f\big), \tag{5}$$

$$H_2^k(z, y_2^p, y_2^k, f) = \max_{g^k \in \mathbb{G}^k} H_3^k\big(z, y_2^p - g^p + g^k, y_2^k + g^p - g^k, f\big), \tag{6}$$

$$\text{where} \qquad \mathbb{G}^i = \begin{cases} [0, \infty) & \text{if } a^i > 0, \\ \{0\} & \text{if } i = p \text{ and } f = 1 \text{ and } a^p = 0, \\ [0, y_2^i] & \text{otherwise}. \end{cases}$$

Here, $f \in \{0, 1\}$ indicates if formal care takes place or not. Players choose non-negative gift flows, which are constrained to their income-on-hand in case they have zero wealth. Gifts are ruled out for parents in formal care when having zero wealth.

3. **Medicaid decision**:

$$\begin{aligned} H_3^i(z, y_3^p, y_3^k, f) &= m H_4^i(z, c_{ma}, y_3^k, 1) + (1 - m) H_4^i(z, y_3^p - f(q - s_f), y_3^k, 0), \\ \text{where} \quad m &= \mathbb{I}\{f = 1\}\mathbb{I}\{a^p = 0\}\mathbb{I}\big\{H_4^p(z, c_{ma}, y_3^k, 1) > H_4^p(z, y_3^p - q + s_f, y_3^k, 0)\big\}, \end{aligned} \tag{7}$$

Here, $\mathbb{I}\{\cdot\}$ is the indicator function. The second line gives the optimal MA decision. This decision is relevant only if the game arrives at the formal-care node, $f = 1$, and the parent is broke, $a^p = 0$. The parent chooses MA if the value from doing so in the next stage of the game is higher than that of choosing private care. In MA, the means-test implies the parent enters the next stage with income-on-hand c_{ma}. In private care, the parent has to pay the price of a nursing home minus the government subsidy.

[24] Since time is continuous, stocks and flows have to be treated separately and we cannot lump a^p into a cash-on-hand variable as in discrete time.

4. **Consumption**:

$$H_4^p(z, y_4^p, y_4^k, m) = \max_{c^p \in \mathbb{C}^p} \left\{ u(c^p) + \alpha^p u(c^k) + \dot{a}^p V_{a^p}^p + \dot{a}^k V_{a^k}^p \right\}, \tag{8}$$

$$H_4^k(z, y_4^p, y_4^k, m) = \max_{c^k \in \mathbb{C}^k} \left\{ \alpha^k u(c^p) + u(c^k) + \dot{a}^p V_{a^p}^k + \dot{a}^k V_{a^k}^k \right\}, \tag{9}$$

$$\text{where} \qquad \mathbb{C}^i = \begin{cases} [0, \infty) & \text{if } a^i > 0, \\ \{c_{ma}\} & \text{if } i = p \text{ and } m = 1, \\ [0, y_4^i] & \text{otherwise,} \end{cases}$$

$$\dot{a}^i = r a^i + y_4^i - c^i.$$

Finally, both players choose consumption to trade off instantaneous felicity and the value of savings. When having zero wealth, a generation's consumption cannot exceed income-on-hand, and parents in MA are not allowed to save.[25]

3.3 Equilibrium Definition

A recursive equilibrium is given by value functions for the kid, V^k, and the parent, V^p, policy rules for the young, $\{g^k, c^k\}$, and the parent, $\{g^p, m, c^p\}$, an informal-care rule, h, and an informal-care transfer function, Q^*, such that, given exogenous endowments and prices, $\{P, w, r, q\}$, and a government policy, $\{s_h, s_f\}$,

1. the value function V^p satisfies (1), the maximum in (5), (7), (8) being attained by the policies $\{g^p, m, c^p\}$, taking as given the kid's policy rules, $\{g^k, c^k\}$;

2. the value function V^k satisfies (1), the maximum in (6), (9) being attained by the policies $\{g^k, c^k\}$, taking as given the parent's policy rules, $\{g^p, m, c^p\}$;

3. the informal-care decision rule, h, and the transfer rule, Q^*, are the symmetric Nash-bargaining solution between kid and parent, i.e. they satisfy (2) and (4).

[25] If $y_4^p < 0$, then $\mathbb{C}^p = \varnothing$; we define $H_4^p = -\infty$ in this case. MA will then automatically be chosen in Stage 3, since it is the only viable choice. This situation can occur when $P < q$, i.e. if the parent's pension cannot cover the private nursing-home cost.

3.4 Bargaining on informal care

We now proceed by backward induction to characterize the equilibrium of the instantaneous game, taking as given the value functions $\{V^p, V^k\}$ and its derivatives. Details are given in Appendix A.

In the final stage, the optimal consumption choice is as in Barczyk & Kredler (2014*a*), except for the trivial case where the parent is in MA. It is characterized by the first-order condition (FOC) $u_c(c^i) \geq V^i_{a^i}$. The agent equates the marginal utility of consumption to the marginal value of saving when unconstrained, but may be forced to consume her income-on-hand when out of wealth, $a_i = 0$.

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. When deciding on MA, the parent will thus just compare the consumption level she obtains in private care after paying for the nursing home, $y^p_3 - q_{net}$, to the MA consumption floor, c_{ma}. The parent's decision rule for MA is thus[26]

$$m = \mathbb{I}\{f = 1\}\mathbb{I}\{a^p = 0\}\mathbb{I}\{y^3_p - q_{net} < c_{ma}\}. \tag{10}$$

We now turn to the gift choice. As in Barczyk & Kredler (2014*a*), we find that in equilibrium $V^i_{a^i} > V^i_{a^j}$ throughout the state space, i.e. each generation prefers that an additional dollar of wealth be given to themselves than to the other. This implies that the donor never gives a gift unless the recipient has zero wealth, meaning that all gifts are delayed until the recipient hits the constraint in equilibrium. The intuition is that this strategy enables the donor to exert control over the recipient's consumption. In fact, the optimal gift-giving strategy here is exactly as in Barczyk & Kredler (2014*a*) unless the elderly is in formal care. The first-order condition for interior gift choices is $\alpha^i u_c(y^j_2 + g^i) = u_c(c^i)$. It says that the donor chooses the gift such that marginal felicity of the recipient, weighted by the donor's altruism, equals marginal felicity of the donor. Equilibrium gifts are (i) increasing in the donor's altruism, α^k, (ii) increasing in the donor's wealth and income, (iii) decreasing in the recipients income. However, the situation is slightly different if formal care was chosen in Stage 1. The child then has to take into account the consequences of her gift on the parent's

[26] This decision rule relies on the consumption function c^p being bounded below by the consumption floor c_{ma}, which implies the parent would not save when offered consumption below c_{ma}. We find this condition to be true in our computations, but cannot prove it. In Appendix A.2 we provide a general solution for the parent's MA choice which also considers the case $c^p < c_{ma}$.

MA decision in Stage 3. In fact, any gift is wasted that does not enable the parent to pay for a private nursing home, since any such gift automatically falls prey to the MA means test. The optimal strategy for the kid is thus to choose to either give no gift, sending the parent to MA in many cases, or choosing the best gift among those that make the parent choose a private nursing home. Gifts to parents in formal care share properties (i)-(iii) above; in addition, they are decreasing in the MA consumption floor, c_{ma}.

In Stage 1, informal care is bargained upon. Here we treat the case where both parent and child have positive wealth. This case has a simple solution that conveys most of the intuition for the determinants of the informal-care decision; the other cases are covered by Proposition A.1 in Appendix A.

We start by writing down the surplus functions from informal care, $S^p(Q)$ and $S^k(Q)$, for an arbitrary transfer $Q \geq 0$. Since both $a^p > 0$ and $a^k > 0$, gifts in Stage 2 will be zero and the parent will not choose MA. Substituting Q into the laws of motion for wealth yields

$$\dot{a}^p = ra^p + P - hQ - (1-h)q_{net} - c^p,$$
$$\dot{a}^k = ra^k + h(Q + s_h) + (1-h)w - c^k.$$

Note that optimal consumption levels, $\{c^p, c^k\}$, do not depend on the transfer Q since both households are unconstrained. Using the laws of motion in the surplus functions in (3) yields[27]

$$S^k(Q) = \underbrace{\alpha^k\eta + (Q + s_h)V^k_{a^k} + q_{net}V^k_{a^p}}_{\text{marginal benefit}} - (\underbrace{wV^k_{a^k} + QV^k_{a^p}}_{\text{marginal cost}}). \tag{11}$$

The kid's marginal benefit of providing care consists of various terms. First, since the kid is altruistic, she takes into account that the parent prefers to stay at home, $\alpha^k\eta$. Second, the child receives a monetary transfer, $Q + s_h$, which she values at her shadow value of wealth, $V^k_{a^k}$. Additionally, the parent saves q_{net} on private care, which the kid evaluates using her shadow value on parent's wealth, $V^k_{a^p}$. The marginal cost of providing informal care consists of the kid's opportunity cost, w, and the transfer, Q, evaluated at their corresponding shadow values.

It is instructive to analyze the child's surplus, $S^k(Q)$, in the extreme cases when altruism is perfect or absent. If both kid and parent are perfectly altruistic, $\alpha^k = \alpha^p = 1$, then they

[27]Formally, use the laws of motion in H^k_4 in (9), and then recursively substitute into H^k_3, then into H^k_2, and finally into (3).

may pool their wealth and behave as one unit. Thus $V^k_{a^k} = V^k_{a^p} = V_a$ in (11), where we denote by V the value function of the dynasty and by a its wealth. The dynasty will choose informal care if and only if $\eta \geq (w - s_h - q_{net})V_a$: the utility gain from informal care has to exceed the losses of flow income to the dynasty, valued at the marginal value of family wealth. On the other hand, consider a selfish kid, $\alpha^k = 0$. For the sake of the argument, also assume that the kid is randomly matched to elderly households with different wealth levels, so that the elderly's wealth is not a state variable for the kid. Then $V^k_{a^p} = 0$, i.e. the child puts no value on the parent's wealth. The selfish child will provide care if and only if $Q + s_h \geq w$, i.e. always when the monetary benefit, $Q + s_h$, exceeds the opportunity cost, w.

The surplus S^k in (11) increases linearly in Q since in equilibrium $V^k_{a^k} > V^k_{a^p}$. We can thus calculate a *reservation transfer* for the child, i.e. the lowest Q for which the kid would provide informal care. Solving $S^k(Q) = 0$ yields

$$\underline{Q}^k = \frac{(w - s_h)V^k_{a^k} - q_{net}V^k_{a^p} - \alpha^k \eta}{\underbrace{V^k_{a^k} - V^k_{a^p}}_{>0}}. \tag{12}$$

The reservation transfer is increasing in the kid's opportunity cost, w, and decreasing in the price of formal care, q_{net}, and the informal-care subsidy, s_h. The more altruistic the child is, α^k, and the more the parent values staying at home, η, the lower the reservation transfer.

For the parent, proceeding in the same way as for the kid, we find the surplus function

$$S^p(Q) = \underbrace{\eta + q_{net}V^p_{a^p} + (Q + s_h)V^p_{a^k}}_{\text{marginal benefit}} - \underbrace{\left(QV^p_{a^p} + wV^p_{a^k}\right)}_{\text{marginal cost}}.$$

On the benefit side, the parent has a direct preference for staying at home, η, and saves the net nursing-home price, q_{net}, when at home. Furthermore, the parent internalizes the fact that the child obtains $(Q + s_h)$, using the shadow value of the kid's wealth to her, $V^p_{a^k}$. On the cost side, the parent has to pay Q for informal care and takes into account the child's opportunity cost, w. Since $V^p_{a^p} > V^p_{a^k}$ in equilibrium, we can find the parent's *willingness to pay for informal care*, i.e. the highest Q the parent would pay to stay at home:

$$\bar{Q}^p = \frac{\eta + q_{net}V^p_{a^p} - (w - s_h)V^p_{a^k}}{\underbrace{V^p_{a^p} - V^p_{a^k}}_{>0}}. \tag{13}$$

This is a mirror image of the child's reservation transfer. The parent's willingness to pay is increasing in her utility from informal care, η, the cost of a nursing home, q_{net}, and the informal-care subsidy, s_h; it is decreasing in the kid's opportunity cost, w, though. Also, note that wealth effects enter through $V^p_{a^p}$ (and $V^p_{a^k}$): the richer the parent (and the kid), the lower the shadow value of wealth, $V^p_{a^p}$ (and $V^p_{a^k}$), and the more important the felicity from informal care, η, becomes compared to monetary considerations. Thus the richer the parent is, the higher will be her willingness to pay.

Since the surplus functions are linear and the bargaining weights are equal, the equilibrium transfer is given by the average between the two players' threshold values if this number is positive. Equations (2) and (4) and the condition $Q \geq 0$ imply that the bargaining result (for the case when both players have positive wealth) is

$$
\begin{aligned}
h(a^p > 0, a^k > 0, \ldots, s = 1) &= \mathbb{I}\{\bar{Q}^p \geq \underline{Q}^k\}, \\
Q^*(a^p > 0, a^k > 0, \ldots, s = 1) &= \max\left\{0, \tfrac{1}{2}(\underline{Q}^k + \bar{Q}^p)\right\}.
\end{aligned}
$$

From the threshold definitions in (12) and (13), we glean that informal care is more likely (i) the more the old values informal care, (ii) the more altruistic the child is, (iii) the more expensive nursing homes are, (iv) the lower the child's effective opportunity cost, $w - s_h$, is, and (v) the richer the parent is.

3.5 Discussion of the timing protocol

The timing protocol for the sequencing of informal-care and MA decisions has important consequences. We have studied an alternative version of the model where the sequencing is reversed: (1) the parent first chooses if to go into MA or not, (2) in case the parent is not in MA, generations bargain on whether informal care or private care occurs, (3) gifts are chosen, and (4) consumption takes place. Under this specification, the parent can commit, at least over a short period of time, not to take advantage of the government's MA provision. But then, by staying out of MA, the parent can force the altruistic child to give transfers to the parent if her pension is not sufficient to pay for private care. The transfer can be either in form of informal care or in the form of a monetary gift. We abandoned this specification since we do not think that the elderly can credibly threaten to reject government aid in case their children do not help her out. Furthermore, we obtained counterfactually high levels of informal care for families with poor parents under this alternative protocol.

3.6 Illustrating the model

We now illustrate the workings of our model in a representative numerical example. We provide results for two different levels of wages and pensions to study how they affect equilibrium outcomes.

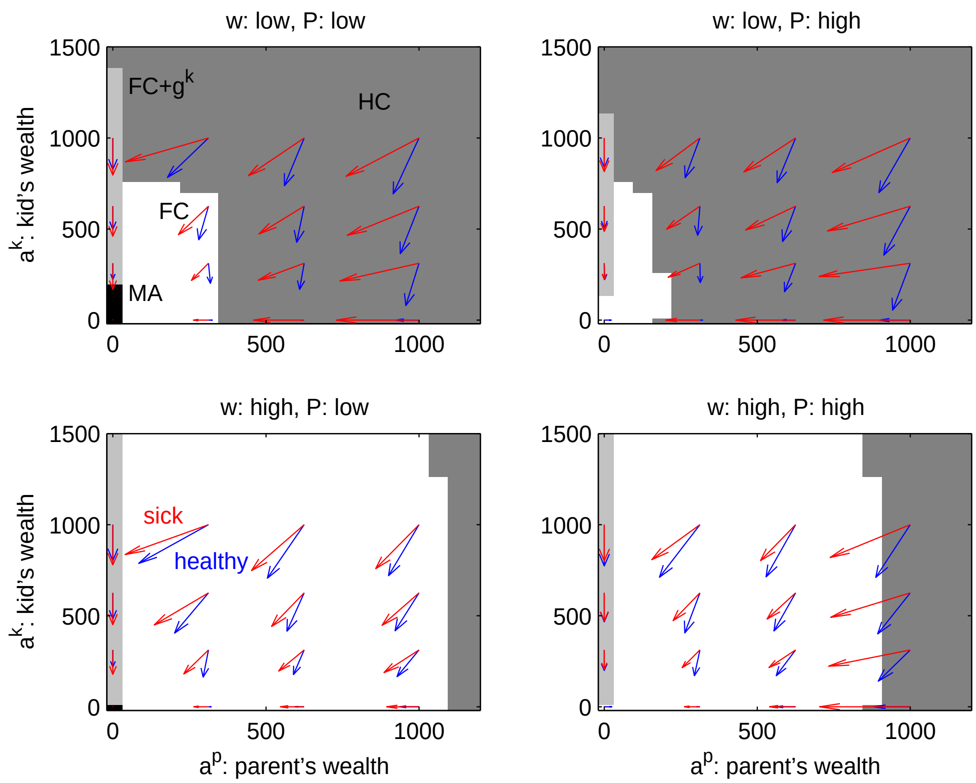

Figure 2: Savings behavior and care arrangements

Arrows represent laws of motion for wealth; blue: parent healthy, red: parent requires LTC. Colored regions represent care arrangements; black: Medicaid-financed formal care, white: privately-financed formal care paid solely by the parent, light grey: privately-financed care supported by gifts from the kid, dark grey: informal care. Axes are in thousands of dollars. Parameters: $u(c) = \ln(c)$, $\alpha^k = 0.25$, $\alpha^p = 0.45$, $\eta = 0.3$, $c_{ma} = \$2,000$, $r = 3\%$, $\rho = 4\%$, $\sigma = 10\%$, $q = \$6,000$; $s_h = s_f = 0$, $w \in \{\$10,000; \$18,000\}$ and $P \in \{\$6,000; \$10,800\}$.

Figure 2 displays the laws of motion for wealth, $\dot{a}^p$ and $\dot{a}^k$, and the equilibrium care arrangements. Each panel corresponds to a different combination of productivities of kid and parent. An arrow represents in which direction and at which speed the family's wealth moves, and the colored regions represent care arrangements.

In terms of savings behavior, we see that the kid dissaves whether or not the parent is in need of care—all arrows point downward. This is because the kid faces no income risk and no life cycle in this simplified example. In contrast, the parent engages in precautionary-savings behavior in anticipation of the health shock, at least in some situations—the blue arrows point to the right in the upper two panels when both parent and child have low wealth. When the kid is wealth-rich, however, the parent also dissaves. This is because she counts on the generosity of the kid should she become sick. When sick, the parent runs down her wealth in all states, as is to be expected.

We now have a look at care arrangements, starting in the upper-left panel. Informal care covers the largest area—this is because the kid's opportunity cost, w, is low. Consider a trajectory of the economy starting in the center of the graph, say at $a^p = a^k = 500$. At this intermediate level of parent wealth, the parent's transfers can induce the kid to provide informal care. The parent then spends down her wealth, and the economy follows the red arrows southeast. Once the parent runs down her wealth and we enter the white area, the parent does not have enough to offer to the child any more, and the parent moves to a private nursing home (FC). Once the private nursing-home expenses have exhausted her wealth, she finally moves into Medicaid, the black area, which is absorbing. Looking upward, we note that MA is only used when the kid is also wealth-poor. When the child is still moderately wealthy, the child gives gifts to her broke parent to enable her to stay in private care. Finally, going all the way to the top of the graph, we see that informal care takes place when the kid is very wealthy and the parent is broke. This is due to a wealth effect similar to the parent's: since we modeled informal care as a normal good, for very wealthy children the monetary costs of informal care become irrelevant compared to the altruistic utility gain from informal care, and the kid starts to give informal care out of purely altruistic considerations.

The situation is qualitatively similar in the lower-left panel, where the kid has a high wage and the parent's pension is low. Since the kid's opportunity cost is high, informal care occurs in fewer circumstances now. The kid instead is more generous giving gifts that enable the parent to pay for private care, as we will see in more detail below. This shrinks the MA area.

Third, we consider the upper-right panel, where the parent enjoys a high pension while the child's wage is low. The MA region disappears because the parent is now able to pay for a private nursing home herself even when broke. The kid still provides gifts to the parent to pay for a private nursing home in some circumstances, but these are less generous because the kid is now income-poor relative to the parent. The informal-care region is large, mostly due to the kid's low opportunity cost. We see that the informal-care region stretches even further to the left then in the upper-left panel—this is because the parent is able to afford higher transfers to the kid.

Finally, the lower-right panel may be understood as a combination of the effects explained so far.

In terms of comparative statics, we draw the following conclusions for care arrangements. As derived theoretically before, higher wages for the kid imply less informal care. The parent's pension is also positively related to informal care, but to a lesser extent. By the same token, informal care is more likely the wealthier the parent is, and – to a lesser extent – the wealthier the kid is. These predictions are in line with the stylized facts from Section 2. Finally, the model predicts that Medicaid is more likely the lower parent's (and child's) income and wealth.[28]

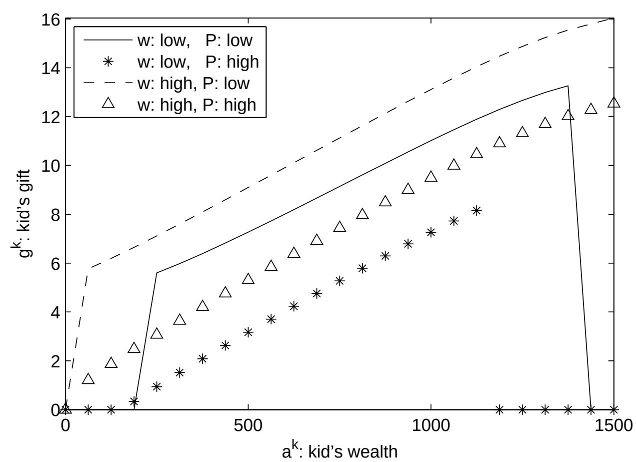

Figure 3: Kid's gifts, parent broke and sick

Figure 3 displays the kid's gifts to a sick parent with zero wealth. In high-wage, low-pension families gifts are largest, and they are smallest in low-wage, high-pension families, as one would expect. Gifts increase in the kid's wealth as long as private care occurs. At the point where the kid starts to provide informal care, gifts drop sharply, in our example even

[28]Note that our model also has strong implications on the temporal sequencing of care decisions. It says that MA is always chosen last, once family members have run down their wealth. Also, informal care is followed by private care but not the other way around. In the data, these patterns are borne out. However, this may also be because health is deteriorating with age and thus nursing homes become more attractive compared to informal care purely for health reasons.

to zero. In the figure we observe this in the two low-wage scenarios.[29] This sharp drop in gifts occurs because the old's income-on-hand increases substantially when not paying the nursing home.[30]

An interesting feature of our model is that generations within the same family may differ in their policy preference. Figure 4 shows which policy out of (i) an informal-care subsidy, s_h, and (ii) a formal-care subsidy, s_f, of the same size each generation would prefer. It turns out that most disagreement occurs for low-wage, high-pension families in our example, so we concentrate on this case. The intuition of what follows is the same in the other scenarios.

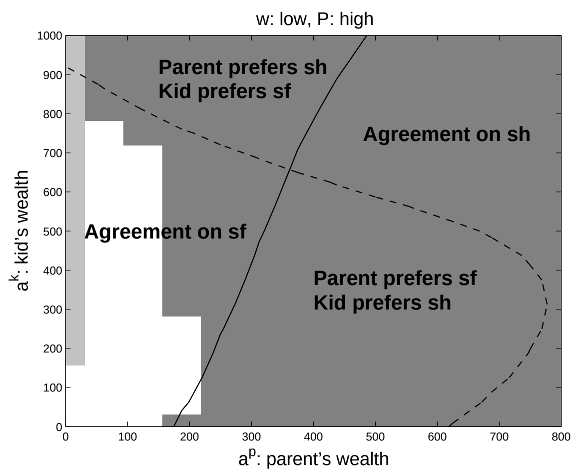

Figure 4: Generations' policy preference

Graph shows which households in a family (low-wage kid and high-pension parent) prefer the informal-care subsidy (s_h = $500$$) to the introduction of a formal-care subsidy (s_f = $500$$) for different starting levels of wealth. Care regions are reproduced from the upper-right panel of Figure 2.

We first discuss situations where both generations agree, since these are easiest understood. Within the white area, the parent will stay in privately-financed care forever, as the phase arrows in the upper-right panel of Figure 2 reveal. It is thus not surprising that both agents prefer the formal-care subsidy in this situation. In the other extreme, in the upper-right corner informal care will occur for a long time, thus making the informal-care subsidy

[29]The drop also occurs in the high-wage scenarios, but is not visible in the figure. Furthermore, for very high levels of a^y the kid's gifts become positive again also in informal care, in all four scenarios.

[30]In the calibrated life-cycle model there is another reason why informal care takes place without an immediate exchange of a transfer. If the kid's income is below the cost of formal care, the kid can benefit from providing care for free, since she can expect a higher bequest when the parent saves on the high private-care expenses.

more attractive to both.

We now turn to the situation in the upper-left corner, where the parent prefers s_h but the child prefers s_f. In this region, informal care takes place for some time until the parent has spent down her wealth. The parent then moves into a private nursing home, and the child helps her with the expenses. The parent likes s_h because it increases the surplus from informal care and makes the parent stay at home longer. Since the surplus from informal care is split between the two households through bargaining, both the parent and the child benefit from s_h. A formal-care subsidy, however, reduces the total surplus from informal care, and with it the parent's part of it. The formal-care subsidy goes entirely into the pockets of the child: it makes it easier for the child to send the parent to a nursing home. The child can maintain the standard of living that it desires for the parent with lower gifts now, and the child appropriates most of the surplus from s_f.

Matters are reversed when the kid is wealth-poor and the parent has moderate amounts of wealth. The parent then prefers s_f, whereas the kid prefers s_h. Why is this? When s_f is introduced, the private-care region expands to the right. Since the parent pays the nursing-home bills in these situations, the surplus from this policy goes solely to the parent. The gains from the informal-care subsidy, however, are partly absorbed by the child, since the child appropriates part of the increased total surplus from informal care in the bargaining process. Note that the nature of disagreement does not depend on the bargaining weight in a qualitative way, thus our results are not limited to the case of symmetric bargaining.

4 Calibration

We now turn to the full model and its calibration. Here we only describe the model structure in broad lines; a detailed description is provided in Appendix B. We solve the model adapting the methods of Barczyk & Kredler (2014*a*) for our purposes; these authors show how to solve a dynamic game in continuous time between two altruistic households using Markov-chain approximation methods.

We model one cycle of interaction between parent and child generation. Each family consists of a parent and a child generation, which are the decision units. The model starts with the parent being 50 years old, and the kid being 20 years old. Each generation retires at 65, and lives maximally up to age 95. The dynasty ends when the child dies. The parent generation consists of one household, whereas the child generation consists of one marginal household (containing the potential caregiver) and a measure $\nu \geq 0$ of infra-marginal households (whose members always work). The parameter ν captures the fertility rate of the parent generation. Each household consists of a male and a female individual.

During his work life, the male inelastically supplies labor. His productivity is governed by a deterministic age profile and a persistent shock process, both parameterized by standard methods. The male in the marginal and infra-marginal kid household share the same productivity shock, and the female's productivity always equals a fraction $1/\beta$ of the male's. $\beta \geq 1$ captures the gender-wage gap. When the parent is healthy, the young female supplies her labor inelastically to the market. When the parent is sick, the female in the marginal child household faces a discrete choice between care and market work. The parent generation faces a labor-productivity process with the same properties, but gives no care.

We estimate conditional death and LTC hazards from the HRS data. We assume that the male has a deterministic care need, which arises while the female is still healthy, and that the female automatically takes care of the male. We include this feature into the model in order to realistically estimate the costs of a informal-care subsidy. As in the simplified model, the female's health follows a binary stochastic process. When sick, she obtains care from either the daughter, privately-financed care, or Medicaid. We take the costs of private nursing homes and Medicaid care from other studies.

Preferences are as in the simplified model, the utility functional being $u(c) = \ln(c)$.[31] However, we introduce two modifications. First, we adjust consumption expenditures using an equivalence scale to account for household economies of scale. Second, it turns out that LTC risk together with the bequest motive implied by altruistic preferences are not enough to generate strong-enough incentives to save in old age. We deem it essential that households have realistic levels of wealth at the time when care decisions are made, since parent's wealth is a key determinant of the care arrangement in the data. To do this in a tractable way, we add a warm-glow bequest motive for the parent household, which allows us to obtain realistic savings behavior in pension age. We assume that upon death, agent $i \in \{p, k\}$ obtains a one-off payoff of $\omega \ln(a^i_{T^i_d} + \bar{a})$, where ω measures the strength of the bequest motive, $a^i_{T^i_d}$ is i's

[31] We choose logarithmic utility since any bounded utility functional $u(\cdot)$ has unpalatable consequences (given our assumption of additive separability for utility on (c, h)-tuples, which we impose for tractability). To see this, consider the class of CRRA preferences, i.e. $u(c) = c^{1-\gamma}/(1-\gamma)$. For $\gamma > 1$, there exists a level of consumption above which the old prefers to obtain informal care to any increase in consumption. For $\gamma < 1$, there exists a level of consumption below which the old is willing to accept zero consumption in order to obtain informal care. Only for $\gamma = 1$ (log-utility) there exists always a finite rate of substitution between consumption and home care, which is a constant fraction of consumption, $\exp(\eta) - 1$.

wealth at the time of i's death, T_d^i, and $\bar{a}$ is the expected discounted lifetime value of income for the next generation. In including $\bar{a}$ we follow the specification of Lockwood (2012) who shows that bequests are luxury goods, which is consistent with altruistic motives.

There are two competitive sectors in the economy that produce the consumption good and formal care with the sole input labor. Productivity of the consumption-good sector is A_y, and the productivity of the formal-care sector is normalized to 1. Increasing A_y allows us to study the consequences of a rise in the relative price of care. The government finances Medicaid, care subsidies, pensions, and other expenditures by a payroll and an income tax. We model the pension and tax system following other studies.

Description	Data	Model
Mean gift: Parents	$1,625	$1,625
Mean gift: Kids	$109	$110
Informal care among LTC cases	42.0%	42.0%
Medicaid among formal-care cases	46.0%	46.2%
Median wealth: Parents aged 50-64	$192k	$195k
Median wealth: Parents aged 65+	$160k	$160k

Table 5: Empirical targets and model-generated counterparts

Data from 2002 wave of the HRS. Parents' mean gift is the average annual gift (including zero amounts) from healthy parents to all non co-residing children of age 18+. Kids' mean gift is the total gift (including zero amounts) a parent household received from all non co-residing children of age 18+ averaged across parent households who do not reside in a nursing home. To calculate mean gifts we exclude outliers. Median wealth of parents aged 50-64 are for couples in the sample. Median wealth of parents aged 65+ are for healthy couples and healthy widows. We excluded households in the top 5% of wealth from our sample.

We now discuss the calibration of the remaining parameters, which are identified by matching closely-associated moments in the data. Table 5 shows the calibration targets and the corresponding values from our model, and Table 6 shows the calibrated parameters. The parents' altruism parameter, α^p, is identified by the average gift made by healthy parents to the child generation. We leave out sick parents since these can also give transfers for exchange-motivated reasons in our model, while they can only be altruistically-motivated for healthy parents. In order to pin down the kid's altruism parameter, α^k, we use the average gift the kid generation gives to parents who are not in a nursing home. In the model, such transfers can only flow due to altruistic motives.[32] The stay-at-home preference, η, and the

[32]We use gifts to nursing-home residents to validate the fit of our model later.

consumption value of the Medicaid consumption floor, c_{ma}, are identified by the prevalence of informal care and Medicaid in the data. Finally, we identify the discount rate, ρ, by targeting the median level of wealth of the age group 50-65 and the warm-glow parameter, ω, by targeting the median wealth for the age group 65 and above.

It is worthwhile to pause for a moment to have a closer look at the parameter estimates in Table 6. Our calibration produces a degree of altruism of 0.39 for parents and 0.26 for kids. The interpretation of these numbers, for the case of the parent, is as follows: a parent makes a kid household of the same size consume 39% of what the parent household consumes whenever the parent gives gifts. We see that kids' altruism is relatively close to parents', despite the fact that their average gift is barely one-fifteenth of the parents'. This is because parents have higher wealth than children and are thus less likely to be constrained.[33]

Description	Parameter	Value
Parents' altruism	α^p	0.391
Children's altruism	α^k	0.256
Stay-at-home preference	η	0.413
MA consumption floor	c_{ma}	\$1,240
Discount rate	ρ	4.17%
Warm glow for bequest	ω	5.25

Table 6: Parameters identified by matching moments

Furthermore, to obtain as much informal care as there is in the data requires a substantial preference for informal care, $\eta = 0.41$. The interpretation is that a parent in a nursing home has to consume 51% more[34] than she consumes at home to obtain the same flow felicity. In a similar vein, the consumption floor has to be fairly low, 1,240\$ yearly, to match the prevalence of Medicaid care in the data. This is lower than what other studies have found because preferences here are represented by log-utility and there is an additional channel of insurance available, namely, the family.

[33]In a related model, Barczyk (2014) finds values of $\alpha^p = 0.28$ and $\alpha^k = 0.12$ with a coefficient of relative risk aversion of 2. He identifies the altruism parameters using aggregate measures of inter-vivos transfers from Gale & Scholz (1994) based on the 1983-86 Survey of Consumer Finances. When making Barczyk's estimates comparable to log-utility using the method proposed by Barczyk & Kredler (2014*a*), his altruism measures turn to $\sqrt{\alpha^p} = 0.53$ and $\sqrt{\alpha^k} = 0.35$. This is not far from the estimates we obtain in our model using the HRS transfer data.

[34]... since $\exp(0.41) - 1 = 0.51$.

We now check the fit of the model for important moments that were not targeted by the calibration. Table 7 shows that the model does quite a good job in replicating the fractions of household giving inter-vivos transfers in healthy families, see the first two lines. This is an important statistic because we see many zeros for transfers in the data. The model is correct in predicting that transfers to parents in nursing-homes are a lot higher than gifts to healthy parents (109$), but overstates both the frequency and amounts of financial aid to parents in nursing homes. The model does a fair job in matching the wealth distribution, but does not create enough wealthy households, especially among the very old. Including medical-expenditure shocks could be a remedy for this, but we refrained from including them to maintain the model focused on LTC. Also, considering a fat right tail in the wage distribution and postponing the certain age of death (95 years) could be remedies for these shortcomings.

Description	Data	Model
% parents giving, parent healthy	16.70%	16.99%
% kids giving, parent at home	1.95%	3.64%
% kids giving, parent in NH	8.20%	16.45%
Kids' mean gift, parent in NH	$525	$2,440
25th pct wealth of parents aged 50-64	$76k	$78k
75th pct wealth	$423k	$313k
25th pct wealth of parents aged 65+	$42k	$60k
75th pct wealth	$348k	$260k

Table 7: Non-targeted moments

"% parents giving" is the fraction of healthy parent households giving positive gift amounts to children. "% kids giving" is the fraction of children giving positive gift amounts to parents who reside at home. "% kids giving, parent in NH" is the fraction of kid households giving positive gift amounts when the parent resides in a nursing home.

As for transfers that flow in exchange for informal care, Q^*, the model predicts an average amount of 11,543$ per year (not in table). This is more than the monetary transfers we see for this group in the data (1,738$), but comes closer once we take into account that 39% of heavy helpers live rent-free with the parent. That being said, the model also generates a large amount of informal care – 29% of informal-care families – for which Q^* is zero. There are two kinds of families with $Q^* = 0$. In the first type (around one-third of families), the parent has zero wealth, so that the kid cannot expect a bequest; caregiving takes place out of purely altruistic reasons in these families. In the second kind of families with $Q^* = 0$, the parent still owns wealth. In these families, children have an additional incentive for caregiving that did not arise in our simplified model: if the kid's wage is below the cost of a nursing home, the kid can benefit from providing care for free, since she can increase her expected bequest by protecting the wealth of the parent. This prediction squares up well with the large bequests to caregiving children that we documented in Section 2.

5 Policy experiments and forecasts

We now study the effects of separately introducing an informal-care subsidy and a formal-care subsidy into our environment. For the informal-care subsidy, we first assume that the subsidy is paid to both caregiving kids and retired parents who give care to their spouses—later we will provide results for a subsidy that is restricted to working-age kids. We consider annual subsidy amounts of 1,000$, 2,000$ or 3,000$ of either type. By way of contrast, during the period 1996 to 2008 Germany's informal-care allowance was on the order of 6,000$ per year for informal caregivers providing 20 hours per week and about 10,000$ per year when providing 35 hours weekly. The subsidy amounts that we consider here are substantially smaller since generous benefits would likely not be politically feasible in the U.S. The effects are approximately linear in the subsidy for higher levels of each subsidy.

Table 8 shows the effects of the informal-care subsidy. The subsidy increases the surplus from informal care and so, unsurprisingly, more informal care is chosen. There is a strong increase (by four percentage points) in informal care in reaction to the initial 1,000$-subsidy, but beyond 1,000$ the fraction of informal care increases at only two percentage points per 1000$ increase. The increase in informal care comes at the expense of privately-paid and Medicaid care. Privately-paid care decreases by more than one percentage point for the initial 1,000$ of subsidy, but then reacts less strongly at higher levels. In contrast, reliance on Medicaid decreases by almost two percentage points per 1000$ at all levels of the subsidy. We conclude that in terms of care arrangements, the primary effect of an informal-care subsidy is that it increases informal care by crowding out Medicaid.

We now turn to the consequences of the subsidy for the government budget, which are summarized in the second block of Table 8. An informal-care subsidy means that (i) the government has to pay out cash to caregivers (both children and spouses), which is summarized in the block's first two lines. The item for spousal care is larger in our calibration than for children because males tend to require care earlier in life than females. Thus the present value of the subsidy payments to spouses is larger than that to children.[35] However, the subsidy also has indirect costs and benefits, which are summarized in the block's next two lines. The government (ii) faces a smaller income tax base as marginal workers exit the labor force. This cost is relatively modest because it is mainly low-earnings individuals who leave the labor force; these individuals did not pay high taxes in the first place. Finally, substantial cost savings accrue to the government since (iii) fewer individuals rely on Medicaid (note that the table gives negative values in parentheses). Adding the various budget items together yields a small increase of the income tax rate in total. However, this tax hike can be reduced to almost zero when restricting the subsidy to working-age caregivers (kids), as we will see in more detail below.

Subsidy amount	none	1000$	2000$	3000$
Care arrangements (%)				
informal care	42.0	46.1	48.3	50.9
private	31.2	28.9	28.5	28.0
Medicaid	26.8	25.0	23.2	21.1
Costs (as $\Delta\tau$)				
subsidy to kid		0.010	0.021	0.031
subsidy to spouse		0.018	0.036	0.055
smaller income-tax base		0.007	0.011	0.016
less Medicaid care		(0.012)	(0.024)	(0.038)
total		0.023	0.044	0.064
Wealth quantiles ($000)				
Q10	7.6	7.5	7.4	7.3
Q25	78.1	77.9	77.7	77.4
Q50	195.7	195.3	194.9	194.2
Q75	313.4	312.7	312.1	311.0
Q90	383.9	383.1	382.4	381.2

Table 8: Effects of an informal-care subsidy

Numbers in brackets are negative values. The block "Costs (as $\Delta\tau$)" shows by how many percentage points the income tax rate has to change to cover the cost of the subsidy, per budget item and in total.

The third block of Table 8 summarizes changes to savings behavior by presenting wealth quantiles of the parent generation. We see that this channel is of minor importance quan-

[35] Recall that we balance the government budget constraint in present value at the birth date of a cohort.

titatively: adjustments to precautionary savings are small. There are two main reasons for this. First, we implicitly assumed a low degree of risk aversion when assuming logarithmic utility, thus precautionary savings motives were not very strong in the first place when compared to other studies. Second, while the subsidy reduces reliance on Medicaid, Medicaid is still a substantial risk that the elderly fear: the savings incentives stemming from Medicaid aversion do not become much weaker when a subsidy is introduced. Before discussing the welfare implications of the informal-care subsidy it is instructive to consider the allocative effects of the formal-care subsidy, which we turn to now.

Subsidy amount	none	1000$	2000$	3000$
Care arrangements (%)				
informal care	42.0	38.2	34.9	33.0
private	31.2	36.4	41.2	44.8
Medicaid	26.8	25.4	23.9	22.2
Costs (as $\Delta\tau$)				
subsidy		0.008	0.017	0.028
larger income-tax base		(0.004)	(0.007)	(0.009)
less Medicaid care		(0.009)	(0.020)	(0.031)
total		(0.005)	(0.010)	(0.012)
Wealth quantiles ($000)				
Q10	7.6	7.5	7.5	7.4
Q25	78.1	78.0	77.9	77.7
Q50	195.7	195.5	195.2	194.8
Q75	313.4	313.0	312.5	312.0
Q90	383.9	383.4	382.9	382.3

Table 9: Effects of a formal-care subsidy

Numbers in brackets are negative values. The block "Costs (as $\Delta\tau$)" shows by how many percentage points the income tax rate has to change to cover the cost of the subsidy, per budget item and in total. In the model, the nursing-home population consists solely of single individuals and so there is no tax item here that accounts for partnered individuals in a nursing home (partnered individuals rarely reside in nursing homes in our data).

Table 9 shows the effects of subsidizing privately-paid care. For this subsidy, our model predicts that both informal care and Medicaid are crowded out in favor of privately-paid care. Interestingly, again the quantitatively more relevant margin is Medicaid, as it was in the case of the informal-care subsidy. This is again due to the substantial degree of Medicaid aversion that we identified in our calibration: already a relatively modest subsidy induces a large number of lower-to-middle-income families to choose a private nursing home instead of Medicaid. As for the financing of this subsidy, the second block of Table 9 shows that the cost savings from less Medicaid alone are enough to pay for the direct costs of disbursing the subsidy. This is because the subsidy is very cheap compared to the cost of Medicaid. Furthermore, the crowding-out of informal care increases labor supply and thus boosts income-tax revenue for the government, resulting in a small decrease in the income tax rate in total.

Subsidy amount	1000$	2000$	3000$
Informal-care subsidy			
parent	0.056	0.117	0.177
kid	(0.010)	(0.016)	(0.020)
parent, $\Delta\tau = 0$	0.081	0.164	0.246
kid, $\Delta\tau = 0$	0.019	0.038	0.059
Formal-care subsidy			
parent	0.019	0.043	0.069
kid	0.013	0.023	0.033
parent, $\Delta\tau = 0$	0.013	0.034	0.056
kid, $\Delta\tau = 0$	0.006	0.012	0.018

Table 10: Welfare implications of informal- and formal-care subsidies

Welfare is measured by consumption equivalent variation (CEV) under the veil of ignorance at the start of the model. The welfare calculations imposing that the subsidy is not financed by these generations, $\Delta\tau = 0$, is included to isolate the taxation effect.

Finally, we assess welfare implications of the two policies using consumption-equivalent-variation (CEV) measures shown in Table 10. We do this under the veil of ignorance: individuals do not know into which family they will be born; they do know, however, if they will be born as a parent or as a child. In order to gauge how much the change in the tax burden matters for welfare effects, we also report the CEVs that arise when paying out the subsidy and keeping the income tax constant, $\Delta\tau = 0$. We see that the parent generation prefers the informal-care subsidy to the formal-care subsidy, and more so when not having to pay for it. For the kid generation, however, the fully-financed informal-care subsidy is the least-desired policy; kids actually prefer the status quo to this subsidy. This dislike stems primarily from the fact that they have to pay for it: without the associated tax hike, the informal-care subsidy is also their most preferred scenario. For the formal-care subsidy, paying or not paying for it is practically irrelevant since the change in tax is basically nil; the CEVs are actually somewhat higher when the tax change is implemented because it is negative.

Which income groups gain most from which policies? For brevity, we restrict the analysis of subsidies to the case of 3000$ from now on. The right-hand side of the first block of Table 11 shows CEV measures for families where parent (*p:low*) or child (*k:low*) start out in the lower half of the productivity distribution. Generally, welfare gains are higher for low-income families than on average; this is simply because low-income families gain most from the subsidy payments from the government as a percentage of income. In families with low-productivity kids or low-productivity parents, parents prefer the informal-care subsidy to the formal-care subsidy by an even wider margin than in average families. The informal-care subsidy also has a better standing with kids from poor families than with kids from average families (although poor-family kids still prefer the formal-care subsidy). This is because low-income families use informal care more often.

We now present the effects of two alternative policies, also in the first block of Table 11: an informal-care subsidy that only goes to working-age children (third line), and a combined informal-and-formal-care insurance of 3,000$ annually each (fifth line). With respect to the unconditional informal-care subsidy, restricting the subsidy to working-age caregivers constitutes a transfer from parents to children. Thus it is unsurprising that children now slightly prefer the (restricted) subsidy to the status quo, whereas parents' enthusiasm for the subsidy is somewhat dampened. Combining the informal- and the formal-care subsidy looks like a good option for parents, who reduce their savings most in this scenario, indicating that they enjoy better insurance. Children also slightly prefer the combination of both subsidies to the status quo; this is despite the fact that the income tax rate increases.

Our structural model also allows us to forecast how several demographic and economic developments will affect LTC provision. We report a set of such forecasts in the the second block of Table 11. The first line shows the effects of reducing the fertility rate in our economy to replacement level (a decrease in ν from 0.5 to 0). Care arrangements do not change much, but taxes and savings increase in response to the increased burden of care. The second line shows the effect of closing the gender-wage gap from 23% to zero. The rising opportunity cost for working-age caregivers has very strong effects: it reduces informal care by almost 10 percentage points. This increases income-tax revenue to the government, but not enough to make a tax reduction possible. This is because an increase in Medicaid of almost 2 percentage points more than offsets the tax gains.

A common source of concern is that prices for care will rise more rapidly than the general price level. We address this issue by increasing the productivity of consumption-good

Scenario	HC	MA	FC	$\Delta\tau$	$Q50$	γ_p	γ_k	$\gamma_p^{k:low}$	$\gamma_p^{p:low}$	$\gamma_k^{k:low}$	$\gamma_k^{p:low}$
baseline	42.0	26.8	31.2		195.7						
$s_h \uparrow$	8.9	(5.7)	(3.2)	0.065	(0.77)	0.177	(0.020)	0.192	0.202	(0.008)	(0.014)
$s_h \uparrow$ only to k	8.9	(5.7)	(3.2)	0.010	(0.20)	0.135	0.008	0.141	0.146	0.013	0.010
$s_f \uparrow$	(9.0)	(4.6)	13.6	(0.012)	(0.46)	0.069	0.033	0.073	0.077	0.034	0.032
$s_h, s_f \uparrow$	4.9	(9.1)	4.2	0.058	(1.38)	0.210	0.007	0.226	0.240	0.019	0.011
$\nu \downarrow$	(0.4)	0.9	(0.5)	0.16	3.3						
$\beta \downarrow$	(9.2)	1.8	7.4	0.01	0.0						
$A^y \uparrow$	5.2	(7.4)	2.2	(0.10)	41.5						
$\nu \downarrow, \beta \downarrow, A^y \uparrow$	(5.7)	(5.3)	11.0	0.07	46.3						
new baseline*	36.3	21.5	42.2		287.0						
$s_h \uparrow$	9.9	(2.5)	(7.4)	0.069	(0.73)	0.104	(0.033)	0.114	0.123	(0.024)	(0.027)
$s_h \uparrow$ only to k	9.9	(2.5)	(7.4)	0.024	(0.28)	0.074	(0.011)	0.077	0.081	(0.008)	(0.010)
$s_f \uparrow$	(3.5)	(3.0)	6.5	(0.005)	(0.56)	0.068	0.024	0.072	0.076	0.026	0.024
$s_h, s_f \uparrow$	2.4	(5.4)	3.0	0.054	(1.22)	0.168	0.001	0.182	0.194	0.011	0.006

Table 11: Counterfactuals

Numbers in brackets are negative values.
Equilibrium outcomes: HC: informal-care prevalence, MA: Medicaid prevalence, and FC private-care prevalence. $\Delta\tau$: change to the income tax rate, $Q50$: median wealth of parents aged 50-65, γ_i: consumption equivalent variation (CEV) for generation i (parent or kid) under veil of ignorance at start of model, $\gamma_i^{j:low}$: CEV for household i under veil of ignorance over families with kid in lower half of productivity distribution ($k : low$), and over families with parent in lower half of productivity distribution ($p : low$) at the start of the model.
Units: Changes to care arrangements and $\Delta\tau$ expressed in percentage points. Changes to $Q50$ and CEVs expressed in percent.
Scenarios: $s_h \uparrow$: informal-care subsidy of 3,000$ (per year), $s_h \uparrow$ only to k: informal-care subsidy of same size that is only paid to working-age caregivers, $s_f \uparrow$: formal-care subsidy of 3,000$ (per year). $s_h, s_f \uparrow$: informal- and formal-care subsidy of 0$ to 3,000$ each. $\nu \downarrow$: change in number of infra-marginal child households from 0.5 to 0 (each household has two kids instead of three), $\beta \downarrow$: reduction of gender-wage gap to zero (while holding total household income constant for working couple), $A^y \uparrow$: change in labor productivity in the goods sector from 1 to 1.5 (this raises the wage rate, the price of a nursing home, the out-of-pocket cost of providing care at home, and the Medicaid cost by a factor of 1.5). *The "new baseline" is the economy with $\nu = 0$ (two kids per household), $\beta = 1$ (no gender-wage gap), $A^y = 1.5$ (increase in labor productivity in goods sector). Scenarios in last block are with respect to new baseline.

production, A_y, in the baseline economy by 50%, keeping the production technology of care unchanged. Since the consumption good is the numeraire, this leads to a 50% increase in the wage and a 50% increase in the price of formal care. Line 3 reports the counterfactual predictions from this experiment. Here, we keep the consumption floor, c_{ma}, at its baseline level—this can be interpreted as maintaining the disabled above an absolute poverty line that is equal to the current one. This change makes Medicaid vastly less attractive, leading to increases in the other care categories and a decrease in taxes. Of course it would be interesting to study how families reacted if the government also raised c_{ma}. However, we refrain from presenting such an exercise since our calibration does not identify the technology linking Medicaid expenditures, q_{ma}, to the utility level perceived by individuals, c_{ma}. Identifying this technology is an interesting challenge for future research.

Finally, the last line of the second block in Table 11 reports the effects of combining the three changes above (decreasing fertility, closing the gender-wage gap, economic growth) to deliver a joint forecast. We see that the total effects are always close to the sum of the partial effects, which indicates that interactions are quantitatively not important.

Finally, note that all of our policy counterfactuals so far were conducted with respect to the baseline economy, which is meant to capture the U.S. economy around the year 2000. But could these policies, if introduced now, have different effects on the economy of the year 2030? The last block in Table 11 gives a tentative answer to this question and evaluates again the informal- and formal care subsidy, but this time taking as a reference point the counterfactual economy with a changed demography, no gender-wage gap and higher productivity. The results show that the results are broadly in line with the policy counterfactuals in the 2000 world, suggesting that the results of our policy analysis also apply under future conditions.

6 Conclusions

In this paper, we have presented a model of LTC provision in which family members dynamically interact without commitment. The model is successful in generating a large range of observed care arrangements. The model suggests that a combination of (non-means-tested) subsidies to both formal and informal care could be an efficient way to to deal with an increasing elderly population in need of care in the U.S. We conclude by briefly discussing practical effects of such subsidies that go beyond our framework.

In reality, implementing a non-means-tested formal-care subsidy may pose a challenge: policy makers have to make the case why financial support should be given even to those who need it least, e.g. wealthy individuals who can easily afford to pay for a private nursing home. But this is of course also a virtue, since means-tested support is more susceptible to the moral-hazard problem of under-saving. Another concern with a formal-care subsidy may be that it enables nursing homes to appropriate some of the consumer surplus and charge higher prices. But this problem is already present with Medicaid, with fears that nursing homes overcharge the government on their services. An increase in nursing-home demand from private agents may plausibly lead to more competition among formal-care providers. This would help to control the price of care, giving another rationale supporting such a subsidy.

Our analysis also suggests that combining a formal-care subsidy with an informal-care subsidy to family caregivers, as has been introduced in Germany, is an attractive policy option. However, an informal-care subsidy would require a disability certification scheme in order to deter families from untruthfully claiming disability. Such a certification scheme has its costs, but it may also offer unexpected benefits. It makes it easier for agents to write Arrow-Debreu-style contracts that pay benefits contingent on disability status and not on nursing-home residency, thus keeping open a larger range of options to the individual. Such contracts are indeed already available on the German market.

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A Theory appendix

A.1 Consumption choice

Since $u_{cc}(\cdot) < 0$, the optimal consumption choice in the final stage of the game is as in Barczyk & Kredler (2014*a*), except for when the parent is in MA:

$$c^i = \begin{cases} (u_c)^{-1}(V^i_{a^i}) & \text{if } a^i > 0, \\ c_{ma} & \text{if } i = p \text{ and } m = 1, \\ \min\left\{(u_c)^{-1}(V^i_{a^i}), y^i_4\right\} & \text{otherwise.} \end{cases} \tag{14}$$

A.2 Medicaid (MA) decision

Unlike in the main text, we will derive a general decision rule that is also valid if the consumption function c^p violates the condition $c^p \geq c_{ma}$ (which does not occur in the equilibrium that we find computationally, however). 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 (9) since the child's income-on-hand, y^k_4, is the same irrespective of the parent's MA decision. Taking together (7) and (8), the parent thus chooses MA in Stage 3 if and only if

$$u(c_{ma}) > \underbrace{u\Big(c^p(z, y_3^p - q_{net}, y_3^k, 0)\Big) + \big[y_p^4 - c^p(z, y_3^p - q_{net}, y_3^k, 0)\big]V_{a^p}^p}_{\equiv G(y_3^p)}. \tag{15}$$

The function $G(\cdot)$ defined on the right-hand side of (15) is strictly increasing in y_3^p. We can thus implicitly define a threshold income level y_{thr}^p that characterizes the optimal MA choice as

$$ma = \mathbb{I}\{f = 1\}\mathbb{I}\{a^p = 0\}\mathbb{I}\{y_3^p < y_{thr}^p\}, \qquad \text{where } y_{thr}^p \text{ solves}$$
$$G(y_{thr}^p) = u(c_{ma}).$$

A.3 Gift choice

A.3.1 No formal care: $f = 0$

We first state the optimal transfer choice for the case $f = 0$, i.e. when the parent is healthy or informal care was chosen in Stage 1. The solution is exactly as in Barczyk & Kredler (2014*a*). Following them, we first define the optimal unconstrained and constrained gifts

$$g_{unc}^i \equiv \max\big\{0, \min\{g_{dict}^i, c_{unc}^j - y_2^j\}\big\},$$
$$g_{constr}^i \equiv \max\big\{0, \min\{g_{stat,dict}^i, c_{unc}^j - y_2^j\}\big\},$$

where $g_{dict}^i \in (-\infty, \infty)$, $g_{stat,dict}^i \in (-\infty, \infty)$ and $c_{unc}^i \in (0, \infty)$ are implicitly defined by

$$V_{a^i}^i = \alpha^i u_c(y_2^j + g_{dict}),$$
$$u_c(y_2^i - g_{stat,dict}^i) = \alpha^i u_c(y_2^j + g_{stat,dict}^i),$$
$$u_c(c_{unc}^i) = V_{a^i}^i.$$

The subscripts "dict" indicate that the gift choices are the "dictator solutions" that a player would choose if she could impose her preferred allocation on the other. c_{unc}^i is the consumption level a player would choose if unconstrained. The optimal gift choices are then

$$g^i(z, y_2^p, y_2^k, f = 0) = \begin{cases} 0 & \text{if } a^j > 0, \\ g^i_{unc} & \text{if } a^j = 0 \text{ and } a^i > 0, \\ g^i_{unc} & \text{if } a^j = a^i = 0 \text{ and } c^i_{unc} + g^i_{unc} \le y^i_2, \\ g^i_{constr} & \text{otherwise}. \end{cases} \tag{16}$$

A.3.2 Formal care: $f = 1$

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 private care, from (10) we see that the child's gift has to be above the threshold $g^k_{thr} \equiv \max\{0, c_{ma} - (P - q_{net})\}$. It follows that the optimal gift on the interval $g^k \in [0, g^k_{thr})$ is $g^k = 0$.[36] 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.

Case 1: child unconstrained ($a^k > 0$). Consider the situation when the child gives a transfer $g^k \ge g^k_{thr} \equiv y^p_{thr} - P + q_{net}$ that makes the parent choose private care. The kid's payoff function is then as in a setting without a consumption floor (see Barczyk & Kredler, 2014*a*). We define

$$H^k_{noMA}(g^k) \equiv \alpha^k u\Big(\min\{c^p_{unc}, P + g^k - q_{net}\}\Big) + [P + g^k - q_{net} - c^p_{unc}]^+ V^k_{a_p} - g^k V^k_{a_k},$$

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

$$\tilde{g}^k = \max\Big\{0, \min\{g^k_{dict}, c^p + q_{net} - P\}\Big\}.$$

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

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

Now comparing the outcome of this transfer choice to zero transfers, the kid's optimal

[36] 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.

transfer when unconstrained is

$$g_{f,unc}^k = \begin{cases} 0 & \text{if } \alpha^k u(c_{ma}) \geq \alpha^k u(P - q_{net} + g_{noMA}^k) - g_{noMA}^k V_{a_k}^k, \\ g_{noMA}^k & \text{otherwise.} \end{cases} \tag{17}$$

In the case that the parent goes to MA with a zero transfer, this is obviously optimal. If the parent does not go to MA given $g^k = 0$, it also gives the correct solution, since the child will also prefer private care if the parent chooses to pay for private care herself.

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 policy $(c_{unc}^k, g_{f,unc}^k)$ from (17) is feasible, then it is obviously also the solution to the problem with the additional constraint. If the unconstrained policy is not feasible, the child will choose a transfer such that the constraint $c^k + g^k = w$ binds since the payoff is strictly concave (again, see Barczyk & Kredler, 2014*a*). To find the optimal transfer that fulfills $c^k + g^k = w$, consider the kid's payoff when the parent does not receive MA and the child is constrained:

$$\hat{H}_{noMA}^k(g^k) = \alpha^k u\Big(\min\{c_{unc}^p, P + g^k - q_{net}\}\Big) + [P + g^k - q_{net} - c_{unc}^p]^+ V_{a_p}^k + u(w - g^k).$$

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

$$\tilde{g}_{constr}^k \equiv \max\Big\{0, \min\{g_{stat,dict}^k, c_{unc}^p + q_{net} - P\}\Big\}.$$

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

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

We still have to consider an exception: it may not be feasible for the child to give a transfer $g^k \geq g_{thr}^k$ if $w < g_{thr}^k$. 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_{thr}^k, then she should again compare the payoff of giving $\hat{g}_{noMA}^k$ to that of zero transfers. To summarize, the child's optimal transfer when constrained is

$$g^k_{f,constr} = \begin{cases} 0 & \text{if } w < g^k_{thr}, \\ 0 & \text{if } w \geq g^k_{thr} \text{ and } \alpha^k u(c_{ma}) + u(w) \geq \\ & \qquad \alpha^k u(P - q_{net} + \hat{g}^k_{noMA}) + u(w - \hat{g}^k_{noMA}), \\ \hat{g}^k_{noMA} & \text{otherwise}. \end{cases} \tag{18}$$

Summary: child's optimal gift for $f = 1$. The child's optimal gift under formal care is

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

Parent's gift for $f = 1$. Parents' optimal gifts are as in the case without formal care if $a^p > 0$, see Equation (16). If $a^p = 0$, then the parent cannot give gifts by assumption.

A.4 Bargaining on informal care

The following discussion of informal-care bargaining encompasses all cases, i.e. also vectors (a^p, a^k) where either 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 "optimal transfer" for the parent, $Q^*_p \in \overline{\mathbb{R}}$, which is potentially negative:

$$Q^*_p \equiv \begin{cases} g^p(z, y^p_2 = P + s_h, y^k_2 = 0, f = 0) - s_h & \text{if } a^k = 0, \\ -\infty & \text{otherwise}. \end{cases} \tag{19}$$

For the case where the kid is broke, $a^k = 0$, this optimal transfer is defined using the gift $g^p(z, y^p_2 = P + s_h, y^k_2 = 0, f = 0)$ that the parent would give if she had all family flow income in her pocket in Stage 2, thus choosing her preferred consumption allocation. 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 make up the difference. 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 transfer stage, the parent's optimal strategy is thus

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

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, $V_{a^p}^p > V_{a^k}^p$, and we define the desired transfer to be $-\infty$.

Similarly, we define an upper bound of transfers. Some transfers may be so high that the kid would give back part of it as a gift. The optimal transfer level for the child, $Q_k^* \in \overline{\mathbb{R}}$, i.e. the highest transfer that is not (at least partly) returned to the parent, is

$$Q_k^* \equiv \begin{cases} P - g^k(z, y^p = 0, y_2^k = P + s_h, f = 0) & \text{if } a^p = 0, \\ \infty & \text{otherwise}. \end{cases} \tag{20}$$

In the case the parent is broke, we use the gift $g^k(y^p = 0, y_2^k = P + s_h, f = 0)$ the kid would give to the parent if she owned all of the family's flow income to find her preferred transfer. Note that this transfer may be negative: if the child is much wealthier than the old, she may want to care for the parent and even pay money to the parent on top to prop up the parent's consumption. When the parent has positive wealth, the kid would like to receive an unbounded transfer flow since $V_{a^k}^k > V_{a^p}^k$.

Now, note that $Q_k^* > Q_p^*$ must hold. If 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, 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. To see that we need not consider $Q < Q_p^*$, observe that 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 and the same surplus as $Q = Q_p^*$, so we may consider these transfers as equivalent and restrict the analysis to $Q \geq Q_p^*$. Similarly, any $Q > Q_k^*$ 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 which both S^k and S^p are monotone: the parent strictly prefers lower transfers and children prefer higher transfers, the bounds of the interval being their respective bliss points. Now taking into account the non-negativity constraint on Q, we define the following bounds on the equilibrium transfer:[37]

$$Q_{lb} = \max\{0, Q_p^*\}, \qquad\qquad Q_{ub} = \min\{0, Q_k^*\}. \tag{21}$$

If $Q_p^* < 0$, the ideal transfer for the parent is zero since we restrict Q to be non-negative. This non-negativity constraint on Q implies that the parent is not allowed to use her bargaining power to extract monetary payments from the kid in order to "allow" the kid to give care her to her. If $Q_k^* < 0$, on the other hand, the child is so well off that she would give gifts to the parent even if given no transfer for informal care. In this situation, any positive transfer, $Q \geq 0$, would be undone and we set $Q = 0$; the child will then implement her preferred allocation in Stage 2 and acts as a dictator.

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

Proposition (*general characterization of informal-care decision*): Let Q_p^* and Q_k^* be defined as in (19) and (20), and let Q_{lb} and Q_{ub} be as defined in (21). Then $Q_p^* < Q_k^*$, and 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

$$Q^* = \max_{Q \in [\underline{Q}^k, \bar{Q}^p]} \{S^k(Q)^{1/2} S^p(Q)^{1/2}\}.$$

   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 $Q^* = 0$.

[37] In practice we also impose an upper bound $Q_{max} < \infty$ on Q_k^* for computational purposes. 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 $V^i_{a^j} - V^i_{a^i}$ approach zero. This can lead equilibrium transfers to reach very high levels, see Equation (13), which has no implications on the allocation of care and consumption but slows down our algorithm considerably.

Proof: $Q_p^* < Q_k^*$ has been proved before. We now go in prove 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 $Q \geq 0$ 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. If both are willing to consider informal care under some transfer, by increasingness of S^k we can find the child's reservation transfer $\underline{Q}^k \in [Q_{lb}, Q_{ub}]$ above which $S^k \geq 0$. Note that this reservation transfer may be equal to Q_{lb} and/or to zero if $S^k(Q_{lb}) \geq 0$. Also, the parent's willingness to pay is $\bar{Q}^p \in [Q_{lb}, Q_{ub}]$, below which $S^p \geq 0$ by increasingness of S^p. This willingness to pay may equal 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^* by evaluating its first-order condition for Q on $Q \in [\underline{Q}^k, \bar{Q}^p]$, which can be shown to be decreasing on $[\underline{Q}^k, \bar{Q}^p]$. The following sub-cases are of interest:

      i. $Q_{lb} = Q_{ub} = 0$: This case arises when the kid is not willing to accept a transfer $Q > 0$ from the parent and would undo this by an altruistic gift, i.e. $Q_k^* < 0$. In this case we only have to check if both agents prefer informal care to formal care for $Q = 0$, in which case informal care takes place 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 Nash-bargaining FOC being negative at $Q = 0$.

      iii. $0 < Q_{lb} < Q_{ub}$: In this case, we typically find an interior solution, which may be identified by finding the root of the Nash-bargaining FOC on (Q_{lb}, Q_{ub}).

Finally, we note that the case where both players have positive wealth is included as a special case covered in Point 2 of the proposition; this case is discussed in detail in Section 3.4 in the main text.

B Calibration appendix

In this appendix we provide a detailed description of the calibration, and further discuss our modeling assumptions.

B.1 Demographics

The cycle of interaction between parent and kid households is shown in Figure 5. While kids do not become parents themselves they do become old and face LTC and death risks. We do this to ensure that they have the right savings incentives when interacting with the parent household regarding the caregiving arrangement. Modeling only one cycle of interaction instead of an entire OLG economy has the following advantages. First, the computational burden decreases substantially. Second, it allows us to track precautionary savings farther back in age. Since our framework can only handle two generations that are simultaneously alive, in an OLG setting the young would have to enter the model at age 35 if the old live from 65 to 95. Third, and related to the second point, starting off the young at age 20 makes it reasonable to assume that they start with zero wealth, whereas in an OLG economy we would have to take a stance on their initial wealth at age 35 and its correlation structure with parents' wealth and earnings of both parents and children. The main concern with modeling only one cycle of interaction is potential non-stationarity: children's decision rules may differ from their parents' decision rules at the same age. We check these deviations in our algorithm and find that the two generations' policies are very close to each other. This suggests that the results in a full OLG model would be very similar.

B.2 Household composition

The parent generation consists of one household, whereas the child generation consists of more than one household: one marginal household of size 1, and an infra-marginal household of size $\nu \geq 0$. ν is chosen so that the number of kids is in line with the relevant fertility rate of the parent generation. We set $\nu = 0.5$ in the baseline, i.e. the average number of children a couple has is three (see Wattenberg, 1984), which is also in line with the number of children in our HRS data. This allows us to study the implications of a decreasing fertility rate, such as scarcity of informal caregivers, and a rising tax burden to pay for government-provided care.

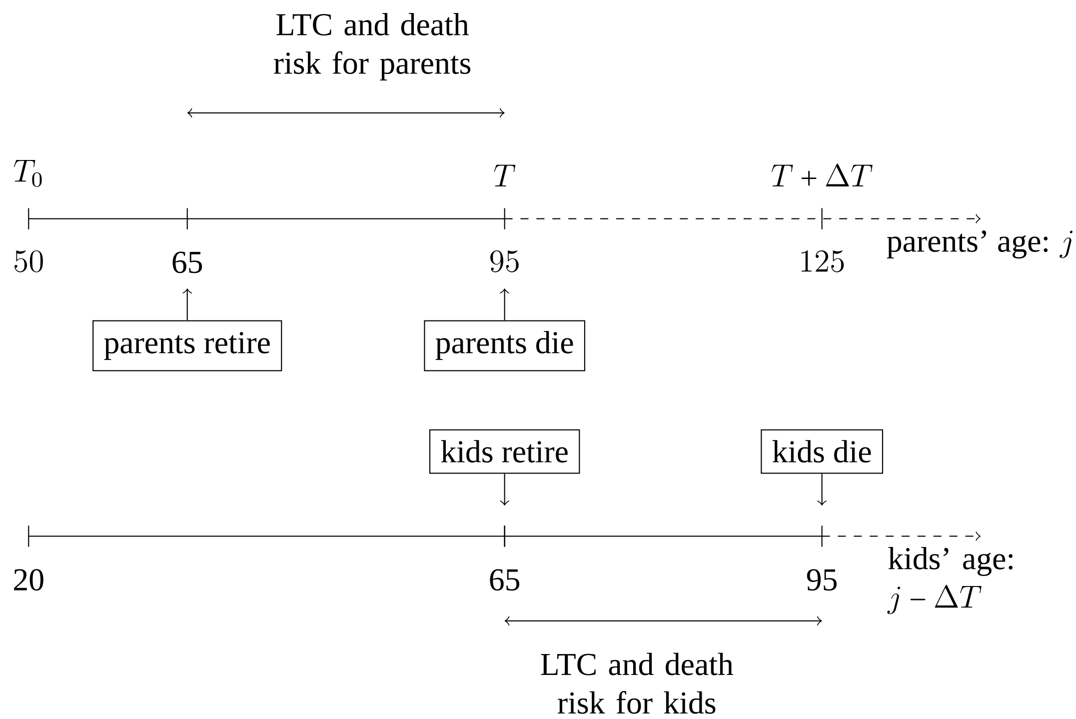

Figure 5: Life-cycle time line for calibration

The female individual in the marginal household of the kid generation is the potential caregiver. The male individual in this marginal household and all workers in the ν infra-marginal household supply labor inelastically. Each of the ν infra-marginal households consists of a male and a female worker, but these inelastically supply their labor to markets and do not provide care.

According to our empirical evidence, a large fraction of care to a disabled elderly is provided by the spouse if the spouse is still alive and retired (which is usually the case). The care decisions of such couples are not the focus of our model, but we include such caregivers into the model to have more realistic estimates of the costs that subsidizing informal care would entail. It is doubtful that it would be legally possible in the U.S. to make a informal-care subsidy conditional on the caregiver being of working age. We thus provide estimates for two scenarios: one in which pension-age caregivers receive the same subsidy as working-age caregivers, and one in which only working-age caregivers receive the subsidy; see Table 11.

In order to avoid increasing the dimensionality of the state space, we assume that a fraction 19.8% of the husband in the parent household is in need of care between ages 65 and

68, and that the husband automatically receives care from the wife. This fraction is chosen so as to match the total hours of care given by spouses. The only point where this becomes relevant is when there is a informal-care subsidy. The household then receives an additional income flow $0.198 s_h$ when the spouse is sick, which has to be paid out of the government's tax revenue.

The size of a household diminishes deterministically from 2 to 1 between ages 65 and 95, consistent with the mortality hazard of males and the average age gap in couples. When the wife is in need of care, the husband is assumed to die immediately, and care decisions unfold as explained in the description of the simplified model.

B.3 Household preferences

We denote by n^k the number of members of a child household, and by n^p the number of members of the parent household. To account for economies of scale within a household we adjust consumption expenditures using the following equivalence scale (see, for example, Bick & Choi, 2013):

$$\phi(n) = \begin{cases} 1 + 0.7(n-1) & n \in [1,2], \\ 1.7 + 0.5(n-2) & n > 2. \end{cases}$$

Per-period felicity of the kid generation, u^k, from consumption expenditure, c^k, with household size n^k is given by

$$u^k(c^k, n^k) = n^k(1+\nu)u\left(\frac{c^k}{(1+\nu)\phi(n^k)}\right).$$

Consider the argument of the function u. A kid household is a collection of $1+\nu$ households and so $c^k/(1+\nu)$ is the per-household consumption expenditure. Per-household consumption expenditure is then divided by the effective number of household members, $\phi(n^k)$, which yields per-kid effective consumption units. Because there are $n^k(1+\nu)$ persons in the child generation, u is multiplied by this number to aggregate individual utilities to obtain u^k.

Similarly, per-period felicity for the parent household, u^p, from consumption expenditure, c^p, when of size n^p is given by

$$u^p(c^p, n^p) = n^p u\left(\frac{c^p}{\phi(n^p)}\right).$$

The kid generation's flow utility is

$$u^k + \alpha^k[u^p + \eta h],$$

and the parent generation's flow utility is

$$u^p + \eta h + \alpha^p u^k.$$

We choose the felicity function as $u(c) = \ln(c)$. Prior to age 65, we set $n^k = n^p = 2$. Afterwards the household size decreases in line with the mortality hazards for males taking into account LTC risks. The calibration of the parameters α^p, α^k and η are discussed in the main text.

B.4 Death and LTC risk

We estimate conditional bi-annual mortality probabilities, using the longitudinal dimension of the HRS (waves 1996-2010). We estimate separate probabilities for non-LTC individuals, π_j^0, and for individuals requiring LTC, π_j^1. The only covariate is age, j.

In order to back out the risk of becoming LTC-dependent, we estimate the probability of requiring LTC at a certain age, λ_j, which we estimate using a logistic regression. Requiring LTC is defined as either residing in a nursing home or having at least 6 functional limitations, which is closely related to hours of care received corresponding to at least a part-time job. We then make the assumption that LTC is an absorbing state and back out the age-dependent hazard function ϕ_j that is consistent with the estimated probabilities λ_j given our estimated death probabilities.[38]

Finally, we transform the conditional probabilities into continuous-time (yearly) hazard rates. We denote by δ_j^0 the mortality hazard for an age-j individual who does not require LTC, by δ_j^1 the death hazard for an individual requiring LTC, and by σ_j the age-j LTC hazard. To do this, we take the matrix logarithm of the bi-annual transition matrix of a Markov chain with states healthy, sick, and dead, and divide the resulting hazard rates by 2 to adjust for annual frequency. Table 12 provides an overview of the estimated conditional probabilities of death and LTC.

[38]We do not estimate ϕ_j directly from the data since some individuals return from sick to healthy, which we assume away in our model.

Parameter	Description	Value
π_j^0	pr. of death by age if healthy	$[1+\exp(-(-3.79+0.093j))]^{-1}$
π_j^1	pr. of death by age if LTC	$[1+\exp(-(-1.25+0.050j))]^{-1}$
λ_j	fraction of LTC population by age	$[1+\exp(-(-4.22+0.138j))]^{-1}$
ϕ_j	pr. of LTC by age	back out using $\pi_j^0, \pi_j^1, \lambda_j$

Table 12: Mortality and LTC probabilities

Logistic-regression estimates based on the HRS waves 3-10 (1996-2010); λ_j is estimated in order to back out ϕ_j together with π_j^0 and π_j^1. The bi-annual probabilities are converted into annual hazard rates: $\pi_j^0 \to \delta_j^0$, $\pi_j^1 \to \delta_j^1$, and $\phi_j \to \sigma_j$.

B.5 Labor productivity and initial wealth

The process for households' labor productivity is modeled in a standard fashion. Productivity is the sum of a deterministic life-cycle component and a persistent shock process. Specifically, efficiency units of labor for an agent with shock ϵ_j at age $j \leq 65$ are given by

$$e(j, \epsilon_j) = \exp(\beta_0 + \beta_1 j + \beta_2 j^2 + \beta_3 j^3 + \sigma_\epsilon \epsilon_j),$$

where $\sigma_\epsilon = \sqrt{\mathrm{Var}(\epsilon_j)} = 0.78$ is the cross-sectional standard deviation of log earnings, which we take from the value that Hintermaier & Koeniger (2011) provide for the lower 90% of the earnings distribution. ϵ_j is the continuous-time analog of an AR(1)-process with unit (unconditional) variance, which we discretize on a grid with 7 values using methods equivalent to those suggested by Tauchen (1986) for discrete-time processes. Transition probabilities (hazards) for this process are pinned down by matching an annual auto-correlation coefficient of $\rho_\epsilon = 0.8$. We obtain the deterministic age profile by running a standard Mincer regression on 1990 Census data (males and females) from IPUMS.

We assume that the old and young generation's productivities have independent innovations, but that their initial productivities are positively correlated. We draw the two initial productivities and the parent's wealth from a trivariate log-normal distribution. The kid's initial wealth is zero. We first draw the initial shocks of parent, $\ln \epsilon_{50}^p$, and kid, $\ln \epsilon_{20}^k$, from a just joint normally distribution with mean 0, standard deviation $\sigma_\epsilon = 0.78$, and by an intergenerational elasticity of earnings of 0.5, as is reasonable considering the estimates reported by Solon (1999).

We then proceed by drawing the initial wealth of the parent, a^p_{50}, using the regression

$$\ln(a^p_{50}) - \mu_a = \zeta\Big[\ln(w^p_{50}) - \mu_{w^p}\Big] + \xi, \quad \xi \sim \mathcal{N}(0, \sigma^2_\xi),$$

where μ_a and σ^2_ξ are the unconditional mean and variance of a^p_{50}, and where is μ_{w^p} the unconditional expectation of $\ln w^p_{50}$. ξ is independent from all other random variables introduced before; we are thus assuming that the kid's labor income does not confer additional information on the parent's wealth at age 50 when knowing the parent's earnings. The relationship of the regression coefficient ζ to the correlation coefficient between parent's wealth and earnings can be calculated to be $\zeta = \rho_{a^p w^p}(\sigma_\xi/\sigma_\varepsilon)$.

Hintermaier & Koeniger (2011) report a Gini coefficient for wealth of around 0.55 for the age category 46-55, excluding the top 10%. We use this value to back out a value for the standard deviation of log-wealth of 1.07, using the properties of the normal distribution. We calibrate the correlation coefficient of log-earnings and log-wealth based on Budria-Rodriguez et al. (2002). They find that in the 1992 SCF, this value is 0.23 but in the 1998 SCF it is 0.47, but for the *levels* and not the logarithms. Because of this discrepancy we take the average of both years, and then adjust to logarithmic units to obtain 0.29. Taken together we obtain a value $\xi = 0.4$. Our initial wealth distribution is then given by

$$\ln(a^p)|\ln(w^p) \sim \mathcal{N}\Big[10.7947 + 0.4\Big(\ln(w^p) - 9.9625\Big), 1.044\Big].$$

B.6 Income and 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 $p = 0.964$.

The taxable income of a kid household, y^k, is given by

$$y^k(h) = \frac{ra^k}{1+\nu} + (1 - \tau^{SS})(\beta + 1 - h)e^k w,$$

where $\tau^{SS} = 0.124$ is the Social Security tax rate (see Kopecky & Koreshkova, 2014), $\beta = 1.25$ is the gender-wage gap (see Blau & Kahn, 2007), $e^k = e(j, \epsilon^k)$ are efficiency units of labor given age j and productivity shock ϵ^k, w is the market wage, and h is the informal-care indicator.

After-tax income of the child generation during their working lives – including informal-care transfers and subsidies for informal care – is given by

$$Y^k(j, \epsilon^k; h) = \underbrace{\left[1 - \tau\left(y^k(h)\right)\right] y^k(h) + h(Q^* + s_h)}_{\text{marginal household's income}} + \nu \underbrace{\left[1 - \tau\left(y^k(0)\right)\right] y^k(0)}_{\text{infra-marginal household's income}} . \tag{22}$$

Prior to retirement a parent household has combined labor income of $(1 + \beta) e^p w$, and so the parent has to pay income taxes on the income

$$y^p = ra^p + (1 - \tau^{SS})(1 + \beta) e^p w,$$

where $e^p = e(j, \epsilon^p)$ maps parent's age and productivity shock into efficiency units of labor. After-tax income of the parent generation is then given by

$$Y^p(j, \epsilon^p; h) = [1 - \tau(y^p)]\, y^p - h(Q^* - s^h). \tag{23}$$

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

$$S(\bar{E}_\epsilon) = \begin{cases} 0.9\bar{E}_\epsilon, & \text{if } \bar{E}_\epsilon < 0.2\bar{E}, \\ 0.9(0.2\bar{E}) + 0.33(\bar{E}_\epsilon - 0.2\bar{E}), & \text{if } 0.2\bar{E} \le \bar{E}_\epsilon \le 1.25\bar{E}, \\ 0.9(0.2\bar{E}) + 0.33(1.25\bar{E} - 0.2\bar{E}) + 0.15(\bar{E}_\epsilon - 1.25\bar{E}), & \text{if } 1.25\bar{E} \le \bar{E}_\epsilon \le 2.46\bar{E}, \\ 0.9(0.2\bar{E}) + 0.33(1.25\bar{E} - 0.2\bar{E}) + 0.15(2.46\bar{E} - 1.25\bar{E}), & \text{if } \bar{E}_\epsilon > 2.46\bar{E}, \end{cases} \tag{24}$$

where $\bar{E}_\epsilon$ is average lifetime labor earnings, and $\bar{E}$ is the average economy-wide labor earnings. We approximate average lifetime labor earnings by taking the average over the labor-earnings profile which corresponds to the final productivity realization, denoted by ϵ_{T_R}, where T_R is the age of retirement, to economize on the number of states. Again, in order to avoid having an additional state, we neglect time taken off for informal care in calculating average lifetime labor earnings.

The child generation's after-tax income when retired is then obtained as

$$P^k(\epsilon^k_{T_R}, n^k) = (1+\nu)\Big[\underbrace{(1-\tau(y^k_P))y^k_P + \frac{n^k}{2}S(\bar{E}_\epsilon)}_{\text{retirement income per household}}\Big], \tag{25}$$

where $\bar{E}_\epsilon$ is understood to be the lifetime income corresponding to the final shock $\epsilon^k_{T_R}$. Now, the only taxable income is capital income, i.e. $y^k_P = \frac{ra^k}{1+\nu}$, and each households' pension income is $\frac{n^k}{2}S(\bar{E}_\epsilon)$. The reason for the term $n^k/2$ is that initially the household consists of two adults, $n^k = 2$, and together they receive Social Security benefit $S(\bar{E}_\epsilon)$. We then let the Social Security benefit decline proportionally to household size.

Finally, pension income P^p of the parent household is given by

$$P^p(\epsilon^p_{T_R}, n^p) = (1-\tau(ra^p))\tau(ra^p) + \left(\frac{n^p}{2}\right)S(\bar{E}_\epsilon). \tag{26}$$

B.7 Care costs and government

We now describe how we pin down the costs of care to private agents and to the government. As for the cost of privately-financed formal care, q, first recall that this parameter only captures the value of basic care services and will thus be below the total cost of a nursing home in the U.S. Meyer (2001) documents that the median daily cost to a private payer of a nursing home is \$$102$. We found information on the components of estimated nursing home costs per resident day in 1994: the categories "nursing" and "other care-related costs" account for approximately 45% of the estimated daily rate per resident day, as reported in the *Analysis of Nursing Home Costs* (1995) (this is for nursing homes in the upper midwest). We use Meyer's median daily rate and take 45% of it to obtain q. Meyer also documents that the median daily cost to the government per Medicaid resident is \$$92$, which we use to obtain q_{ma} Finally, studies also document that informal care entails non-negligent expenses for adjustments to the house, equipment etc. Following the findings of a study conducted by Evercare & NAC (2007), we assume an out-of-pocket expenditure of \$4,000 on behalf of the caregiver.

Since we follow one dynasty over time and do not have an OLG structure, we do not use period-by-period clearing of the government budget constraint; instead we require the net present value of government expenditures to be equal to the net present value of tax revenues. Policy changes are financed by an increase of $\Delta\tau$ percentage points that is applied uniformly to the income-tax schedule, i.e. the counterfactual income tax schedule $\tilde{\tau}(y)$ is given by the function $\tilde{\tau}(y) = \tau(y) + \Delta\tau$, where $\Delta\tau$ is chosen to balance the following government (intertemporal) budget constraint:

$$\begin{aligned} G + &\int_{50}^{95} e^{-r(j-50)} \left[(1-m_j)SS_j + m_j q_{ma} + h_j s_h + f_j s_f\right] \mathrm{d}\lambda_j \mathrm{d}j \qquad (27) \\ = &\int_{50}^{95} \int e^{-r(j-50)} \Big(\underbrace{\tau_{ss}\left[y_j^p + y_j^k(h_j) + \nu y_j^k(0)\right]}_{\text{SS taxes}} + \underbrace{\tau(y_j^p) + \tau(y_j^k(h_j)) + \nu\tau(y_j^k(0))}_{\text{income taxes}} \Big) \mathrm{d}\lambda_j \mathrm{d}j. \end{aligned}$$

Here, we follow dynasties over the life of the parent, i.e. for ages $j \in [50, 95]$. λ_j denotes the measure over dynasties at age j. m_j, h_j and f_j are the dynasty indicator variables for MA, informal and privately-financed care. SS_j is social-security income of the parent, which falls prey to the means test if in MA. On the left-hand side of (27), we see government spending: the costs of LTC policies, social-security payments, and other government expenditures, G, which we hold constant in counterfactuals. On the right-hand side, we see government revenue: social-security contributions and income-tax payments from the parent and kid generation, which in turn is comprised of the marginal kid household and the ν infra-marginal kid households.

Parameter	Description	Value	Source
r	interest rate	3.5%	standard
ϵ	noise in law of motion	5%	Barczyk & Kredler (2014*a*)
q	cost of formal care	\$16.75k	Meyer (2001)
q_{ma}	Medicaid cost	\$33.2k	Meyer (2001)
σ_ϵ	std. (log) efficiency units	0.78	Hintermaier & Koeniger (2011)
σ_{a^p}	std. (log) wealth	1.07	Hintermaier & Koeniger (2011)
$\rho_{a^p w^p}$	corr. (log) wealth/earnings	0.29	Budria-Rodriguez et al. (2002)
$\rho_{\epsilon^p,\epsilon^k}$	generational earnings elasticity	0.5	Solon (1999)
$\{\beta_k\}_{k=0}^3$	age-earnings profile	Mincer reg.	own estimation
ρ_ϵ	auto-correlation eff. units	0.8	standard
δ_j^{ltc}	mortality hazards	see Table 12	own estimation
σ_j	LTC hazards	see Table 12	own estimation
various	income tax	see App. B.6	Gouvieia & Strauss (1994)
various	social-security benefits	see Eq. (24)	Kopecky & Koreshkova (2014)
$1/\beta$	gender-wage gap	0.77	Blau & Kahn (2007)
ν	number of kid HHs	1.5	Wattenberg (1984)
A_y	goods-sector productivity	1	normalization

Table 13: Parameters calibrated outside of model