

# Evaluating Long-Term-Care Policy Options, Taking the Family Seriously<sup>☆</sup>

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## Abstract

We propose a dynamic non-cooperative framework for long-term-care (LTC) decisions of families and use it to evaluate LTC policy options for the US. We first document the importance of informal caregiving and economic determinants of care arrangements. We then build a heterogeneous-agents model with imperfectly-altruistic overlapping generations to account for the patterns we find. A key innovation is the availability of informal care, which is determined through intra-family bargaining. This opens up a new margin in response to policy and allows for informal insurance through home-production of care. Our calibrated model captures the observed care arrangements well. We study the implications of non-means-tested informal-care and formal-care subsidies as well as changes to means-tested Medicaid. We find that informal care responds strongly to these policies. An informal-care subsidy substantially reduces reliance on Medicaid, while the reduction of tax revenues due to lower labor supply by caregivers is modest. There are large welfare gains from a combination of informal-care and formal-care subsidies, even when combined with a reduction of the Medicaid program.

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# 1 Introduction

A 21<sup>st</sup>-century challenge to governments is to find ways to deal with a growing number of elderly citizens in need of care. In Germany and Japan, for example, governments have already stepped in; both countries have universal long-term-care (LTC) insurance for the elderly.<sup>1</sup> In the US, the Affordable Care Act signed into law in 2010 contained legislation on a market-based LTC policy, which subsequently failed. This led to renewed debates on LTC policy options. In a recent report to congress, the bipartisan Commission on Long-Term Care (2013) forcefully defends the importance of family-caregivers and the need to enable the elderly to stay at home, shifting attention away from private LTC insurance.<sup>2</sup> Debates about LTC reform are bound to intensify as the ratio of elderly who require LTC to the working-age population is projected to increase, and nursing-home prices continue to grow rapidly.<sup>3</sup>

We argue that the evaluation of LTC policy has to take seriously the response of the family. After all, in the US and elsewhere, the family constitutes a very important source of care. 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 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 (e.g. working-age children), or simply ineffective if it goes primarily to infra-marginal caregivers (i.e., to caregivers who would provide care irrespective of the subsidy, such as retired spouses). On the positive side, encouraging informal care could help to keep Medicaid spending in check.

We see our main contributions as the following. First, we document the importance of family-provided care and study its economic correlates and the compensation of caregivers in the Health and Retirement Study (HRS). Second, we build a fully-dynamic non-cooperative model of two interacting generations. An innovation with respect to the literature is that there

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<sup>1</sup>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, and eating) or with instrumental activities of daily living (e.g. buying groceries, preparing meals).

<sup>2</sup>Also most other countries that have undertaken LTC reforms have shied away from market-based solutions. They have instead opted for universal insurance schemes, as opposed to the means-tested Medicaid program in the US, see Gleckman (2010).

<sup>3</sup>The dependency ratio is projected to increase from 6.4% in 2010 to 7.4% in 2020, and to 9.6% in 2030, see Johnson et al. (2007). Stewart et al. (2009) document that annual private-payer nursing-home prices grew by 7.5% annually from \$8,645 in 1977 to \$60,249 in 2004. Medicaid reimbursement rates grew by 6.7% annually from \$9,491 in 1979 to \$48,056 in 2004.

are both altruistically-motivated and exchange-motivated transfers in the model. The model gives rise to a wide range of care arrangements and their financing, which we characterize. Third, we calibrate the model, using a quantitatively realistic life cycle, family, and risk structure, and analyze a set of policy reforms. With respect to the macroeconomic old-age-risks literature, our innovation is that we take into account the family margin when it comes to the response to LTC policies, and that we show that this margin matters quantitatively.

Using the HRS, we find that almost two-thirds of all hours of care are provided informally, particularly by retired spouses and working-age children. The remaining one-third of care hours comes from formal sources, primarily nursing homes (formal home care playing a more minor role).<sup>4</sup> We find that children's opportunity costs in the labor market and parental wealth (typically housing) matter significantly in the determination of care arrangements.<sup>5</sup> We also find that, both within and across families, caregiving children receive higher transfers (especially in the form of co-residence, but also by being signed over home ownership during the parent's lifetime). These facts strongly hint at an intra-family bargaining channel in the care decision.<sup>6</sup>

To capture these facts, we write down a dynamic heterogeneous-agents model with overlapping generations. Parents and children make separate, non-cooperative savings decisions and lack commitment. Separate savings decisions are crucial to evaluate LTC policy. For the elderly, savings are a key source of insurance. Children tend to be in their prime saving years when facing the decision if to give care to a frail parent or not, and so their expectations about bequests from the parent are crucial. Also, the Medicaid means test explicitly conditions on the *elderly household's* wealth and not on that of the extended family.<sup>7</sup> We model the provision of

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<sup>4</sup>See also Stoller & Martin (2002); Wolff & Kasper (2006); etc.

<sup>5</sup>Our findings here are in line with the literature. Garber & MaCurdy (1990) show that owning a home decreases the probability of going to a nursing home. Headen (1993) finds that wealth significantly reduces the hazard of nursing-home entry and that nursing-home entry is positively related to opportunity costs of informal caregivers in the family.

<sup>6</sup>See also, Bernheim et al. (1985), who argues that parents strategically withhold resources to "purchase" attention from their children with a larger bequest. Cox & Rank (1992) find evidence that parents exchange gifts for services from their children. Boersch-Supan et al. (1992) find that those with higher incomes are less likely to go to a nursing home, possibly because they use it to make transfer payments to children. Norton & Houtven (2006) and Norton et al. (2013) find evidence for such an exchange specifically for caregiving; Brown (2006) and Groneck (2015) find empirical evidence that caregiving children obtain larger bequests than their non-caregiving siblings. Johnson & Sasso (2006) also find evidence consistent with bargaining.

<sup>7</sup>Note that in cooperative models of the family (with commitment), the evolution of the distribution of wealth between family members as well as the timing of financial transfers is indeterminate. This implies that in the presence of a Medicaid means test, it is a dominant strategy for the family to leave all wealth in hands of the child. But this is not what is observed in reality (parents tend to cling to their wealth until death), nor is it legal for parents to circumvent the means test by such a transfer. In our model, parents endogenously stick to their wealth for strategic reasons.

informal care by intra-family bargaining. In each period, parent and child bargain; if they agree on informal care, a financial transfer may flow in exchange for a time transfer (care). However, households are also altruistic towards each other. They take into account the other's economic situation and preferences in the bargaining process and can make transfers that are purely altruistic in nature (*gifts*). As a result, our setting gives rise to a host of care arrangements. The child may provide informal care (i) in exchange for immediate transfers, (ii) without contemporaneous 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. The model captures care and transfer arrangements well, but produces too little altruistic care compared to the data.

We calibrate our model to the US economy and use it to evaluate several policy options. We first consider non-means-tested subsidies for informal and formal care. We base the amounts of these subsidies on Germany's LTC reform. Germany provides universal (i.e. non-means-tested) subsidies for both informal and formal caregiving, where the subsidy for informal caregiving is less generous than the one for institutionalized care. We also study how a reduction in the size of the current Medicaid program in conjunction with the introduction of these subsidies affects the economy. In our setting, policy affects welfare through four channels. It (i) alters pre-existing labor-supply distortions induced by the tax system (*labor-wedge channel*), (ii) provides insurance (*insurance channel*), (iii) influences the use of means-tested Medicaid (*Medicaid channel*), and (iv) helps to overcome within-family commitment problems (*family-commitment channel*). The formal-care subsidy, but not the informal-care subsidy, is welfare-improving through the labor-wedge channel. However, the informal-care subsidy is superior in the other three channels since it is better at targeting disadvantaged families for which these channels are particularly relevant.

We find that a non-means-tested informal-care subsidy is partly self-financing since it strongly decreases reliance on Medicaid. On the flip side, it has the cost that it reduces labor supply as individuals temporarily exit the labor force to provide care; but this cost is relatively small as primarily individuals of lower productivity respond. Overall, the informal-care subsidy provides sizeable welfare gains in both the short and long run. A non-means-tested subsidy to private payers of formal care is more expensive and less popular as it benefits primarily richer families. We find that a combination of the two subsidies (for formal and informal care) creates large welfare gains; such a combination retains the advantages from either subsidy: Low-income elderly make use of informal care, instead of undesirable and costly Medicaid. High-income elderly come to rely more on privately-paid care instead of informal care, which brings more

productive children back into the labor force. Interestingly, this policy option remains popular across all population groups even if it is paired with a cut to the size of the Medicaid program.

Our paper is most directly related to a macroeconomic literature that is concerned with the evaluation of government insurance policies for the elderly, such as Medicaid and Medicare (for example, Attanasio et al., 2011; Braun et al., 2015; and DeNardi et al., 2013). Our results indicate that these papers miss a key margin by neglecting the role of the family. For example, we find that in the long run a Medicaid expansion drives twice as many people from informal care into Medicaid than from private-payer nursing homes. A model without family only captures the shift of private payers into Medicaid and thus vastly underestimates the cost increases in the Medicaid program. The presence of the family also matters for welfare implications of policies. For example, we find that a cut to Medicaid is partially offset within the family through additional informal care and financial help from children. A model without family leaves individuals with fewer margins of adjustment and thus likely overstates welfare losses. Finally, our model opens up the possibility to evaluate a wider range of policies, such as informal-care subsidies, than considered by the previous literature.

We combine elements from this macroeconomic literature with those from an applied microeconomic literature, which is explicitly concerned with the role of the family in providing care. Pauly (1990) argues that if parents prefer to obtain care from their children over formal care, individuals would strategically abstain from buying private LTC insurance to induce caregiving from children, even at actuarially fair prices.<sup>8</sup> Byrne et al. (2009) estimate a static model that captures the interaction between parents and multiple children in the choice between formal home care and informal care, leaving aside nursing-home care. We find stronger reactions to care subsidies than they do, most likely because our model includes Medicaid-financed nursing homes as an alternative for poor families. These are exactly the families that react most to financial incentives in our model. The estimation exercises of Van Houtven et al. (2013) and Skira (2015) show that the opportunity costs of caregiving play a crucial role in the caregiving decision, in line with our results.

In a wider sense, our paper relates to a macroeconomic literature on old-age risks and savings behavior. This literature has identified uncertain medical expenditure as a prime candidate to explain why wealthy elderly Americans dissave at a rate that is slower than standard life-

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<sup>8</sup>According to our calibrated model, the elderly indeed have a preference for informal care, which would give a role to this channel. We do not model private LTC insurance, however, since it is not used much. Only 14% of the elderly have a private policy (Brown & Finkelstein, 2011), and only 4% of all LTC expenditures are paid for by private insurance (CBO, 2004). It remains a puzzle of why in the US private LTC insurance is so unpopular even though it apparently is such a large financial risk.

cycle models would predict. Palumbo (1999) and DeNardi et al. (2010) show that augmenting a standard model with medical expenditures can solve the puzzle. Kopecky & Koreshkova (2014) zero in on nursing-home expenditure risk and find it to be an important determinant of precautionary savings. In contrast to these papers, elderly in our framework have access to family insurance, thus nursing-home expenditures are discretionary. Although our model generates large and persistent LTC expenditures in line with the data, retired household in our model dissave faster than in reality.

This paper is also part of another literature that asks if the government should intervene in markets for services that can be produced both within the family and by the market. In contrast to us, the literature on child care typically finds that subsidies for family care harm welfare. Domeij & Klein (2013), for example, provide a rationale why day care for children should be subsidized: In the presence of distortionary taxes on labor, subsidizing family-provided child care magnifies labor-supply distortions, whereas day-care subsidies attenuate them (the *labor-wedge channel* in our model). Bick (2015) also finds negative aggregate welfare effects of family-child-care subsidies. Erosa et al. (2010) study the effects of parental-leave policies in a model with search frictions and job-specific human capital. They find negative welfare effects of policies that encourage parental leave, primarily because subsidies distort the leave decision (similar to our labor-wedge effect) and distributive effects (our insurance effect) are not able to counter it. Our result that subsidizing informal care is a good idea is directly opposed to this child-care literature. This is because (i) there are two channels (Medicaid and family-commitment) that are absent in the child-care context, and (ii) the insurance channel is quantitatively stronger since elderly care is more expensive.

In Barczyk and Kredler (2014a, 2014b), we study the timing of altruistically-motivated transfers in a dynamic setting without commitment. In the current paper, we include a time transfer (informal care) alongside financial transfers. The substantial modeling innovation here is that this transfer is determined by intra-family bargaining. This gives rise to exchange-motivated transfers alongside altruistically-motivated transfers (gifts). To the best of our knowledge, we are the first to study a dynamic model that includes both of these commonly-used transfer motives. Also, the overlapping-generations structure gives rise to the possibility that children give care in anticipation of a future bequest, despite an absence of explicit contracts governing this exchange.

The paper is structured as follows. Section 2 provides an overview of the institutional setting in the US and presents our empirical results. Section 3 introduces the model and characterizes its predictions. Section 4 describes the calibration procedure, Section 5 presents the policy

analysis, and Section 6 concludes.

## **2 Empirical facts on LTC**

We first provide a brief background on the US nursing-home sector. We then document facts about care arrangements, caregivers, determinants of informal care, and transfers that informal caregivers receive. We refer the reader to Section 1 in the Online Appendix for details on our empirical work.

### **2.1 How does the US nursing-home sector work?**

Nursing-home residents in the US pay for care mainly out-of-pocket or by qualifying for means-tested Medicaid. Private LTC insurance is limited, paying for about 4% of nursing-home expenditures (CBO, 2004). Medicaid is the dominant purchaser of nursing-home services, accounting for at least 50% of all revenues of nursing homes (Grabowski et al., 2008). Medicare only covers stays up to 100 days following a hospital stay, and thus accounts for only about 11% of nursing homes' revenues (Norton & Newhouse, 1994).

In principle, any nursing home can admit Medicaid-financed payers, but does not have to. Doing so requires government certification for Medicaid and Medicare residents, this certification being basically universal (Grabowski et al., 2008). Private-paying residents are charged the price set by the nursing home; nursing homes compete freely for these private payers. Individual states set Medicaid per-diem reimbursement rates, which are typically 10 to 30 percent below the private-payer price (Norton, 2000; Stewart et al., 2009). Thus it is unsurprising that nursing homes preferentially admit private payers (see, for example, Ettner, 1993). In order to qualify for Medicaid, an individual must contribute all assets in excess of \$2,000, subject to a homestead exemption, and all monthly income. Medicaid only covers the most basic necessities (room, board, and nursing care), leading to a lower quality of life, and so individuals have been found to be averse of becoming reliant on it (Ameriks et al., 2011). Medicaid is the only safety net available for LTC in the US; there is neither an informal-care subsidy nor a universal (i.e. non-means-tested) formal-care subsidy.

### **2.2 How frequent are the different LTC arrangements?**

We use the Health and Retirement Study (HRS) to document facts about LTC in the US. The HRS is representative of the US population of age 50 and above. It contains specific informa-

tion about a respondent's functional limitations with regards to activities of daily living (ADLs) and instrumental activities of daily living (IADLs), about the identity of the caregiver(s), and on hours of care each helper provides.<sup>9</sup> We construct a sample (the *care sample*) that includes all individuals who receive help due to functional limitations. We differentiate between an individual's residency: community, i.e. at home, or nursing home (NH); the type of care provision for community residents: informal care (IC), formal home care (FHC), or a mix of IC and FHC; and whether nursing-home residents are private payers (PP) or Medicaid (MA)-supported.

Table 1 shows that the vast majority of respondents in our care sample live in the community. When living in the community, IC is most common. Few individuals rely solely on FHC, while a mix of FHC and IC is somewhat more common. Only 13.3% reside in a nursing home, about 62.5% of such individuals being supported by Medicaid.<sup>10</sup>

The care sample contains also relatively young individuals (the average age is 73). Thus, it includes many individuals with minor care needs and relatively good opportunities to obtain care from family members (48.9% are partnered). As a result, one may argue that this sample overstates the importance of IC. To address this concern we consider an older and single segment of the population, the *AHEAD singles* sample. Here, we restrict the care sample to include only widow(er)s/singles who are born prior to 1924. Among them, the average age is 88. Nonetheless, as shown in Table 1, more than two-thirds among this group still lives in the community, with IC as the dominant source of care; the importance of FHC increases but is nowhere near that of IC. The importance of NH rises substantially, but stays at around one third of all cases. The MA-recipient rate among these nursing-home residents is 58.5%.

However, even among the oldest individuals there is still large variation in the severity of care needs, and it is to be expected that the most severe cases end up in nursing homes, whereas less severe cases are being taken care of informally. In order to account for the intensity of care, the second part of Table 1 shows the percentage of total hours of care contributed by different forms of care. Indeed, formal care increases in significance, but IC still keeps its dominant role. Almost two-thirds of all hours of care are provided informally in the care sample. Within formal care, nursing homes provide about three times as many hours as FHC. Among the oldest-old widow(ers)/singles, IC hours continue to be substantial and are in the ballpark of care provided

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<sup>9</sup>The HRS does not collect hours of care for nursing-home respondents. We assign one dummy-helper to each such individual and impute care hours from a regression of care hours on (I)ADLs, dementia, and other controls for individuals living in the community.

<sup>10</sup> Medicaid coverage is similar to that reported by Grabowski et al. (2008). They use data of all nursing home residents from 7 states obtained from the Minimum Data Set for nursing homes and find that the Medicaid recipient rate is 64%, private payers make up 32%, and other type of payers account for 4%.



Table 1: Care arrangements

Case counts							
Sample	<i>community</i>				<i>nursing home</i>		
	IC	FHC	IC+FHC	Total	MA	PP	Total
Care sample	72.0%	4.4%	10.4%	86.7%	8.3%	5.0%	13.3%
AHEAD singles	45.3%	7.5%	16.2%	69.0%	18.1%	12.9%	31.0%

Hours (out of all hours)			
Sample	IC	FHC	NH
Care sample	63.5%	9.8%	26.7%
AHEAD singles	42.8%	13.3%	43.9%

Data source: HRS waves 2000-2010. *Care sample* includes individuals who receive help due to functional limitations. *AHEAD singles* are those in the care sample born prior to 1924 (HRS's AHEAD cohort). Table shows: fractions of individuals living in community who receive exclusively informal care (IC), formal home care (FHC), or a mix of IC and FHC; fractions of nursing-home (NH) residents who are Medicaid (MA)-supported and private payers (PP). Fractions of NH coverage, i.e. MA or PP, based on individuals with nursing-home stays of at least 100 days to exclude Medicare cases. An individual is classified as Medicaid-supported if Medicaid is claimed, and nursing-home expenditures are either fully, mostly, or partially covered. Table 9 in the Online Appendix provides an overview of nursing home expenditures by Medicaid reciprocity and coverage. Respondent-level weights are used.

Data source: HRS waves 2000-2010. Fractions out of all hours of care contributed by IC, FHC and NH. 32.1mil annual total hours (unweighted) in care sample. 11.3mil annual total hours in AHEAD singles sample. Respondent-level weights are used.

in nursing homes.

### 2.3 Who provides care, and how much?

We now ask who the informal caregivers are. We split informal helpers into two groups, depending on whether they face opportunity costs in the labor market or not. Helpers in retirement age are defined as *old* (these are most often spouses), and those of working-age are defined as *young* (these are typically children of the disabled). We also create a residual informal-caregiver category (*other*) for helpers who are relatives or friends, but for whom the HRS does not provide their age. We define three care-intensity categories: weekly hours of care of <7.5 is *light*, 7.5-19 weekly hours is *medium*, and *heavy* stands for at least 20 weekly hours (equivalent to a part-time job or more). We classify care hours that FHC and NH helpers provide into the same intensity categories. We define a respondent as *disabled* when (s)he receives 90 or more monthly hours of care.<sup>11</sup>

<sup>11</sup> We use imputed hours for NH residents, which implies that most (90.3%) but not all nursing-home residents are counted as disabled. Our definition of disability corresponds exactly to disability levels (*Pflegestufen*) II and above in the German LTC insurance system. To be declared level II (severe disability), a person must be in need of at least 3 hours of care daily (90 hours monthly), see the German health ministry's website, <http://www.bmg.bund.de/themen/pflege/pflegebeduerftigkeit/pflegestufen.html>.

Table 2: Who provides care, and how much?

Helper type	# Cases (out of all helpers)			Hours (out of all hours)		
	light	medium	heavy	light	medium	heavy
young	28.6%	5.7%	<b>9.1%</b>	3.3%	3.3%	<b>23.1%</b>
old	13.8%	3.1%	<b>9.4%</b>	1.9%	1.9%	<b>25.3%</b>
other	8.0%	1.1%	1.4%	0.7%	0.6%	3.3%
FHC	4.6%	1.9%	3.7%	0.7%	1.1%	8.0%
NH	0.6%	0.6%	<b>8.5%</b>	0.0%	0.4%	<b>26.3%</b>
total	55.6%	12.4%	<b>32.1%</b>	6.6%	7.3%	<b>86.0%</b>

Data source: HRS waves 2000-2010. Joint distribution of care intensity and caregiver type in care sample. Helper-intensity categories *light*, *medium*, and *heavy*, correspond to < 7.5, 7.5 – 19, and > 19 weekly care hours, respectively.

Hours (out of all hours) among disabled					
Partner status	old	young	other	FHC	NH
married/coupled	<b>64.7%</b>	14.6%	1.3%	5.9%	13.5%
widow(er)/single	1.9%	<b>40.4%</b>	6.5%	12.4%	<b>38.8%</b>
any	<b>28.4%</b>	<b>29.5%</b>	4.3%	9.7%	<b>28.1%</b>

Data source: HRS waves 2000-2010. Care sample restricted to individuals receiving monthly hours of care of at least 90 hours (*disabled* individuals). Partner status is of respondent. Table shows fractions of hours disabled respondent receives from helper types conditional on partnership status.

Table 2 shows the joint distribution of care intensity and helper type, both for helper counts and for hours. The majority of all helpers provide care of light intensity, most of them being young. Among heavy helpers, young, old, and nursing-home helpers are about equally common. Heavy helpers make up about one-third of all helpers, but provide the lion’s share of all hours of care. This indicates that caregiving is heavily concentrated on some helpers. Consistent with this notion, we find that disabled elderly living in the community receive care most commonly from exactly one heavy helper.<sup>12</sup> The lower part of Table 2 is restricted to *disabled* individuals – they obtain the lion’s share of all hours of care – and shows the fractions of care hours provided by the helper types depending on the respondent’s partnership status. We see that old IC helpers are critical when the respondent is married/coupled. For widow(ers)/singles the young and nursing homes play a central role and are of similar importance.

From the perspective of children, we find that care is usually concentrated on one child. In families with multiple children and at least one heavy-helper child, it is most often exactly one child who takes on this role (86.2%). When considering characteristics of kid heavy-helpers we

<sup>12</sup>To be precise, among disabled married/coupled individuals, 3.7% have no heavy helper, 83.7% have exactly one heavy helper, 10.3% have two, and 2.3% have three or more. Among disabled widow(ers)/singles living at home, 10.5% have no heavy-helper, 69.2% have exactly one heavy helper, 16.0% have two, and 4.3% have three or more heavy helpers.

find that they are middle-aged (average age is 48); predominantly female (74%); are less often full-time employed (38.4%, versus 64.7% among all *young* in our sample); and less educated (17.9% have a college degree, versus 24.1% among all *young*).<sup>13</sup>

## 2.4 Which families opt for informal care?

We have seen that IC is predominant among disabled individuals who are married. It is reasonable to expect that this arrangement is not very responsive to policy changes, as care among spouses usually takes place automatically. However, for disabled widow(ers)/singles, children and nursing homes are the main sources of care, and we would expect care arrangements to be more responsive to policies among this group. But what explains that in some families IC takes place while it does not in others?

In order to gain an understanding we estimate a linear probability model for the IC choice depending on covariates drawn from both the parent and child households. The results are shown in Table 3 (for children, a characteristic is that of the average across all children of the care recipient).<sup>14</sup> The first column shows that the presence of a spouse/partner is a key predictor of IC, even after controlling for a variety of other characteristics. For all other covariates, their coefficients are quite robust across all specifications (we restrict the sample to singles in the second column and further to disabled singles in the third column). The number of children has a significant positive impact on the likelihood of IC. But the effect is small compared to the large negative effect that children's education has, indicating that children's opportunity costs in the labor market are the key for the IC decision. Parent household wealth makes IC more likely when moving from no wealth (the omitted category) to low wealth. Differences in the likelihood when moving to higher wealth categories are small and statistically not significant. The effect of elderly's income is not robust across specifications. In our preferred specification, the disabled single sample, the effect is negative on the relevant income range, but the effect is very weak.<sup>15</sup> Finally, we see that there is a systematic difference based on the ethnicity of individuals even after controlling for a variety of other characteristics. *Ceteris paribus*, IC is more likely for non-Caucasians (about one-third in our sample), which suggests a cultural

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<sup>13</sup>The Online Appendix provides further statistics on heavy-helper children and care recipients.

<sup>14</sup>The dependent variable is whether or not IC takes place. An individual who receives a mix of FHC and IC is counted as a formal-care recipient if the majority of hours of care is due to FHC; vice versa, if the majority of hours stem from IC we count the individual as an IC recipient. We also considered other specifications than that shown in the table, such as logits and models with interaction terms. Our results were robust across specifications.

<sup>15</sup>When comparing an individual at the 10th percentile of the income distribution with one at the 90th percentile, *ceteris paribus*, the decrease in the probability of IC is 4%.

Table 3: Linear probability model for informal care

Covariate	Care sample		Single sample		Disabled single sample	
	all (N=11,501)	disabled (N=5,197)	all (N=5,756)	disabled (N=2,818)	MA eligible (N=1,566)	MA ineligible (N=1,252)
married/partnered	0.165*** (0.00949)	0.229*** (0.0160)				
siblings	0.00215 (0.00160)	0.000539 (0.00285)	0.00481 (0.00304)	0.000869 (0.00478)	0.00270 (0.00593)	-0.00287 (0.00822)
# kids	0.00675*** (0.00163)	0.0114*** (0.00276)	0.0100*** (0.00278)	0.0137*** (0.00411)	0.0115* (0.00492)	0.0190* (0.00746)
grandkids	-0.000244 (0.00366)	-0.00596 (0.00548)	-0.00308 (0.00535)	-0.0116 (0.00704)	-0.00860 (0.00813)	-0.0121 (0.0134)
# (I)ADLs	-0.0412*** (0.00164)	-0.0414*** (0.00241)	-0.0465*** (0.00250)	-0.0414*** (0.00362)	-0.0441*** (0.00485)	-0.0383*** (0.00557)
dementia	-0.104*** (0.0103)	-0.125*** (0.0143)	-0.123*** (0.0161)	-0.126*** (0.0202)	-0.120*** (0.0277)	-0.134*** (0.0301)
low wealth	0.0898*** (0.0102)	0.102*** (0.0159)	0.112*** (0.0152)	0.103*** (0.0229)	0.0962** (0.0323)	0.0665 (0.0439)
medium wealth	0.110*** (0.0118)	0.145*** (0.0192)	0.130*** (0.0189)	0.129*** (0.0274)	0.193*** (0.0485)	0.0802 (0.0451)
high wealth	0.0972*** (0.0149)	0.0897*** (0.0242)	0.122*** (0.0242)	0.146*** (0.0332)	0.172 (0.106)	0.117* (0.0458)
log income	0.0275 (0.0269)	0.0569 (0.0563)	0.105* (0.0435)	0.247*** (0.0533)	0.136 (0.0743)	0.293** (0.0989)
(log income) <sup>2</sup>	-0.00191 (0.00140)	-0.00280 (0.00294)	-0.00677** (0.00249)	-0.0146*** (0.00311)	-0.00678 (0.00523)	-0.0179*** (0.00514)
caucasian	-0.0694*** (0.00901)	-0.116*** (0.0150)	-0.0994*** (0.0155)	-0.171*** (0.0234)	-0.186*** (0.0281)	-0.151*** (0.0448)
some college (kid)	-0.0145 (0.00829)	-0.0283* (0.0140)	-0.0350* (0.0147)	-0.0565** (0.0217)	-0.0387 (0.0284)	-0.0774* (0.0333)
college (kid)	-0.0818*** (0.0129)	-0.110*** (0.0199)	-0.142*** (0.0209)	-0.184*** (0.0273)	-0.165*** (0.0406)	-0.200*** (0.0386)

Linear probability model with dependent variable IC. Standard errors in parentheses. \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ . Three samples: (1) the care sample (see text), (2) widower/singles from the care sample, and (3) disabled widower/singles from the care sample. All: regression uses all individuals in sample. Disabled: restricted to individuals receiving at least 90 hours of monthly care. Medicaid (MA) eligible: non-housing wealth < \$2,000 and income < \$20,500. #(I)ADLs: count index (0-10); number of functional limitations with activities of daily living and instrumental activities of daily living. Dementia: dummy variable; whether a doctor has ever diagnosed a memory-related disease. For care sample, which includes couples and singles, low wealth is \$7.5k-\$135k, medium wealth is \$135k-\$405k, and high wealth is >\$405k; the omitted category is wealth below \$7.5k. For regression using singles we lower the wealth thresholds: low wealth is \$5k-\$90k, medium wealth is \$90k-\$270k, and high wealth is >\$270k; the omitted category is wealth below \$5k. Income includes social security, and all other sources of income. Caucasian: non-hispanic white, about one-third in our sample. Some college (kid): average years of children's education is between 13-16 years. College (kid): 16 years and more; the omitted category is that average schooling is below 13 years. Not all covariates are shown here; see Online Appendix Table 5 for full regressions.

element in the decision for care (e.g. stronger family values, a norm to care for the parent) and/or discrimination in admissions to nursing homes.

Under the US system, incentives for entering a nursing home are different for the poor (who are MA eligible) and the rich. The final column splits disabled singles into MA-eligibility groups as a robustness check. We see that even though a disabled individual is MA-eligible, wealth increases the likelihood of IC (recall that MA-eligible individuals may own housing wealth due to the homestead exemption). The coefficients on most variables are similar to the other specifications, but the estimates are less precise due to the smaller sample size.

Finally, in all specifications we see that an individual's frailty (the number of (I)ADLs and dementia – whether a doctor has ever diagnosed a memory-related disease) have a large negative impact on IC. In view of this result, one may wonder in how far IC really is a feasible choice for the severely disabled, and if not, for how many elderly a nursing home is the inevitable outcome. We turn to this question now.

## 2.5 Is IC really a choice for all elderly?

Despite the negative relationship of disability measures with IC found above, our data suggest that IC indeed *is* a choice even for the most severely disabled.<sup>16</sup> We find that 64% of respondents who currently have a memory-related disease still reside at home. Even among the most frail (10 out of 10 possible (I)ADL conditions plus memory-related disease), about 30% of respondents are at home. These numbers are not that surprising if we think about the nature of the (I)ADL limitations; they do not require sophisticated technology but rather large amounts of low-skilled labor to be taken care of.<sup>17</sup> Consistent with this, we find that many care recipients living in the community indeed report that they receive high amounts of care. Among community residents with 6 or more (I)ADL issues, 50% receive more than 192 care hours per month (or more than 6 hours per day), 25% receive more than 480 monthly hours (16 daily hours), and 10% of them even report monthly hours of 621 or more (20.7 per day). When the elderly is additionally afflicted by a memory-related disease these numbers become substantially higher especially at the median, see Table 7 in the Online Appendix.

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<sup>16</sup>This is in line with Charles & Sevak (2005), who find that informal home care substantially reduces the probability of long-term nursing-home use, which they interpret as evidence for informal care and nursing-home care being substitutes.

<sup>17</sup>Note that being frail is not the same as requiring hospitalization. Nursing facilities are actually not designed to handle severe medical conditions. If individuals are in need of medical care, the HRS categorizes these cases as hospital stays. In our model, these stays (which are typically of much shorter duration than nursing-home stays) will be included in the medical-cost shock process.

Relatedly, one may wonder for how many elderly formal care is the only option, simply because they lack a social network. In our sample, however, such cases are rare. For example, among singles with heavy care needs, only 13% are childless. Even among these childless disabled singles, 71% report at least one informal caregiver, suggesting that they have relatives or friends they are in close contact with. A full 26% of childless disabled singles receives the majority of their care from informal caregivers. This suggests that even among childless singles, informal care is an option for most people.

Finally, one may ask in how far disabled elderly are still part of the decision-making process when it comes to the care choice, especially given how wide-spread dementia issues have become. We find that among disabled individuals in the care sample, a full 76% declare that they have not been diagnosed with any memory-related disease. Even among the remaining 24%, there are certainly many individuals who are still well capable of decision-making: Many memory-related diseases progress slowly and can be diagnosed in early stages. We thus argue that the incapability to make decisions is, to a first order, a minor issue.<sup>18</sup>

In summary, our data is in line with the notion that typically there is a choice between staying in the community and going to a nursing home and that the large majority of disabled elderly is still capable of decision-making when the care choice is made.

## 2.6 How are informal caregivers compensated?

We now present evidence that child caregivers receive substantial economic compensation. We define a *child-caregiver family* as a disabled widow(er)/single parent with at least one heavy-helper child who receives the majority of care hours informally (recall that in these cases there is typically one heavy-helper kid). We refer to transfers that occur in the same time period as care is reported as *contemporaneous exchange*. We present evidence *across families*, that is, we measure transfers from the parent generation to the child generation in child-caregiver families and compare them to *formal-caregiver families*, i.e. disabled widow(er)/single parents that receive the majority of care formally. In child-caregiver families for which there are no such transfers, we study how much wealth the parent holds, and refer to it as *potential bequest*, a mechanism which previous literature has found to be important.

Table 4 provides an overview of our classification. The most common form of compensation is that children live rent-free in the parent's home (in the vast majority of cases only

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<sup>18</sup>Note that even when the elderly is incapable of decision-making, there are many mechanisms that can lead to decisions that are *as if* the elderly was still deciding, such as pressure on caregiving children to decide in the elderly's best interest that is exerted by siblings, other family members, and the wider society.

Table 4: Compensation of caregivers

contemporaneous exchange				potential bequest (no contemporaneous exchange)			
rent-free	home transfer	money	total	housing wealth	life insurance	financial wealth	total
47.3%	15.0%	<i>negligible</i>	62.3%	11.6%	10.0%	3.8%	25.4%

Data source: HRS waves 2000-2010. Contemporaneous exchange. Rent-free: child lives in parent’s home. Home transfer: child lives in home whose ownership was transferred to him/her by the parent (median housing wealth is \$65K). Potential bequest, no contemporaneous exchange. Housing wealth: respondent owns home (median \$63.1K). Life insurance: respondent does not own home but children beneficiaries of life insurance. Financial wealth: no home, no life insurance, but respondent has at least \$7K (approximately the annual imputed rent); median \$70.4K. For remaining 12.3% there is no measurable compensation in the data.

the heavy-helper child co-resides), whereas this is the case in only 3.9% of formal-caregiver families. Considering that median gross rents in the US in the year 2000 were \$602/month (U.S. Census Bureau, 2003), rent-free living constitutes a sizeable transfer. In another 15.0% of child-caregiver families, the parent has transferred ownership of her home to children (this number is 0.8% in formal-caregiver families). In our data, financial transfers to caregiving children are infrequent and small (the 90th percentile is merely \$500 annually, including zeros) and so we are ignoring these cases in this category. Thus, substantial contemporaneous transfers to the child generation take place in 62.3% of child-caregiver families. In addition to these contemporaneous transfers, children may also expect a bequest (not shown in the table).

For another 25.4% of child-caregiver families, we find that there is no contemporaneous transfer, but that the child can expect a bequest. Most common is that the parent has housing wealth. The second-most common case is that there is no housing wealth, but that the child is the beneficiary of life insurance. Finally, the remainder of the potential-bequest group is made up by parents who have neither housing wealth nor life insurance but own substantial, at least \$7K, financial wealth.<sup>19</sup>

Finally, in only 12.3% of child-caregiver families do we find neither contemporaneous exchange nor potential bequests. Our model will rationalize such behavior by altruism.

### 3 The model

We now build a quantitative dynamic model that is motivated by the stylized facts established in the previous section: (i) IC is a feasible choice for most elderly, but it entails large investments

<sup>19</sup>Table 8 in the Online Appendix compares transfers to children *within* child-caregiver families. We find that a heavy-helper child receives transfers (co-residence, home of parent, beneficiary of life insurance) much more frequently than her non-heavy-helper siblings. In terms of realized bequests, Groneck (2015) finds that caregiving children receive substantially higher bequests than non-caregiving siblings.

of time by the caregiver that are usually incompatible with full-time work, (ii) the vast majority of care goes to disabled elderly (i.e. those with the most severe conditions), (iii) IC is usually concentrated on one caregiver: the spouse for the married, and a child for singles, (iv) IC is more likely the lower the opportunity cost of the child, and the higher the wealth of the parent is, and (v) caregiving children receive substantial compensation.

Time is continuous. The economy is populated by overlapping generations of individuals. The population grows at a constant rate  $g$ . An individual's age is denoted by  $j$ . Individuals work when  $j \in [0, j_{ret})$ , where  $j_{ret}$  is the retirement age, and then retire. The maximum lifespan is given by  $j_{dth} = 2j_{ret}$ . Markets to insure against risk are absent; there is a savings technology with exogenous return  $r$ , and agents face a no-borrowing constraint.

## 3.1 Families

### 3.1.1 Family structure

A *family* is made up of two decision units, or *agents*: a *kid generation* (or just *kid*, indexed by  $k$ ) of age  $j^k \in [0, j_{ret})$  and a *parent generation* (or just *parent*, indexed by  $p$ ) of age  $j^p = j^k + j_{ret}$ . There is a continuum of families for each kid age  $j^k \in [0, j_{ret})$  in the economy. In each family, the parent generation consists of one household, whereas the kid generation consists of a measure  $(1 + \nu)$  households. Consistency with the population growth rate requires  $\nu = e^{gj_{ret}} - 1$ . A kid household has two individuals: one *female* and one *male*.<sup>20</sup> A parent household consists of  $n^p \in [1, 2]$  members: one female (*wife*, or *widow* when  $n^p = 1$ ) and a male (*husband*) of measure  $(n^p - 1)$ . The measure of husbands decreases deterministically over retirement age; more on this below. This is merely a modeling device that keeps the dimensionality of the state space manageable, while capturing aspects of reality that are quantitatively important but not the main focus of our analysis.

### 3.1.2 Sources of uncertainty and household structure

We first establish some useful notation. A family's state is given by the vector  $z \equiv (a^k, a^p, s, \epsilon^k, \epsilon^p, j^k)$ .  $a^k \geq 0$  denotes the kid's wealth, and  $a^p \geq 0$  the parent's.  $\epsilon^k$  and  $\epsilon^p$  are productivity states from a set  $E \equiv \{\epsilon_1, \dots, \epsilon_{N_\epsilon}\}$ .  $s \in \{0, 1\}$  is a binary disability state for the wife in the parent generation.

<sup>20</sup> We assume an asexual model to simplify matters. Our families can best be imagined as matrilineal dynasties in which each parent household has  $(1 + \nu)$  daughters and  $(1 + \nu)$  sons. All sons leave their dynasty at age  $j = 0$  and form matches with daughters from families that are identical to their own in all characteristics (i.e. we implicitly assume perfect assortative mating).



$s = 0$  stands for healthy;  $s = 1$  corresponds to *disabled* (in the sense of our empirical work, i.e. requiring care for at least 90 hours per month).

The kid agent faces uncertainty only about her labor productivity:  $\epsilon^k$  follows a Poisson process with age-independent hazard matrix  $\delta_\epsilon = [\delta_\epsilon(\epsilon_i, \epsilon_j)]$ .<sup>21</sup> The kid household's endowment in labor efficiency units is given by a function  $y(j^k, \epsilon^k)$ . Within each kid household, a fraction  $\beta \in (0, 1)$  of efficiency units pertains to the male and a fraction  $(1 - \beta)$  to the female. Once the kid generation retires, it splits up into  $(1 + \nu)$  separate parent households. A parent household keeps the productivity state it has at the point of retirement, i.e.  $\epsilon^p = \epsilon_{j_{ret}}^k$ , and receives an age-invariant pension flow,  $y_p(\epsilon^p)$ , per household member. A new family is formed by a match of the parent household with a new kid. The new kid inherits the productivity of the parent and enters the economy with zero wealth.

The wife in the parent generation faces LTC and mortality risk. At  $j^p = j_{ret}$ , she starts out healthy ( $s = 0$ ). From  $j_{ret}$  on, she faces hazard rate  $\delta_s(j^p, \epsilon^p)$  of transiting into the disabled state ( $s = 1$ ), which is absorbing. In both states, she faces a mortality hazard  $\delta_d(j^p, \epsilon^p, s)$ . When the death shock hits, both wife and husband (if still alive) in the parent generation die. All assets,  $a^p$ , are then transferred to the kid generation.<sup>22</sup> We now turn to the modeling of the husband, which aims to capture three facts: Males typically have LTC needs first, are out-lived by their spouses, and obtain care mostly from their spouses. In order to economize on the number of states, we assume that the husband diminishes deterministically in size. Let  $n^p(j^p, \epsilon^p, s) \in [1, 2]$  be the measure of alive individuals in the parent generation. We assume that the husband dies once the wife becomes disabled, i.e.  $n^p(\cdot, \cdot, s = 1) = 1$ . This state captures the (largely female) single population of disabled elderly that we are mainly interested in. While the wife is healthy, we assume that the function  $n^p(\cdot, \epsilon^p, 0)$  smoothly decreases in age  $j^p$ ,  $n^p(\cdot) - 1$  being the measure of males alive. Furthermore, as long as the wife is healthy, a measure  $s_m(j^p, \epsilon^p)$  of the husband is disabled and requires LTC. An exogenous fraction  $\iota \in [0, 1]$  of this disabled husband receives informal care from his wife (at zero cost). The remaining fraction,  $(1 - \iota)$ , receives privately-paid care in a nursing home.

Finally, the parent faces medical-spending risk. At a hazard rate  $\delta_m(j^p, \epsilon^p, s)$ , a *medical event* occurs to each individual, meaning that the household's probability of facing a medical event over an interval of infinitesimal length  $dt$  is  $[n^p(\cdot) \times \delta_m(\cdot)]dt$ . Given a medical event, the

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<sup>21</sup>A Poisson process is the continuous-time analog of a Markov process in discrete time.  $\delta_\epsilon(\epsilon_i, \epsilon_j)$  is the hazard rate of transitioning from  $\epsilon_i$  to  $\epsilon_j$ , meaning that the probability of transitioning from state  $i$  to  $j$  is  $\delta_\epsilon(\epsilon_i, \epsilon_j)dj$  over an interval of infinitesimal length  $dj$ .

<sup>22</sup>We do not model an estate tax since in the US only the estates of the wealthiest 0.2% of households pay estate taxes, see Joint Committee on Taxation (2015).

parent incurs a lump-sum medical cost  $M$ , which is drawn from the cdf  $F_m(M)$ .

### 3.1.3 Choices: Care, gifts, consumption, and savings

*Parent healthy* ( $s = 0$ ). As long as  $s = 0$ , households face a standard consumption-savings problem with the additional possibility of gifts. In each instant, both agents first decide on a non-negative gift flow,  $\{g^i\}_{i \in \{k,p\}}$  (*gifts*, or *altruistically-motivated transfers*), to the other agent in this family, followed by the choice of a non-negative consumption flow,  $\{c^i\}_{i \in \{k,p\}}$ . Savings are then residually determined from the budget constraint.

*Parent disabled* ( $s = 1$ ). A disabled widow either has to obtain *informal care* (IC) from the kid or formal care. The family's IC decision is denoted by  $h \in \{0, 1\}$ . When IC occurs ( $h = 1$ ) the female in one of the kid households (the *marginal household*) does not supply labor to the market, and the parent can give a non-negative *exchange-motivated transfer* flow  $Q \geq 0$  to the kid. Formal care is either paid for privately (private-payer care, PP) or by the government through means-tested Medicaid (MA). In PP care, the parent has to buy *basic care services* at market price  $p_{bc}$ ; these capture the flow cost of care, excluding room, board, amenities, and any specialized medical procedures. For the purposes of our model, we treat both nursing-home care (NHC) and formal home care (FHC) under the category formal care (FC).<sup>23</sup> The parent's MA decision is denoted by  $m \in \{0, 1\}$ . We will describe the MA means-test and the timing and bargaining protocols for care decisions in Section 3.1.5.

### 3.1.4 Taxes and government transfers

The government levies a linear social-security payroll tax,  $\tau_{ss} > 0$ , on labor earnings. It also runs a progressive income-tax system, which works as follows. A household's taxable income,  $y_{tax}$  (the sum of labor and capital income) is taxed at rate  $\tau(y_{tax})$ , where  $\tau(\cdot)$  is an increasing function. Social-security (SS) benefits are not taxed. Tax payments of the parent household,  $T^p$ ,

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<sup>23</sup>For the purposes of our analysis, pooling NHC and FHC under formal care is reasonable. The cost of FHC and NHC is rather similar in the data. From nursing-home expenditure data, see the calibration in Section 4, we estimate the annual cost of basic care services in a nursing home to be 21,640\$ (in year-2000\$). As for FHC, in our care sample a disabled widower/single living in the community receives a median of 210 hours of care monthly. According to the BLS the hourly mean wage of a home health aide is \$10.93 (this is for 2015; <http://www.bls.gov/oes/current/oes311011.htm>). Thus, the annual cost of FHC is about 27,500\$ (in 2015), or about 20,000\$ in 2000 when adjusting for inflation.

and the kid household,  $T^k$ , depend on the state  $z$  and the IC decision  $h$  as follows:

$$\begin{aligned}
T^p(z) &= ra^p \tau(ra^p), \\
T^k(z, h) &= \tau_{ss} y_l + [(1 - \tau_{ss}) y_l + y_k] \tau((1 - \tau_{ss}) y_l + y_k), \\
\text{where } y_l &= [1 - h(1 - \beta)] w y(j^k, \epsilon^k), && \text{(labor income)} \\
y_k &= \frac{ra^k}{1 + \nu}, && \text{(capital income)}
\end{aligned}$$

where  $w$  is the wage rate. Parents only pay taxes on asset returns but not on SS benefits. Kids pay SS contributions on labor income and income taxes.<sup>24</sup> Note that if  $\tau(\cdot)$  is an increasing function (i.e. if income taxation is progressive), then this constitutes an implicit subsidy for IC since the kid household pays a lower tax rate if  $h = 1$ . It is understood in the above formula that  $h = 0$  for the infra-marginal kid household.

Agents also receive government transfers for LTC and medical events. The kid receives an IC subsidy flow,  $s_{ic} \geq 0$ , whenever IC occurs ( $h = 1$ ). The parent receives a PP subsidy flow,  $s_{pp} \geq 0$ , whenever she is in PP care ( $s = 1$  and  $h = m = 0$ ). The same subsidies are paid for the fractional disabled husbands who receive IC and PP. Finally, the government pays a lump sum  $M - a^p$  to the parent in case a medical shock exceeds the stock of wealth.<sup>25</sup>

### 3.1.5 Timing and Medicaid (MA) means test

We now describe the timing of decisions over an instant of time, which occurs in four *stages*.

**Stage 1: Bargaining on IC.** The family considers whether to undertake IC and what the exchange-motivated transfer  $Q \geq 0$  should be in this case. If IC generates surplus for both parent and kid, IC takes place ( $h = 1$ ).  $Q$  is pinned down through generalized Nash bargaining, where the kid has bargaining weight  $\omega \in [0, 1]$ .

**Stage 2: Gift-giving.** Next, kid and parent choose the gift flows  $g^p \geq 0$  and  $g^k \geq 0$  simultaneously. This is especially relevant if the family chooses formal care in Stage 1: The kid can enable the parent to avoid Medicaid by helping to pay privately for a nursing home.<sup>26</sup>

<sup>24</sup>Recall that the kid generation consists of  $(1 + \nu)$  households, thus the generation's capital earnings have to be divided by  $(1 + \nu)$  to obtain capital earnings on the household level.

<sup>25</sup>This models a means-tested part of Medicaid that insures poor families against medical-spending shocks.

<sup>26</sup>Note that the sequencing matters here. If the gift-giving stage took place after the Medicaid decision, the parent could hold the child hostage as follows. By deciding  $m = 0$ , the parent could 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 would force the altruistic child to give transfers to the parent if her pension is not sufficient to pay for private care. We do not think that the elderly can credibly threaten to reject government aid and thus discarded this

**Stage 3: Medicaid decision.** In case the family has chosen formal care ( $h = 0$ ), the parent decides if to opt for MA ( $m = 1$ ) or for PP ( $m = 0$ ). MA is free but means-tested: The elderly has to hand over to the government the entire stock of wealth,  $a^p$ , the pension flow,  $y_p(\epsilon^p)$ , and any gift flow,  $g^k$ . The parent receives a consumption floor  $C_{ma}$ ; this floor includes any negative utility from MA, such as stigma effects and poorer quality of the nursing home.<sup>27</sup> If PP is chosen ( $h = m = 0$ ), the parent pays the market price of basic care services,  $p_{bc}$ , and receives a subsidy flow from the government,  $s_{pp}$ . Unlike in MA, in PP the parent can freely decide consumption,  $c^p$ , and gifts,  $g^p$ . Following Kopecky & Koreshkova (2014), we will interpret  $p_{bc} + c^p$  as the parent's nursing-home expenditures. The variable component  $c^p$  captures room and board and the amenities of the facility. This modeling strategy allows us to represent the fact that there is large variation in nursing-home quality and expenditures.

**Stage 4: Consumption-savings decision.** In the last decision stage, parent and kid simultaneously choose their consumption flows,  $c^p$  and  $c^k$ . Finally, both agents receive interest payments on their assets and collect utility. After this, the game moves on to the next instant.

### 3.1.6 Preferences

Per-period *felicity* of the kid from consumption expenditure,  $c^k$ , is given by

$$u^k(c^k) = \frac{2(1+\nu)}{1-\gamma} \left( \frac{c^k}{(1+\nu)\phi(2)} \right)^{1-\gamma},$$

where  $\gamma > 0$  is the parameter of relative risk aversion and where  $\phi(n) = 1 + 0.7(n - 1)$  is an equivalence scale that adjusts consumption for household size.<sup>28</sup> The kid generation's consumption expenditure,  $c^k$ , is divided by the number of households,  $(1 + \nu)$ , and the equivalence scale,  $\phi(2)$ , to obtain individual-level consumption. Individual flow felicity is then multiplied by the number of individuals,  $2(1 + \nu)$ .

Similarly, per-period felicity for the parent is

$$u^p(c^p, h; z) = \frac{n^p(z)}{1-\gamma} \left( \frac{c^p - s(1-h)C_f}{\phi(n^p(z))} \right)^{1-\gamma}$$

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modeling strategy.

<sup>27</sup>We rule out that the kid gives gifts to the parent to lift her consumption level above  $C_{ma}$  in MA. The assumption is that the government only pays for basic care services and that individuals have to accept this consumption floor.

<sup>28</sup> See Bick & Choi (2013) for an analysis of equivalence scales and weighting schemes of utility by household size.

When the parent is healthy ( $s = 0$ ) or when IC takes place ( $h = 1$ ), this felicity functional is analogous to the kid's. When the parent receives formal care, however, the term involving the felicity penalty  $C_f$  becomes relevant.  $C_f$  is a parameter that governs the parent's preference for IC. The interpretation is that when in formal care, the parent requires  $C_f$  more units of consumption than in IC to be indifferent between the two scenarios.<sup>29</sup> From survey evidence, we expect  $C_f$  to be positive—the elderly typically say they prefer staying at home to going to a nursing home.<sup>30</sup> Note that our additive specification makes IC relatively more attractive for poor people. The higher a person's consumption level, the lower is the percentage increase in consumption required to make her prefer formal over informal care.

The kid's flow utility is  $u^k(\cdot) + \alpha^k u^p(\cdot)$ . The parent has flow utility  $u^p(\cdot) + \alpha^p u^k(\cdot)$ . The parameters  $\alpha^k, \alpha^p \in [0, 1]$  govern the strength of altruism. Once dead, the parent values the kid's felicity at  $\alpha^p$ , the grandchild's felicity at  $(\alpha^p)^2$ , and so forth.<sup>31</sup> Future utility flows are discounted at rate  $\rho > 0$  by all agents.

### 3.1.7 Flow budget constraints

Before we present the value functions that characterize the agents' problems recursively over the four stages of the instantaneous game, we present agents' flow budget constraints consolidated over the four stages of an instant. They show all potential revenues and outlays in one

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<sup>29</sup> Our preference specification assumes that the kid does not experience more disutility from care than from working. However, there is evidence that caregivers experience high levels of stress and other problems. In view of this evidence, we have experimented with a version of the model that includes a disutility-of-care parameter,  $\xi$ . First, we found that a model with  $\xi > 0$  and  $C_f = 0$  could not generate as much IC as there is in the data. The reason is that many families choose IC over FC even if there are economic losses to the family as a whole. When letting both  $\xi > 0$  and  $C_f > 0$ , we faced an identification problem we could not overcome: For any model with  $\xi > 0$  and  $C_f > 0$ , we could find a model  $\tilde{C}_f > C_f$  and  $\tilde{\xi} < \xi$  such that the two models delivered predictions that were almost indistinguishable. The intuition can be gleaned from a unitary framework ( $\alpha^p = \alpha^k = 1$ ): In such a model,  $\xi$  and  $C_f$  describe exactly the same preferences (if they enter the felicity functionals in the same functional form).

<sup>30</sup> According to the survey *Aging in Place* (2011), 90% of seniors say they want to stay in their home as long as possible.

<sup>31</sup> This is standard in the literature on altruism and gives rise to a simple recursive formulation for value functions.

place and thus serve as a summary of the physical environment.<sup>32</sup>

$$da^k = \left( ra^k - c^k - g^k + g^p + (1 + \nu)[y(j^k, \epsilon^k) - T^k(z, 0)] \right. \\ \left. + sh[Q + s_{ic} - (1 - \beta)y(j^k, \epsilon^k) - T^k(z, 1) + T^k(z, 0)] \right) dj, \quad (1)$$

$$da^p = \begin{cases} \left( ra^p - c^p + g^k - g^p + y_p(\epsilon^p) - T^p(z) - shQ - s(1 - h)(p_{bc} - s_{pp}) \right. \\ \quad \left. + (1 - s)s_m[\nu s_{ic} - (1 - \nu)(p_{bc} - s_{pp})] \right) dj - \min\{M, a^p\} & \text{if } m = 0, \\ -a^p & \text{if } m = 1. \end{cases} \quad (2)$$

If the wife does not require LTC ( $s = 0$ ) or care is formal ( $h = 0$ ), the kid receives flow income from savings,  $ra^k$ , and the  $(1 + \nu)$  households' labor earnings,  $y(j^k, \epsilon^k)$ . It pays taxes on these earnings, consumes, and may give or receive gifts. When the marginal kid household gives IC ( $s = h = 1$ ), then there is an inflow of transfers from parent and government,  $Q + s_{ic}$ , but also an opportunity cost from lost labor income,  $(1 - \beta)y(\cdot)$ , which is again partially offset by a reduction in tax payments.

Note that all changes to the kid's wealth are *flows* (they are all multiplied by  $dj$ ), whereas the parent's wealth may decrease by a lump sum. Such lump-sum payments may occur for two reasons: medical-spending shocks,  $M$ , and Medicaid uptake ( $m = 1$ ). The remaining items on the parent's budget constraint are flows, most of which are familiar from the kid's constraint. The parent pays  $Q$  to the kid in case of informal care ( $s = h = 1$ ), she pays  $(p_{bc} - s_{pp})$  for care in a nursing home in the case of PP ( $s = 1, h = 0$ ), and she has outlays and subsidy income for the measure  $s_m$  of disabled husbands who are residing in the household when the wife is healthy ( $s = 0$ ).

### 3.1.8 Agents' problems

Agents' decision problems are characterized by Hamilton-Jacobi-Bellman equations (HJB). The value functions  $V^k$  and  $V^p$  satisfy the HJBs

$$\rho V^i(z) = V_{j^k}^i(z) + J^i + H^{i,1}(z, \underbrace{V_{a^p}^p, V_{a^k}^p, V_{a^p}^k, V_{a^k}^k}_{\equiv V_a}), \quad i \in \{k, p\}, \quad (3)$$

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<sup>32</sup>These budget constraints are only valid while the death shock does not hit the parent. In the case this shock hits, an additional (lump-sum) term  $+a^p$  appears in the kid's budget constraint; the parent agent disappears.

where subscripts to  $V^i$  denote partial derivatives.  $J^i$  stands for a series of jump terms that encode stochasticity of productivity, medical-spending, health, and death. Appendix A.1 gives the definition of  $J^i$  and other details on the HJBs.  $\{H^{i,1}(\cdot)\}_{i=k,p}$  are Hamiltonian functions that take the state,  $z$ , and the vector of partial derivatives,  $V_a$ , as arguments. Equation (3) is thus a first-order partial differential equation (PDE). We now derive the Hamiltonian functions  $\{H^{i,1}(\cdot)\}_{i=k,p}$  by backward induction on the stages of the instantaneous game. We do this for the general case when the parent is disabled; only Stages 2 and 4 are relevant when she is not disabled. Let  $H^{i,n}(\cdot)$  denote the Hamiltonian of player  $i$  in the  $n$ 'th stage of the game. Also, let  $y_{i,n}$  denote player  $i$ 's stage- $n$  flow-income-on-hand, which is determined by decisions in the stages before  $n$ . We also define the vector  $y_n \equiv [y_{k,n}, y_{p,n}]$ .

**Stage 4: Consumption-savings decision.** Given the IC decision,  $h$ , the MA decision,  $m$ , and Stage-4 incomes,  $y_4$ , both players optimally trade off instantaneous felicity and the marginal value of savings:

$$H^{k,4}(z, V_a; y_4, h, m) = \max_{c^k \in \mathbb{C}^k} \left\{ \alpha^k u^p(c^p, h; z) + u^k(c^k) + \dot{a}^p V_{a^p}^k + \dot{a}^k V_{a^k}^k \right\}, \quad (4)$$

$$H^{p,4}(z, V_a; y_4, h, m) = \max_{c^p \in \mathbb{C}^p} \left\{ u^p(c^p, h; z) + \alpha^p u^k(c^k) + \dot{a}^p V_{a^p}^p + \dot{a}^k V_{a^k}^p \right\}, \quad (5)$$

$$\text{where } \mathbb{C}^i = \begin{cases} [0, \infty) & \text{if } a^i > 0, \\ \{C_{ma}\} & \text{if } i = p \text{ and } m = 1, \\ [0, y_{i,4}] & \text{otherwise,} \end{cases}$$

$$\dot{a}^i = y_{i,4} - c^i \quad \text{for } i \in \{k, p\}.$$

Note that consumption cannot exceed flow income once wealth is depleted ( $a^i = 0$ ), in which case the agent may be constrained. Parents in MA are bound to consume the consumption floor.<sup>33</sup>

**Stage 3: Medicaid decision.** 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 PP instead, and choose consumption  $c^p > C_{ma}$ . This strategy obviously yields a higher utility flow and higher assets (and thus more future options) after an instant  $dj$  than handing in a positive stock of wealth to the government. Given the IC decision,  $h$ , and Stage-3

<sup>33</sup>Formally, we allow for  $y_{p,4} < 0$  in Stage 4. In this case we set  $\mathbb{C}^p = \emptyset$  and  $H_4^p = -\infty$ .

incomes,  $y_3$ , the Stage-3 Hamiltonians are

$$H^{i,3}(z, V_a; y_3, h) = mH^{i,4}(z, V_a; [y_{k,3}, C_{ma}], 0, 1) + (1 - m)H^{i,4}(z, V_a; [y_{k,3}, y_{p,3} - p_{bc} + s_{pp}], h, 0), \quad \text{for } i \in \{k, p\}, \quad (6)$$

$$\text{where } m = \begin{cases} 1 & \text{if } s = 1 \text{ and } h = 0 \text{ and } a^p = 0 \text{ and} \\ & H^{p,4}(\cdot; [y_{k,3}, C_{ma}], 0, 1) > H^{p,4}(\cdot; [y_{k,3}, y_{p,3} - p_{bc} + s_{pp}], 0, 0), \\ 0 & \text{otherwise.} \end{cases}$$

The second equation gives the optimal MA decision. This decision is relevant only if the game arrives at the formal-care node ( $s = 1$  and  $h = 0$ ) and the parent is broke ( $a^p = 0$ ). The parent chooses MA if the value from doing so in the Stage 3 is higher than that of choosing PP. In MA, the means test implies that the parent enters the next stage with income-on-hand  $C_{ma}$ . In PP care, the parent has to pay the price of a nursing home minus the government subsidy.

**Stage 2: Gift-giving.** Given the IC decision,  $h$ , and Stage-2 incomes,  $y_2$ , the Stage-2 Hamiltonians are

$$H^{k,2}(z, V_a; y_2, h) = \max_{g^k \in \mathbb{G}^k} H^{k,3}(z, V_a; [y_{k,2} + g^p - g^k, y_{p,2} - g^p + g^k], h), \quad (7)$$

$$H^{p,2}(z, V_a; y_2, h) = \max_{g^p \in \mathbb{G}^p} H^{p,3}(z, V_a; [y_{k,2} + g^p - g^k, y_{p,2} - g^p + g^k], h), \quad (8)$$

$$\text{where } \mathbb{G}^i = \begin{cases} [0, \infty) & \text{if } a^i > 0, \\ \{0\} & \text{if } i = p \text{ and } s = 1 \text{ and } h = 0 \text{ and } a^p = 0, \\ [0, y_{i,2}] & \text{otherwise.} \end{cases}$$

Players choose non-negative gift flows, which are constrained to their income-on-hand in case they have zero wealth. We rule out gifts by parents in formal care when they have zero wealth.<sup>34</sup>

**Stage 1: Bargaining on informal care.** Given the state,  $z$ , and value-function derivatives,

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<sup>34</sup>This is not a strong assumption. The government has control on the SS benefits of Medicaid recipients, making gifts to children impossible for a parent who has no wealth. Also for elderly in PP with zero wealth, gift-giving is almost impossible – private nursing homes are expensive in the US, and usually exceed SS benefits by far.



$V_a$ , the Stage-1 Hamiltonians are

$$H^{i,1}(z, V_a) = H^{i,2}(z, V_a; [(1-h)y_{k,fc} + h(y_{k,ic} + Q^*), y_{p,1} - Q^*], h) \quad \text{for } i \in \{k, p\}, \quad (9)$$

where  $y_{p,1} = ra^p + y_p(\epsilon^p) - T^p(z) + (1-s)s_m[\iota s_{ic} - (1-\iota)(p_{bc} - s_{pp})]$ ,

$$y_{k,fc} = ra^k + (1+\nu)[y(j^k, \epsilon^k) - T^k(z, 0)],$$

$$y_{k,ic} = ra^k + (1+\nu-\beta)y(j^k, \epsilon^k) - T^k(z, 1) - \nu T^k(z, 0) + s_{ic},$$

$$h = \begin{cases} 1 & \text{if } s = 1 \text{ and } \exists Q \geq 0 \text{ s.t. } S^p(Q) \geq 0 \text{ and } S^k(Q) \geq 0, \\ 0 & \text{otherwise,} \end{cases} \quad (10)$$

where  $S^i(Q) = H^{i,2}(z, V_a; [y_{k,ic} + Q, y_{p,1} - Q], 1) - H^{i,2}(z, V_a; [y_{k,fc}, y_{p,1}], 0)$ , (11)

and  $Q^* = \begin{cases} \arg \max_{Q \geq 0} \{ [S^k(Q)]^\omega [S^p(Q)]^{1-\omega} \} & \text{if } h = 1, \\ 0 & \text{otherwise.} \end{cases}$  (12)

Informal care is provided to a disabled parent if there exists a non-negative transfer  $Q$  such that both players' surplus is positive. The surplus is the difference between the Hamiltonians,  $\{H^{i,2}\}_{i \in \{k,p\}}$ , under the IC scenario and the formal-care scenario in Stage 2. For the parent, the Stage-2 income under IC is lowered by  $Q$  with respect to formal care since she has to pay the transfer. The kid receives the transfer  $Q$  only under IC. But there is also a difference in income due to labor supply (it is  $y_{k,ic}$  for  $h = 1$ , but  $y_{k,fc}$  for  $h = 0$ ). Gross labor income is lower in IC since the marginal caregiver does not work. On the other hand, the kid receives the IC subsidy,  $s_{ic}$ , and pays lower income taxes,  $T^k$ . Finally, if IC takes place, the equilibrium transfer  $Q^*$  is determined such that it maximizes the Nash-bargaining criterion in (12).

## 3.2 Firms

There are two market goods that are produced by competitive firms using only labor: a consumption good,  $y$ , and formal (or nursing-home) care,  $f$ . The representative firm in the consumption-goods sector chooses the labor input  $L_y$  to solve the profit-maximization problem

$$\max_{L_y \geq 0} \{ A_y L_y - w L_y \}, \quad (13)$$

where  $A_y > 0$  is productivity in the consumption-goods sector and  $w$  is the wage rate. For the formal-care sector, we assume that nursing homes provide basic care services using labor. The

representative nursing home's problem is

$$\max_{L_f \geq 0} \{p_{bc} A_f L_f - w L_f\}, \quad (14)$$

where  $A_f > 0$  is productivity in the nursing-home sector and  $p_{bc}$  is the market price of basic care services. Perfect competition implies that in equilibrium profits are zero in both sectors. Equations (13) and (14) thus imply that equilibrium prices are

$$w = A_y, \quad p_{bc} = \frac{A_y}{A_f}. \quad (15)$$

### 3.3 Government

The government purchases basic care services in the formal-care market at price  $p_{bc}$  and spends  $y_{ma}$  consumption goods per nursing-home slot on room, board etc. Thus, the total MA reimbursement rate is  $p_{bc} + y_{ma}$ . MA nursing-home patients receive a consumption flow  $C_{ma}$ .<sup>35</sup> The government runs a balanced budget in each instant. It collects payroll taxes on labor income and taxes income from labor and capital. From these revenues, it pays social-security benefits, MA nursing-home slots, subsidies for IC and PP care, means-tested benefits for medical expenditures, and a fixed level of other government consumption. See Appendix A.2 for the detailed budget constraint.

### 3.4 Equilibrium

We adopt a standard recursive equilibrium definition. The parent and kid in each family are best-responding to each other, being restricted to Markovian strategies. The government balances its budget in steady state, i.e. under the ergodic measure of families over the state space. Firms make zero profits and markets clear. See Appendix A.3 for the detailed equilibrium definition.

### 3.5 Characterizing the IC choice

Using backward induction on the instantaneous game between kid and parent, one can characterize the consumption, gift-giving, and Medicaid decisions in Stages 2-4, taking as given the

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<sup>35</sup>We allow for  $C_{ma} < y_{ma}$ ; this captures that there may be stigma effects of Medicaid and/or that the government sector provides care inefficiently.

value functions and their partial derivatives (see Section 2.1 of the Online Appendix). Here, we focus on the key modeling innovation of this paper: the determination of IC in a dynamic setting (Stage 1). The intuition behind this choice is best understood in the special case in which both agents have positive wealth; we thus concentrate on this case. We provide a general characterization of the IC decision in Proposition 2.1 in Section 2.3 of the Online Appendix.

In order to obtain the family's IC decision, we obtain the surplus functions  $S^i(Q)$ ,  $i \in \{k, p\}$ , from IC as the difference between the Hamiltonians under the scenario that IC takes place and that it does not for an arbitrary transfer  $Q \geq 0$ , see Equation (11). In the special case where both agents have positive wealth, the surplus functions turn out to be linear in  $Q$  and we can back out cut-off values for IC and the equilibrium transfer in closed form.<sup>36</sup>

**Proposition 3.1 (IC cut-off values)** *Consider  $z$  such that  $a^k > 0$ ,  $a^p > 0$ ,  $s = 1$ , and suppose that  $V_{a^k}^k(z) > V_{a^p}^k(z)$ ,  $V_{a^p}^p(z) > V_{a^k}^p(z)$ , and  $m(z) = 0$ . The parent's willingness to pay for informal care at  $z$ , i.e. the highest  $Q$  the parent is willing to pay, is*

$$\bar{Q}^p(z) = \frac{(C_f + p_{bc} - s_{pp})V_{a^p}^p(z) - (\Delta y_{ic} - s_{ic})V_{a^k}^p(z)}{V_{a^p}^p(z) - V_{a^k}^p(z)}, \quad (16)$$

where  $\Delta y_{ic} \equiv y_{k,fc} - y_{k,ic}$  is the net-income loss the kid experiences when giving IC. The kid's reservation transfer, i.e. the lowest  $Q$  for which the kid is willing to provide IC at  $z$ , is

$$\underline{Q}^k(z) = \frac{(\Delta y_{ic} - s_{ic})V_{a^k}^k(z) - (C_f + p_{bc} - s_{pp})V_{a^p}^k(z)}{V_{a^k}^k(z) - V_{a^p}^k(z)}. \quad (17)$$

Since agents will value both their own and the other agent's wealth positively in equilibrium, i.e.  $V_{a^j}^i > 0$  for  $i, j \in \{k, p\}$ , and since  $V_{a^i}^i > V_{a^j}^i$  for  $i \neq j$ , we can deduce the following comparative statics from (16) and (17). The parent's willingness to pay for IC is increasing in the price of FC,  $p_{bc}$ , her preference for informal care,  $C_f$ , and the IC subsidy,  $s_{ic}$ . It is decreasing in the PP subsidy,  $s_{pp}$ , and the kid's opportunity cost,  $\Delta y_{ic}$ . Also, note that the parent's altruism towards the kid enters through  $V_{a^k}^p$ : The more altruistic the parent is, the more will she value the kid's wealth.

The kid's reservation transfer is a mirror image of the parent's willingness to pay. It is increasing in the kid's opportunity cost and the PP subsidy, and it is decreasing in the IC subsidy, the price of FC, and the parent's preference for IC. The term  $V_{a^p}^k$  encodes altruistic and strategic bequest considerations by the kid: The more altruistic the kid and the more likely a sudden

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<sup>36</sup>Proofs for the following two propositions are provided in the Online Appendix in Section 2.2.

bequest from the parent is, the higher her valuation of parental assets,  $V_{a^p}^k$ . Quantitatively, we find that the term  $p_{bc}V_{a^p}^k$ , which encodes the child's desire to protect the parent's wealth from being spent on nursing-home fees, is key for kids to provide IC at low or even zero contemporaneous transfers.

**Proposition 3.2 (IC choice and exchange-motivated transfers)** *Consider  $z$  such that  $a^k > 0$ ,  $a^p > 0$ ,  $s = 1$ , and suppose that  $V_{a^k}^k(z) > V_{a^p}^k(z)$  and  $V_{a^p}^p(z) > V_{a^k}^p(z)$ . Then the care arrangement satisfies*

$$h(z) = \mathbb{I}\{C_f + p_{bc} - s_{pp} \geq \Delta y_{ic} - s_{ic}\}, \quad (18)$$

$$Q^*(z) = \max\{0, (1 - \omega)\underline{Q}^k(z) + \omega\bar{Q}^p(z)\}. \quad (19)$$

*The IC rule  $h(z)$  is intra-family efficient: It is identical to the care decision that a family planner would choose who maximizes a weighted sum of family members' utilities, taking government policies and market prices as given.*

The family chooses IC if and only if the parent's utility-adjusted cost of PP exceeds the opportunity cost of the kid. Also, we see that wealth accumulation helps the family to achieve efficient outcomes. It enables players to make large-enough side payments to achieve efficiency.

**Corollary 3.1 (Comparative statics for IC choice and transfer)** *Consider  $z$  such that  $a^k > 0$ ,  $a^p > 0$ ,  $s = 1$ , and suppose that  $V_{a^k}^k(z) > V_{a^p}^k(z)$  and  $V_{a^p}^p(z) > V_{a^k}^p(z)$ . Then IC is more likely (i) the more the old values informal care (the higher  $C_f$ ), (ii) the more expensive FC is (the higher  $p_{bc} - s_{pp}$ ), and (iii) the lower the child's effective opportunity cost (the lower  $\Delta y_{ic} - s_{ic}$ ). Fixing the other derivatives of  $V^p$  and  $V^k$ ,  $Q^*$  is (i) decreasing in  $V_{a^p}^k$  and (ii) increasing in  $V_{a^p}^p$ .*

The IC decision depends in the expected way on the care preference, the nursing-home cost, and the kid's opportunity cost. As for wealth effects, the corollary tells us that the more the kid values the parent's wealth, be it due to altruism or strategic bequest considerations, the lower is the contemporaneous transfer that the parent makes in equilibrium. As for parent's wealth,  $Q^*$  is higher the lower the parent's marginal value from wealth,  $V_{a^p}^p$ , i.e. the richer the parent.

The cases in which one or both agents have zero wealth are more cumbersome to characterize. We will illustrate these cases below using figures generated from the numerical solution of the model.

### 3.6 Numerical solution: Dynamics and care arrangements

We solve for the equilibrium of the game between the parent and kid numerically, backward-iterating jointly on the value functions in age. For this, we use the characterizations of care decisions from the previous section and combine them with the Markov-chain approximation algorithm from Barczyk & Kredler (2014a) for the consumption-savings and gift-giving decisions.<sup>37</sup> Given the equilibrium laws of motion, we then forward-iterate in age to find the ergodic measure of families over the state space, using the same techniques. Online Appendix 4 gives the details.

Figure 1 illustrates typical care arrangements and dynamics of the model (these are generated for parent age 80, using the calibrated model discussed in Section 4). The various care arrangements are represented by different shades of grey as a function of  $(a^p, a^k)$ , given different productivity levels of parent and kid in the sub-figures. The wealth dynamics,  $(\dot{a}^p, \dot{a}^k)$ , are represented by arrows.

*Consumption-savings behavior.* The kid engages in precautionary-savings behavior and saves when income is high – all arrows point upward in the upper figures. The kid dis-saves when income is low to smooth consumption. The pension of the parent is deterministic and because she is already in need of LTC she dis-saves in order to smooth her consumption (all arrows point to the left).

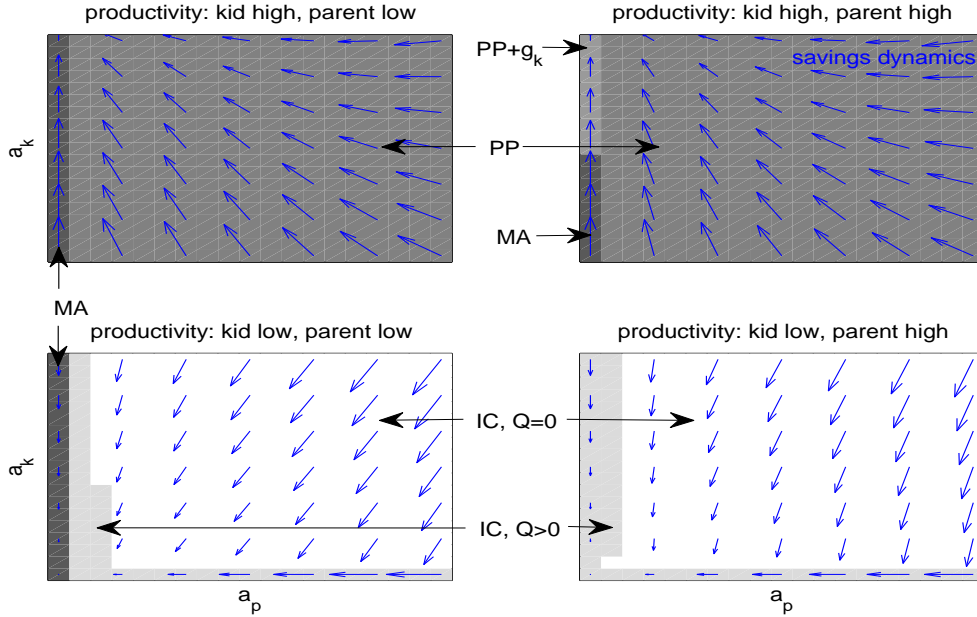
*Care arrangements.* In families with a high-opportunity-cost kid, IC never takes place, no matter how wealthy the parent is. Instead, the parent relies on PP care – at least as long as she has wealth. Once she spends down her wealth she either comes to rely on MA if her pension is too low; or –despite a low pension– continues in PP care if the kid is wealthy enough to support her financially with gifts (region  $PP + g^k$ ).

When the kid’s opportunity cost is low (the lower two figures), IC takes place whether the parent’s pension is high or low, so long as the parent owns wealth. When the parent has sufficient wealth, then the expectation of a bequest is enough to motivate the kid to give care, and there is no contemporaneous transfer (IC,  $Q = 0$ ). When the parent has low wealth, however, contemporaneous transfers flow (IC,  $Q > 0$ ). When the parent exhausts her wealth and her pension is high, she continues to receive IC because she still has enough to offer in exchange for care; with a low pension, however, the parent makes use of MA. Since the kid is rela-

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<sup>37</sup>This Markov-chain approximation method can also be cast as a classical finite-element solution techniques for PDEs. It discretizes continuous states (wealth and age) and uses finite approximations of the value function derivatives to update the value function.

Figure 1: Care choices and savings dynamics



Snapshot of state space at parent age 80 in calibrated model; parent disabled. Kid productivity: *high* is the top grid point (out of 7 grid points), *low* is the third-lowest grid point. Parent productivity: *high* is top grid point (out of 7), *low* is bottom grid point. Arrows depict law of motion of family wealth ( $\dot{a}^p, \dot{a}^k$ ). Shaded regions correspond to care regions: IC without transfers (IC,  $Q = 0$ ) = white; IC with transfers (IC,  $Q > 0$ ) = light grey; PP care plus financial support from children (PP+  $g^k$ ) = medium grey; PP care without kid support (PC) = dark grey; Medicaid (MA)=black.

tively income-poor in this case, it does not provide financial support for paying a nursing home. Transfers are also positive when the kid is broke, since the parent wants to prop up the kid's consumption; there is an altruistic component to  $Q$  then. The model also generates regions in which the kid gives purely altruistic care (IC with  $Q = 0$  to parent with  $a^p = 0$ ), but these are small in our calibration since the kid's altruism is low and do not show up in the figure.

## 4 Calibration

We calibrate our model to the US economy in the year 2000. We first describe how we choose parameters pertaining to demography, health and other risks, technology, and the government. We estimate these parameters directly from the data or take them from the literature. We then describe how we identify preference parameters and the bargaining weight jointly by matching model-generated moments to their data counterparts. Finally, we evaluate the model fit in non-targeted dimensions and discuss implications of our calibration. Online Appendix Section 3

gives details on our calibration exercise.

## 4.1 Demography, shocks, technology, and government

*Demography.* We set model age 0 to be equivalent to age 35 in the data. Individuals retire at model age  $j_{ret} = 30$  (data age 65); certain age of death is  $j_{dth} = 60$  (data age 95). We set  $\nu = 0.5$ , i.e. the kid generation per parent household has three members, corresponding to the average number of children in our HRS data.<sup>38</sup>

*Labor productivity.* We assume that efficiency units of labor have the following (standard) functional form in age and productivity:

$$\log[y(j, \epsilon)] = \beta_0 + \beta_1 j + \beta_2 j^2 + \beta_3 j^3 + \sigma_\epsilon \epsilon,$$

We estimate the coefficients for the age profile using the year-2000 US Census data for individual full-time workers. We discretize  $\epsilon$  on a grid with  $N_\epsilon = 7$  values using methods equivalent to those suggested by Tauchen (1986) for discrete-time processes, using an annual autocorrelation coefficient of  $\rho_\epsilon = 0.95$ , a standard number in the literature, and the estimate  $\sigma_\epsilon = 0.78$  from the Census data. In our setting,  $\rho_\epsilon$  also governs the correlation of parent's and kid's productivity. Our choice implies that at age 50, a typical age for child caregivers, the correlation coefficient between kid's and parent's productivity is 0.46, which lines up quite well with estimates on the inter-generational correlation coefficient of (log) lifetime incomes, which are around 0.4 (see the survey by Solon, 1999, section 4.2). We set  $\beta$ , the fraction of efficiency units pertaining to the male household member, equal to the male earnings share in married-couple families in the data; for the year 2000 this fraction is 0.66 (U.S. Bureau of Labor Statistics, 2013).

*LTC risk and mortality.* We obtain estimates for the disability hazard,  $\delta_s(j^p, \epsilon^p)$ , and the mortality hazard,  $\delta_d(j^p, \epsilon^p, s)$ , from our HRS data. For our estimations, we use logistic regressions on females only. The regressions include a polynomial in age and interaction terms of age with education.<sup>39</sup> Mortality hazards also depend on the disability state of the individual. We use a likelihood-ratio criterion to determine the preferred specification.

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<sup>38</sup>A shortcoming of our framework is that we can only handle two generations per family, i.e. parents and children (but no grandchildren), due to the difficulty that strategic interactions present. The way we choose the initial ages, initial parent age 65 and initial kid age 35, reflects a compromise we make between a proper demographic structure and a clean, self-contained model.

<sup>39</sup>We consider education since it is a fixed characteristic whereas SS benefits vary with widowhood status. We map productivity,  $\epsilon^p$ , in the model to education in the data as follows. We measure the fraction of elderly females with high school ( $q_{hs}$ ) and some college ( $q_{sc}$ ). We then assign the  $q_{hs}$  lowest  $\epsilon^p$ -values in the model to high-school, the  $q_{sc}$  next-lowest to some college, etc.

As in our empirical work, we classify an individual as LTC-dependent if more than 90 monthly hours of care are received. Using this variable, we estimate the death hazards,  $\delta_d(\cdot)$ , from a logistic hazard model with the covariates described above on the sample of women. As for the disability hazard,  $\delta_s(\cdot)$ , we face the following complication. In the model the disability state is absorbing, whereas in the data –while not the norm– some individuals return from disability to the healthy state. Our strategy to deal with this issue is to first estimate the fraction of disabled females,  $\lambda(j^p, \delta^p)$ , conditional on age and education with a logistic regression. We then back out the hazard function  $\delta_s(\cdot)$  that, given the estimated death hazards  $\delta_s(\cdot)$  and the assumption that disability is absorbing, delivers the observed fraction  $\lambda(\cdot)$  of disabled individuals for each  $(j^p, \epsilon^p)$  by solving a system of differential equations.

Section 3.1 in the Online Appendix provides further details on this procedure, shows the implied life expectancies and expected LTC durations, and gives the hazard functions. Consistent with the literature, we find that female and high-education individuals live longer. Low-education individuals tend to become LTC-dependent at lower ages, when death hazards are relatively low. On expectation, they thus spend more years in disability than high-education individuals (both unconditionally and conditional on entry into disability).

*Husbands.* In order to pin down  $n^p(\cdot)$ , which determines the number of men in parent households, we proceed as follows. We estimate the number of surviving men above age 68 as a function of age and education. Assuming that the marriage-age gap is 3 years in all couples, we then set  $n^p(j^p, \epsilon^k, s = 0)$  such that we exactly match the number of men in each age-education cell in the population.

For care arrangements for husbands in couples, we proceed as follows. We first estimate the fraction of disabled males,  $\lambda_m(j^p, \delta^p)$ , conditional on age and education with a logistic regression in the same way as described above for women. We then choose  $s_m(j^p, \epsilon^p)$  such that the total number of disabled men in the model matches the number of disabled men in the data for each age-education cell. We determine  $\iota$  from the fraction of disabled husbands who receive IC, which in our data is 85%.

*Medical expenditures.* We follow Kopecky & Koreshkova (2014) to estimate a post-Medicare and pre-Medicaid out-of-pocket (OOP) medical-expenditure shock process, excluding LTC costs. For this, we use the HRS and its exit interviews. We choose a log-normal form for the distribution of payments conditional on an event,  $F_m(M)$ , and back out its parameters from the expenditures of individuals who had exactly one medical event. We then estimate  $\delta_m(j^p, \epsilon^p)$  from the number of events occurring to an individual.

*Technology and nursing homes.* We measure the consumption good  $y$  in dollars of year-2000



output. We define one efficiency unit of labor as the amount required to produce one unit of  $y$  in 2000, i.e. we normalize  $A_y$  to 1. As for the nursing-home technology, we first note that the annual Medicaid reimbursement rate is \$38,500 in the data (from Stewart et al., 2009), which is equivalent to  $p_{bc} + y_{ma}$  in the model. We now have to pin down how much of this reimbursement rate is spent on  $p_{bc}$ . Let  $\psi = p_{bc}/(p_{bc} + y_{ma})$  be the fraction of nursing-home spending that is used for basic care services. From the Minnesota Office of the Legislative Auditor (1995), we find that wages, payroll taxes, and administrative costs in a nursing home accounts for 56.2% of total costs, and so we set  $\psi = 0.562$ . We then back out  $p_{bc} = \psi(p_{bc} + y_{ma}) = \$21,640$ . From Equation (15), we then find that productivity in the formal-care sector is  $A_f = p_{bc}^{-1} = (21,640)^{-1}$ . The return to the savings technology is set to  $r = 0.02$ , which is standard in the literature.

*Government.* Taxation of joint household income is based on the tax function by Gouveia & Strauss (1994), and the Social Security benefit schedule is taken from Kopecky & Koreshkova (2014). The calibration of the MA reimbursement rate  $p_{bc} + y_{ma}$  was discussed above. Subsidies  $s_{ic}$  and  $s_{pp}$  are zero in the baseline calibration. Other government spending is residually determined after paying for LTC and medical expenditures. Counterfactual policy changes are paid for by a uniform increase to the income-tax schedule, i.e. we determine the tax change  $\Delta\tau$  such that the new income-tax schedule,  $\tilde{\tau}(y) = \tau(y) + \Delta\tau$ , makes the government budget constraint hold in steady state.

## 4.2 Preferences and bargaining weight

We set the coefficient of relative risk aversion  $\gamma$  to 2, a standard value in the macroeconomics literature. The remaining parameters are obtained by matching model-generated moments to their counterparts in the data.

We identify the discount rate  $\rho$  by matching the median wealth of parents aged 70-75 in the model to the median net worth of households of the same age group in the data. We choose this age range because we deem it important that the model generates the right amount of wealth around the time LTC risk becomes substantial, but when most individuals are still alive.

We pin down the consumption penalty for formal care,  $C_f$ , and the MA consumption floor,  $C_{ma}$ , by targeting the percentage of IC recipients and the ratio of total PP to MA spending on nursing homes. We target aggregate spending instead of the percentage of MA recipients since there are many mixed forms between MA and PP in our data, and because getting public LTC spending right is a priority for us.<sup>40</sup> Our PP-to-MA ratio is taken from data for the year 1997

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<sup>40</sup>A further advantage of using aggregate LTC expenditure data is the heterogeneity in MA reimbursement rates

from Giacalone (2001). We adjust them to the year 2000 using data on price growth in the nursing-home sector given by Stewart et al. (2009).

We identify parental altruism,  $\alpha^p$ , by matching the average gift from non-LTC parents to the kid generation. We include also zero transfers, thus covering both the intensive and extensive margin. The reason we leave out LTC parents is that they can also give transfers for exchange-motivated reasons in our model while for non-disabled parents they can only be due to altruism.

In order to pin down kid's altruism,  $\alpha^k$ , we use the average gift the kid generation gives to a parent residing in a nursing home. Again, such transfers can only flow due to altruism in our model. We prefer this moment over transfers flowing from kids to non-LTC parents. The latter are quite rare in the data, and so we worry that we identify altruism of a very selected group of individuals.

Finally, the kid's bargaining weight,  $\omega$ , is calibrated in order to match the mean transfer by parents to caregiving children in the data, \$9,878. To compute this number, we take the weighted average of the imputed value of rent-free living and the per-annum value of housing assets transferred to kids, where the weights on the two categories are based on our data in Section 2.6.<sup>41</sup>

### 4.3 Results

Table 5 presents the calibration results. The fit to the targeted moments is exact. Our estimate of the consumption floor is in the ballpark of estimates in the literature.<sup>42</sup> The estimate for the formal-care consumption penalty,  $C_f$ , means that a PP nursing-home resident has to incur a

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across states and individuals. We use the ratio on *nursing-home* spending since we have good data on aggregate expenditures on nursing homes, but not for community residents. One may worry that FHC individuals are almost always PP and thus our measure overstates MA usage. However, we find that among widow(er)/single disabled FHC individuals, 46.9% are MA supported, with median out-of-pocket expenditure of only \$1,000 annually. This coverage is very similar to MA coverage in the nursing-home population, see Table 8, suggesting that the nursing-home statistics represent the overall formal-care population well.

<sup>41</sup>We impute yearly rent from median gross rents in the US in the year 2000 of \$602/month (U.S. Census Bureau, 2003). The average home value of single parents with heavy-helper children is \$86,300 in our data, excluding the top 1% of this group. The expected duration of LTC in our model is 2 years and so to obtain a yearly home-transfer value we divide the home value by two. The mean exchange transfer is then imputed to be 47.3% of \$7,200 plus 15.0% of \$43,150.

<sup>42</sup>For example, DeNardi et al. (2010) estimate a value of \$2,700 (in 1998 dollars) but in their model the coefficient of relative risk aversion is substantially higher, 3.8. When estimating the MA consumption floor with this higher coefficient of relative risk aversion we obtain \$4,650 (not shown here). Thus, our consumption floor is relatively higher. This can be explained by the introduction of the family-insurance channel in our model: In order to generate enough Medicaid uptake in the presence of this additional option, the consumption floor has to become more generous.

cost of \$3,800 before an additional dollar begins to yield the same utility as when receiving IC at home. This is consistent with survey evidence that the elderly typically prefer to stay in a familiar environment.

Table 5: Calibration

$\gamma$	$r$	$\rho^\epsilon$	$\nu$	$\beta$	$p_{bc} + y_{ma}$	$\psi$	$A_y$	$A_f$	$\iota$
2	2%	0.95	0.5	2/3	\$38,500	56.2%	1	$(21.64)^{-1}$	0.85

Parameters calibrated outside of model.  $\gamma$ , coefficient of relative risk aversion,  $r$ , interest rate, and  $\rho^\epsilon$ , auto-correlation of efficiency units: standard values.  $\nu$ , measure of infra-marginal child households: chosen to obtain three children per parent household.  $\beta$ , male contribution to household income: based on U.S. Bureau of Labor Statistics (2013).  $p_{bc} + y_{ma}$ , annual average Medicaid reimbursement based on *National Nursing Home Survey* taken from Stewart et al. (2009).  $\psi$ , percentage of nursing home costs due to care: from Minnesota Office of the Legislative Auditor (1995).  $A_y$ , goods-sector productivity: normalization.  $A_f$ , formal-care-sector productivity:  $A_f = [\psi(p_{bc} + y_{ma})]^{-1}$ .  $\iota$ , fraction of disabled husbands obtaining informal care (IC): matches fraction of disabled married males who receive IC.

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

Authors' own estimates for efficiency units of labor, LTC risk and mortality, and medical expenditures excluding LTC costs; see main text and Online Appendix for details.

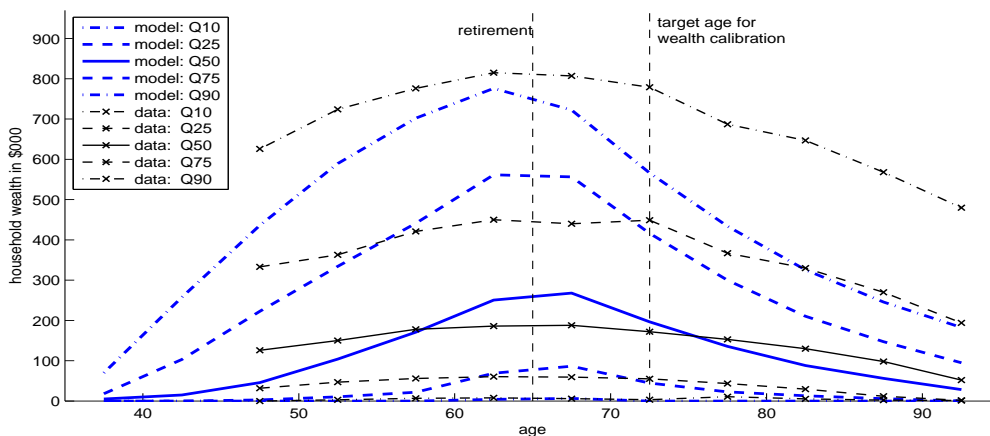
Calibration target	Data	Model
Median wealth (ages 70-75)	\$178,600	\$178,600
Informal care	44.5%	44.5%
Total PP/MA spending	0.82	0.82
Parent (healthy) gift	\$1,548	\$1,548
Kid gift to parent (PP)	\$620	\$620
Exchange transfer	\$9,878	\$9,878
Parameter	Description	Value
$\rho$	Discount rate	0.0545
$C_f$	FC consumption penalty	\$3,800
$C_{ma}$	MA consumption floor	\$3,020
$\alpha^p$	Parent altruism	0.6922
$\alpha^k$	Kid altruism	0.0121
$\omega$	Kid bargaining weight	0.0205

Parameters calibrated for baseline model. Data source: HRS waves 2000-2010. Median wealth is of coupled and widow(er)/single households (excluding top 5%). Informal care is fraction of disabled widow(er)/singles receiving IC. Total private pay (PP) to Medicaid (MA) spending on nursing homes based on HCFA Office of the Actuary, National Health Expenditures, from Giacalone (2001). Parent mean gift is average annual gift from healthy parent(s) aged 65+ to all non-co-residing children. Kid mean gift is average gift to private-payer nursing-home parent. Exchange transfer is based on value of rent-free living and home-transfer to children in single-parent families with heavy-helper children. All transfers are averages and include zeros.

The estimate for the parent's altruism is high. In conjunction with the curvature on the utility function, it means that a parent chooses a consumption ratio  $c^k/c^p = (\alpha^p)^{1/\gamma} = 0.832$  when giving gifts to the kid.<sup>43</sup> This high value also implies that the parent has a strong bequest motive. For the kid, the equivalent measure is a lot lower:  $c^p/c^k = (\alpha^k)^{1/\gamma} = 0.11$ . Finally, we

<sup>43</sup>This measure of altruism is proposed by Barczyk & Kredler (2014a).

Figure 2: Wealth quantiles by age



Data source: HRS waves 2000-2010. Wealth is of coupled and widow(er)/single households (excluding top 5%) in \$000.

see that almost all bargaining power has to be assigned to the parent in order for the model to generate the relatively low exchange-motivated transfers observed in the data. This will also imply that a substantial fraction of caregiving kids in the model will be motivated by expected bequests.

#### 4.4 Model fit

We now evaluate the fit of the model in dimensions that were not targeted.

*Savings behavior.* We start with a comparison between the wealth distribution from the model and the one from our data, see Figure 2. The model matches lower wealth quintiles very well, but does not create enough wealthy households. This is especially the case among the very old; in this sense there is a retirement savings puzzle. The reason for low wealth of the very old in our model is that medical-expenditure shocks in old age, once netting out nursing-home expenses, are not that large any more; Medicare provides reasonable insurance against these shocks to the elderly in the US.<sup>44</sup> Nursing-home expenditures are discretionary in our model, in contrast to much of the previous literature. The family provides additional insurance, making self-insurance through savings less urgent. However, wealth may also be low at high age in our calibration due to the shortcoming that the certain age of death is low (due to the modeling constraints we face in our strategic setting).

<sup>44</sup>For an overview of out-of-pocket medical expenditure see Table 10 in the Online Appendix.

Table 6: Bequest distribution (\$000)

Source	p25	p50	p75	p90	p95	p99
Data	0.0	20.5	136.4	277.9	421.2	744.9
Model	5.6	58.1	169.0	324.6	438.9	657.0

Data source: HRS exit waves 2002-2012. Percentiles of bequest distribution in data compared to model. Includes individuals with an exit interview who at time of death are widow(er)/single.

Since bequests play a key role for informal care in the model it is important that the model generates a bequest distribution in line with the data. Table 6 shows the distribution of bequests generated by the model in comparison to the data. Bequests are based on individuals who are widow(er)/single at time of death, in order to exclude bequests to the spouse; this is the closest data counterpart to our model. Overall, our model does a good job in generating a realistic bequest distribution.<sup>45</sup>

*Determinants of care arrangements.* In order for our model to serve as a useful tool for evaluating policy, it is also important that it fits well which families opt for informal care (IC). We now consider how the model performs quantitatively in matching the observed care arrangements by kids' education, parents' pension income, and parental wealth.<sup>46</sup> The first part of Table 7 shows that the model does a decent job in replicating the IC gradient between the two largest categories, *high school* and *some college*. However, the model counterfactually predicts no IC at all when all children in the family have a college degree. The model probably fails here for two main reasons: (i) education is an imperfect proxy for opportunity costs (but we assume a one-to-one mapping for the model), and (ii) there is heterogeneity in altruism, which we ignore in our model.

The second part of Table 7 shows IC prevalence, split up by quintiles of the parent's SS benefits. The model predicts an arch, while the data suggests a slight downward trajectory when moving to higher pension quintiles. Specifically, our model suggests less IC in families with pension-poor parents than we observe in the data. This divergence might be driven by the fact that in reality family values run so strong for some that economic incentives matter less; we find evidence consistent with large differences in the preference for IC in the significant and large loading of the race dummy in our linear probability model (Table 3). Also, while in the model access to a nursing home is frictionless, in reality some Medicaid-financed individuals may face longer waiting times of being admitted to a nursing home, as nursing homes preferentially admit

<sup>45</sup>There are several reasons why the estate distribution in the HRS is lower than the wealth distribution may suggest: large measurement error, cohort effects, high end-of-life expenditures, and costs of dissolving estates.

<sup>46</sup>Kid's productivity in the model is mapped to education as described in Footnote 39 for parents.

Table 7: Informal care by economic characteristics

IC by kid education			
Source	high school	some college	college
Data	57.9%	47.0%	26.7%
Model	62.3%	42.6 %	0.0%

Data source: HRS waves 2000-2010. Education pertains to average years of education of children in a family with a widow(er)/single parent and heavy-helper children. Categories correspond to average education of at most 13 years of schooling, between 13 and 16 years of schooling, and 16 years and more.

IC by parent pension quintile					
Source	Q1	Q2	Q3	Q4	Q5
Data	47.0%	49.5%	48.2%	43.6%	40.7%
Model	23.8%	44.4%	59.7%	57.0%	45.3%

Data source: HRS waves 2000-2010. Pension quintiles (social security retirement, spouse or widow benefits) of disabled widow(er)s/singles.

Linear probability model for IC									
Source	low wlth	med wlth	high wlth	Q2	Q3	Q4	Q5	some coll	coll
Data	0.10	0.12	0.07	0.03	0.05	0.03	0.04	-0.08	-0.22
Model	0.61	0.62	0.61	0.20	0.23	0.20	0.12	-0.27	-0.83

Data source: HRS waves 2000-2010. Linear probability model of informal care for disabled widow(er)s/singles. Low wealth is <90K, medium wealth is [90K,270K], and high wealth is >270K. Regression uses pension quintiles (social security retirement, spouse or widow benefits). Omitted variables: no wealth, pension quintile Q1, and average schooling of at most 13 years. Model estimates based on linear probability model using model-generated data.

private payers (see Norton, 2000 and references therein). Beyond the first pension quintile the fit improves. Parents at the high end of the pension spectrum tend to be associated with children of high opportunity costs and so PP nursing-home use increases and IC decreases.

Finally, we turn to conditional correlations. We run a linear probability model on model-generated data, regressing the IC dummy on a polynomial in age and dummies for parental wealth, public-pension quintiles, and kid education. We compare the results to those obtained from a regression very similar to the one presented in Section 2.<sup>47</sup> The quantitative predictions of the model are starker than those implied by the data. This is to be expected, since the regression covariates cover almost all determinants of IC in the model. In the data, however, there are omitted sources of heterogeneity (such as altruism, the income share of the marginal caregiver, etc.) and measurement error (especially in the kid’s opportunity cost and parent wealth), both of which make us expect that the coefficients on economic variables are attenuated downward. The direction of the model’s implications are, however, very much consistent with the data. In terms of parent’s wealth, we see that the model successfully replicates the “threshold effect”

<sup>47</sup>The only difference here is that we now include only public pension income (as in the model), whereas, before we included all sources of income, and that we use quintiles of pension income instead of the logarithm of income.

we find in the data: When going from zero to the lowest wealth category, IC becomes more likely, but the likelihood of IC remains almost unchanged at higher wealth levels. In the data, there is only a weak relationship between parent's pension income and the probability of IC. In the model this relationship is also the weakest; it is hump-shaped whereas in the data it is more noisy. In both the model and the data, families with higher-educated children are less likely to rely on IC, *ceteris paribus*, the coefficient on the college category being by far the largest.

*Transfers.* Table 8 shows that in terms of non-targeted transfer arrangements, the model achieves a decent fit. The model is very successful in generating bequest-motivated care in line with the data. The parent's high bargaining weight keeps contemporaneous transfers down, but children in the model still provide care, since they can increase the expected bequest by protecting the wealth of the parent. The parent does not spend down her wealth recklessly due to the strong bequest motive implied by altruism, strengthening the bequest channel.

The model understates the number of kids who help out with their parent's nursing home expenditure (the extensive margin of gifts), which means that it overshoots on the intensive margin (recall that the unconditional mean was targeted). For the other targeted moments – gifts by healthy parents – the model is, however, almost spot-on in the decomposition between the extensive and the intensive margin. Finally, in line with the data, the model generates very low transfers from kids to healthy parents. This is because kids' altruism is weak and the wealth distribution at this life-cycle stage is tilted in favor of parents. The fit in terms of MA coverage is satisfactory given that the model is constrained to pure forms of coverage.

*Nursing-home use and expenditures.* The model generates larger PP nursing home expenditures than we find from the HRS data, except for the highest percentiles. However, the numbers from the HRS appear to be quite small in contrast to a Medicaid reimbursement rate of \$38,500, which suggests that there is some measurement error in the HRS data. The literature also hints at this possibility: Stewart et al. (2009), for example, report an average annual private-nursing-home price in the year 2000 of \$45,800, based on the National Nursing Home Survey, which is close to the number predicted by our model.

Since in the data there are many mixed forms of financing, it is also important that the model can fit the distribution of expenditures when pooling MA and PP individuals together. The third panel of Table 8 shows that the model correctly predicts that median OOP expenditures are small as so many elderly rely on MA. For individuals above the median, costs in the model increase more rapidly than in the data, but overall the model's predictions line up well with the data counterpart. Consistent with the data, the model also generates a gradient of nursing-home expenditures in pension quintiles of the elderly, but overstates this gradient somewhat. In the

Table 8: Non-targeted moments

Description	Data	Model
exchange	62.3%	78.8%
potential bequest	25.4%	21.2%
no compensation	12.3%	0.0%
parent (healthy) gift to kid	15.0%	14.9%
kid gift to parent (PP)	7.6%	5.3%
kid gift to parent (healthy)	\$85	\$0
full MA	45.7%	62.2%
mostly MA	10.4%	-
partial MA	9.2%	-
PP	34.6%	37.8%

## PP nursing-home expenditures (\$000)

Source	mean	p25	p50	p75	p90	p95	p99
Data	39.6	22.7	34.6	48.5	66.5	89.0	129.2
Model	52.0	40.5	49.0	61.0	72.2	78.6	88.6

Data source: HRS waves 2000-2010. Transfer arrangements are documented in Section 2.6. *Parent (healthy) gift to kid*, fraction of healthy parent households giving positive gift amounts to children. *Kid gift to parent (PP)*, fraction of children giving positive gift amounts to private-payer parents in nursing home. *Kid gift to parent (healthy)* is average financial transfer from kid to non-disabled parents including zeros. MA coverage is for disabled widow(er)/single individuals with nursing-home stays of at least 100 days. Full MA: MA-recipient with full coverage. Mostly & partial MA: MA-recipient with some coverage. PP expenditure statistics are for disabled widow(er)/single individuals conditional on at least \$10,000 annual expenditure. Weights for nursing-home expenditures are adjusted by authors to account for missing values by assigning a higher weight to non-missing observations.

## All nursing-home expenditures (\$000)

Source	mean	p25	p50	p75	p90	p95	p99
Data	15.4	0.0	3.2	23.7	46.2	61.0	102.8
Model	19.7	0.0	0.0	43.3	60.1	69.2	83.2

## All nursing-home expenditures by pension quintile (mean in \$000)

Source	Q1	Q2	Q3	Q4	Q5
Data	11.6	12.1	15.6	17.0	22.8
Model	0.1	0.5	3.1	13.5	40.8

## Lifetime utilization of nursing home (years)

Source	mean	p50	p75	p90	p95	p99
Data	1.1	0.0	0.6	3.7	6.4	12.2
Model	1.1	0.0	0.9	3.8	6.0	11.0

## Persistence of nursing-home-utilization time

Source	$d_0$ to $d_0$	$d_1$ to $d_1$	$d_2$ to $d_2$	$d_3$ to $d_3$	$d_4$ to $d_4$
Data	93.0	15.6	10.0	5.8	76.2
Model	95.5	2.5	22.2	13.1	91.8

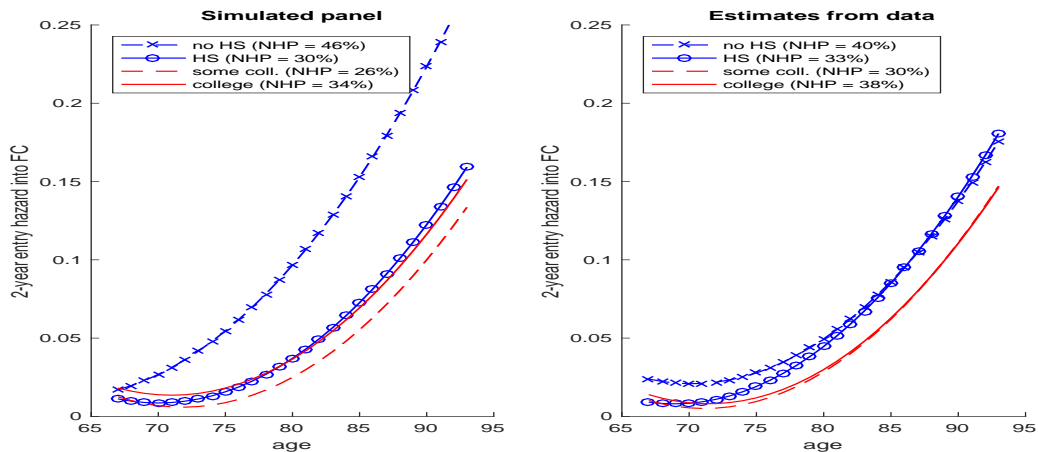
Data source: HRS waves 2000-2010 (includes exit interviews). All nursing-home expenditures for widow(er)s/singles with nursing-home stays of at least 100 days (to exclude Medicare cases). In model, nursing-home expenditure is zero for Medicaid recipients and equals cost of basic care plus private consumption for private payers. Weights adjusted by authors to account for missing values by assigning a higher weight to non-missing observations. Dollar figures converted into year-2000 values. Lifetime nursing-home use (in years) is cumulative of individuals who are part of the HRS between 1998-2012 and are widow(er)/single at time of death. Nursing-home-utilization: Time spend in nursing home as fraction of time between interviews:  $d_0 = 0$ ,  $d_1 = (0, 10\%]$ ,  $d_2 = (10, 50\%]$ ,  $d_3 = (50, 90\%]$ ,  $d_4 = (90, 100\%]$ . HRS weights are used.



data, some low-pension individuals still face costs, whereas these individuals are all covered by MA in the model.

Apart from the cross-sectional distribution of nursing-home use, it is important that the model can also match the timing of nursing-home use in order to represent the financial risks for elderly Americans correctly. The model's distribution of lifetime utilization of nursing home is remarkably similar to that in the data. The second-to-last panel of Table 8 shows how many years Americans spend in a nursing home over their entire life and how this matches up with our model. The last panel shows that the model does a very good job in terms of the persistence of nursing home use, even for shorter nursing-home stays, despite the fact that in the model disability is absorbing.<sup>48</sup> Finally, Figure 3 shows two-year hazard rates of nursing-home entry, which in the model is endogenous, over age by educational achievement. The model fits the data extremely well for all levels of education at all ages except for those with less than high school. This is the mirror-image from before, where we have seen that the model understates IC of parents in the lowest pension quintile, Table 7.

Figure 3: Nursing-home entry hazards



Data source: HRS waves 2000-2010 (including exit waves). Model and data comparison of entry hazards into nursing home, excluding short-term stays, by age and educational attainment. Percentages in the legend are probabilities of ever ending up in a nursing home at age 65 (nursing-home probabilities, NHP).

<sup>48</sup>Table 13 in the Online Appendix shows the entire transition matrix. Additionally, Table 11 shows that the model successfully reproduces medical, nursing-home, and total expenditures (medical+nursing home) by age in the data, and Table 12 shows that total expenditures in the model for the largest expenditure category are as persistent as in the data.

## 5 Policy experiments

We now study counterfactual experiments in order to evaluate policy proposals that have been discussed in the political arena. Before presenting our results, we describe the different channels in our model that determine welfare and analyze how these channels matter for different types of subsidies.

### 5.1 Channels determining welfare

There are four sets of frictions in the model: (i) distortionary taxation of labor, (ii) incomplete markets (no insurance against LTC, medical-expenditure, and labor-market risks), (iii) the Medicaid means-test, and (iv) lack of commitment within families. In order to understand the welfare consequences of policies, it is useful to first think about the allocation in a first-best (frictionless) world, and then to analyze how each type of friction interacts with certain policies.

*First-best.* Consider a social planner who faces no restrictions and weighs welfare of all agents equally. The planner’s outcome can be attained in an equilibrium setting with (i) appropriate lump-sum transfers by the government, (ii) insurance markets against all risks, (iii) the possibility to administer Medicaid without a means test, and (iv) complete and enforceable contracts between parents and kids within each family. First, note that given the parameters identified by our calibration the planner will not use the MA technology since the utility level  $u(C_{ma})$  delivered by Medicaid can be attained at lower cost using the PP technology.<sup>49</sup> Second, the planner equalizes marginal utility of consumption across all agents, implying that agents do not bear consumption risk. Third, for productive efficiency the planner chooses whether care is provided through IC or PP in each family. It is easy to see that the planner chooses IC if and only if

$$(1 - \beta)y(j^k, \epsilon^k) < p_{bc} + C_f, \quad (20)$$

i.e. if and only if the marginal social cost of IC (the productivity, or gross wage, of the marginal kid caregiver) is lower than the marginal social benefit (freeing one formal-care worker up for production plus the utility benefit of informal care). Quantitatively, the marginal social benefit of care amounts to  $p_{bc} + C_f \simeq \$26,000$  in our calibration, and thus all marginal caregivers with gross earnings below this threshold give informal care under the efficient allocation.

*Labor-wedge channel.* Now we remove lump-sum taxation and instead the government taxes

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<sup>49</sup>The planner’s cost of attaining utility  $u(C_{ma})$  in PP is  $p_{bc} + C_f + C_{ma}$ , whereas it is  $p_{bc} + y_{ma}$  in MA. Since  $C_f + C_{ma} < y_{ma}$  in our calibration, it follows that PP is always a superior choice.

labor. The private cost of IC (the caregiver's net wage) is then lower than its social cost (the caregiver's gross wage), and thus too much IC takes place. This distortion provides a rationale for FC subsidies, but against IC subsidies: A FC subsidy reduces the wedge between private and social cost of IC, whereas an IC subsidy increases it.

*Insurance channel.* In the absence of insurance markets, the LTC shock poses a large consumption risk for families. Any policy that transfers resources to families in this adverse state has welfare-enhancing effects, particularly when they flow to poor families with high marginal utility.

*Medicaid channel.* Medicaid has positive insurance effects and targets the poorest through the means test. However, there are two drawbacks: (a) The means test distorts the savings decision, and (b) Medicaid is technologically inferior to other forms of care according to our calibration. A policy that reduces MA reliance thus has positive effects through these two mechanisms.

*Family-commitment channel.* Finally, there is the friction that parent and kid within a family cannot write complete contracts. Efficient risk sharing within the family would require that agents provide resources to each other in adverse (high-marginal-utility) states of the world, e.g. kids should provide care or financial help when the parent is disabled. Productive efficiency would require that the IC decision is intra-family efficient (i.e. efficient from the family's point of view, given the taxes and subsidies in place). Observe that wealth accumulation by parents helps the family to get closer to efficiency on both counts. In terms of risk sharing, a wealthy parent can induce the kid to give informal care through transfers and bequests. Alternatively, if the child's opportunity cost is high, she can spend down her wealth on PP, which is effectively a transfer from the kid as spending on a nursing home reduces the estate. If the parent is lucky and stays without disability, she leaves a large bequest to the child, thus relinquishing resources in this favorable state of the world. As for productive efficiency, Proposition 3.2 tells us that the IC decision is intra-family efficient if both parent and child have wealth, which occurs because agents can always make side payments to achieve efficiency. In contrast, for poor parents there may be under-provision of IC: When the parent has nothing to offer to the kid when disabled, the kid may leave the efficient risk-sharing agreement, and the parent may be forced into MA.

In summary, we note that the IC subsidy dominates the PP subsidy in all of the channels, except for the labor-wedge channel. This is because the IC subsidy is more likely to be taken up by less well-off households and, hence, is more effective than the PP subsidy in providing insurance, in avoiding MA, and in overcoming commitment problems within families. This will be key to understand the policy evaluation to which we turn next.

## 5.2 Non-means-tested IC and PP subsidies

In the first set of counterfactuals we study non-means-tested subsidies for IC, PP, and for both. We base the amounts of these subsidies on the German LTC program, introduced in 1995, which makes subsidies available for either informal or formal care. For individuals that we classify as *disabled*, the current (as of 2015) home-care subsidy, is \$4,375 per year; for individuals living in a nursing home it is \$11,460 per year (in year-2000 dollars).<sup>50</sup> We assume that the IC subsidy is paid to both caregiving kids and parents who give care to husbands (i.e. a *caregiver allowance*). We also provide separate results for an IC subsidy that is restricted to working-age individuals (i.e. kids only).

Table 9 provides an overview of the equilibrium effects of the LTC policy options. In general, we present the long-run effects on allocations, that is, when using the ergodic distribution over families resulting from the policy. For welfare, however, we present two consumption-equivalent variation (CEV) statistics under the veil of ignorance. The *short-run CEV* is that of a kid born into the economy precisely at the moment that the government introduces the subsidy, coming as a surprise to agents. Thus, this kid is matched to a parent who did not anticipate the reform and made savings choices expecting the baseline policies to be in place. The *long-run CEV*, in turn, is for a kid born into the economy with the subsidy in place for an infinite amount of time. This kid draws a parent from the ergodic measure of families under the counterfactual policy; the parents' savings decisions were made under full anticipation of the policy.

In the experiment  $s_{ic} \uparrow$ , an annual subsidy of \$4,375 is given to informal caregivers of any age. The subsidy strongly reduces MA in favor of IC, also – to a lesser extent – crowding out PP care. More IC care is provided without contemporaneous compensation from the parent due to the caregiver allowance. The type of IC that grows most is care not accompanied by a contemporaneous transfer.

We decompose the tax change required to finance the subsidy  $\Delta\tau$  into three contributions: (i)  $\Delta\tau_s$ : the change due to the payout of the subsidy itself, (ii)  $\Delta\tau_{ma}$ : the change due to changes in the size of the MA program, and (iii)  $\Delta\tau_{inc}$ : changes to income-tax revenue, which are

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<sup>50</sup>Our information is from the *Tabelle Pflegeleistungen BRat* by the German Ministry of Health as of 2015. Subsidy amounts depend on care needs, which are classified into I, II, III, with sub-categories according to dementia. Most relevant to us are levels II and III, which correspond to daily care of at least 3 hours. For  $s_{pp}$ , we draw on the subsidies for institutional care: We take the subsidy for level III (1,612 Euros per month), which lies just between the levels for II and III-*Härtefall*. For  $s_{ic}$ , we draw on the subsidies for care at home, which in Germany can be used to pay both formal and informal caregivers: We first average the subsidies within II (458 Euros, but 545 with dementia) and then average again with III (728). We then convert to USD in PPP, use the CPI to deflate to 2000, and convert to yearly amounts.

Table 9: Policy experiments

LTC policy	Care type (%)			Costs (change to tax rate in percentage points)				Wealth (\$000, age 70-75)			Ex-ante CEV (%)	
	IC	MA	PP	$\Delta\tau =$	$\Delta\tau_s +$	$\Delta\tau_{ma} +$	$\Delta\tau_{inc}$	p25	p50	p75	short run	long run
status quo	44.5%	34.5%	21.0%					\$52K	\$179K	\$391K		
$s_{ic} \uparrow$	61.1	22.6	16.4	0.09	0.25	-0.24	0.07	41	164	375	<b>0.46</b>	<b>0.25</b>
$s_{ic}^k \uparrow$	61.1	22.5	16.5	-0.04	0.14	-0.24	0.06	44	167	378	0.37	0.22
$s_{pp} \uparrow$	24.6	31.0	44.4	0.18	0.31	-0.07	-0.06	48	167	371	0.13	0.01
both $\uparrow$	46.6	19.7	33.7	0.20	0.47	-0.29	0.02	36	154	361	<b>0.61</b>	<b>0.31</b>
MA $\uparrow$	41.7	38.7	19.6	0.17		0.15	0.02	41	171	386	0.09	-0.04
MA $\downarrow$	50.0	27.3	22.7	-0.21		-0.19	-0.02	64	187	394	-0.11	0.04
MA $\downarrow$ ,both $\uparrow$	48.1	16.2	35.7	0.10	0.48	-0.39	0.01	41	157	363	<b>0.55</b>	<b>0.31</b>

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

LTC policy	IC transfers			FC Financing			IC by kid educ			IC by parent pension				
	Exchg	Beqst	Altrsm	$g^k > 0$	$g^k = 0$	MA	HS	HS+	Collg	Q1	Q2	Q3	Q4	Q5
status quo	78.8%	21.2%	0.0%	2.0%	35.9%	62.1%	62.3%	42.6%	0.0%	23.8%	44.4%	59.7%	57.0%	45.3%
$s_{ic} \uparrow$	73.3	26.6	0.1	3.5	38.6	57.9	86.0	57.6	0.4	55.3	63.5	68.5	66.2	54.6
$s_{ic}^k \uparrow$	73.0	26.9	0.1	3.5	38.8	57.7	86.0	57.7	0.4	55.3	63.7	68.5	66.2	54.6
$s_{pp} \uparrow$	92.0	8.0	0.0	4.9	54.0	41.1	51.3	0.0	0.0	17.9	29.8	32.9	27.6	17.9
both $\uparrow$	89.0	10.9	0.2	7.4	55.7	36.9	83.6	18.7	0.0	52.6	54.9	49.6	43.8	31.0
MA $\uparrow$	80.3	19.7	0.0	1.0	32.6	66.3	58.4	40.1	0.0	20.0	40.0	55.6	55.9	45.2
MA $\downarrow$	78.1	21.9	0.0	4.0	41.3	54.7	71.8	45.6	0.0	33.6	56.1	63.7	57.8	45.5
MA $\downarrow$ ,both $\uparrow$	88.2	11.7	0.0	10.3	58.4	31.3	86.3	19.6	0.0	57.0	56.4	50.8	43.7	30.9

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

chiefly caused by changing labor supply of caregivers.<sup>51</sup> The payout of the IC subsidy increases the tax rate by one-quarter of a percentage point. However, this is offset by crowding-out of the comparatively expensive MA program. A cost of this subsidy is that it shrinks the labor force. But the resulting loss in tax revenue is fairly small, as IC is taken up by children of low productivity. The most dramatic increase of IC is among parents with low SS benefits because it allows them to exit MA. In terms of wealth, we see that savings at age 70-75 decrease, and more so at the lower end of the wealth distribution. This is because the subsidy diminishes the need for self-insurance as it renders family-provided care cheaper.

Over the short run, the welfare gain for unborn agents under the veil of ignorance from the IC subsidy is large: An unborn agent has to be offered a permanent 0.46% increase in consumption in the baseline scenario (for the entire future, to all agents in her family, and in all states of the world) to be indifferent to a world in which the IC subsidy is in place. It remains substantial, but decreases somewhat, from a long-run perspective. The difference is driven by the fact that savings decrease, and so future new-borns are born into families with poorer parents. We conclude that the positive effects working through the insurance, Medicaid, and family-commitment channels override the negative effects that the IC subsidy has through the tax-wedge channel. The distortionary effects through the tax-wedge channel are relatively small, since largely low-productivity kids take up the subsidy whose labor-supply distortions are low to start with. The gains through the other channels are large, again precisely because the policy successfully targets poor families.

It is interesting to compare this unconditional IC subsidy to one which is conditional on the caregiver being of working age,  $s_{ic}^k \uparrow$ . The care arrangements change in the same way as before, because the payoffs of the marginal caregivers are affected in the same way. Effects on the government budget and thus required tax changes are small. But the direct cost of the subsidy is only about half of that before, due to the fact that about half of all informal caregivers are of retirement age. This policy turns out to be budget-neutral. Despite its lower cost, welfare gains of the restricted IC subsidy are smaller. The reason is that in our model, the IC subsidy for the disabled husband works like an annuity that provides insurance against longevity risk to the elderly, which is the only feature of  $s_{ic}$  that is absent from  $s_{ic}^k$ .

In the third experiment,  $s_{pp} \uparrow$ , an annual subsidy of \$11,460 is given to all PP of formal care (without a means test).<sup>52</sup> Note that the support by this subsidy is relatively generous,

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<sup>51</sup>  $\Delta\tau_{inc}$  is also affected by changes in savings behavior, but the labor-supply channel dominates in our counterfactuals. Changes in the government budget stemming from payments for medical shocks are negligible; such payments account for only 0.1% of tax revenue in our economy.

<sup>52</sup> This subsidy is also paid to the measure  $s_m(1 - \iota)$  of males receiving formal care in parent households with

covering more than half of basic care services (\$21,600). The subsidy doubles the prevalence of PP care with the increase being driven almost exclusively by a reduction in IC. This is a stark example of what we may miss when ignoring the family margin: The outflow from IC (19.9 percentage points) is about 5 times that from MA (3.5 p.p.). We find that the decrease in IC occurs especially in families with medium opportunity costs, allowing many informal caregivers to stay in the workforce and giving rise to additional tax revenue. However, the PP subsidy leaves the MA population almost unchanged since for them paying privately for a nursing home is still too expensive. Thus, cost savings from MA are more modest than under the IC subsidy. Overall, this subsidy is much more expensive than the IC subsidy. Savings are reduced, especially in richer families. Lower parent wealth together with the higher tax rates means that children entering the economy enjoy only minor welfare gains in the long run. Also the short-run gains are smaller than for the IC subsidy, as the FC has weaker effects through the insurance, Medicaid, and family-commitment channels. The gains through the labor-wedge channel are not enough to overcome these.

In the fourth type of policy, we combine the IC subsidy,  $s_{ic} \uparrow$ , and the PP subsidy,  $s_{pp} \uparrow$ . According to the model, such a policy would leave IC almost unchanged due to two offsetting effects. On the one hand, more low-productivity kids provide IC due to the caregiver allowance. On the other hand, families with medium-productivity kids move from IC to PP. The two effects are offsetting, leaving income-tax revenues almost unaffected. This mix of subsidies decreases wealth by more than any of the other policies since it provides better insurance for all families. Thus, this policy allows for increased current consumption and is very popular in the short run. In the long run, the ex-ante CEV is about half of its short run counterpart because savings decrease and the tax rate increases. This policy provides the benefits of the IC and the PP subsidies discussed above.

### 5.3 Changes to Medicaid

Next, we use the model to study the consequences of an expansion or a contraction of the Medicaid program on the economy. In reality, changes to the MA program would be implemented by making eligibility criteria to qualify for MA more or less stringent. However, since in our model MA uptake is a choice we model changes to the MA program by alterations to the consumption floor. We base the magnitude of the changes to be in the ballpark of the existing variation in MA reimbursement rates between US states. Finally, we evaluate the policy option in which a

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$s = 0$ .

cut to the MA program is accompanied by an introduction of both IC and PP subsidies.

In the counterfactual policy experiment  $MA \uparrow$ , we study a 20% increase to  $C_{ma}$ . We assume that this increase in  $C_{ma}$  is matched by a 20% increase to  $y_{ma}$  (government expenditures on non-care consumption per MA recipient), which amounts to an 8.3% (or 3,088\$) increase in the MA reimbursement rate.<sup>53</sup> As Table 9 shows, the policy reduces both IC and PP by about 7%. As MA finances two-thirds of all formal care in the counterfactual this policy is relatively expensive. The additional labor supply helps only little to overcome the increase in MA expenditures as primarily families with low-productivity children respond who pay fairly low taxes when back in the labor force. There are also fewer PP of nursing homes and so additional costs are shifted to the public sector. The need for self-insurance at the low end of the wealth distribution becomes much less pressing, thus savings decrease. In the long-run, this is the least popular policy option among all we consider, and even in the short run it leads to only a modest increase in welfare.

Second, consider the opposite policy,  $MA \downarrow$ , in which we decrease both  $C_{ma}$  and  $y_{ma}$  by 20%. The effects are practically the mirror image to the previous scenario. Both IC and PP increase. The existence of the family as an informal-insurance network buffers the loss in public insurance as children provide additional financial support to PP parents ( $g^k > 0$ ). Furthermore, cost savings are fairly substantial and so the tax rate decreases. As a result of the additional savings and the lower tax rate, there is actually a small welfare gain from a cut in Medicaid in the long run. But the policy is the least popular in the short run, driven by the large losses of the oldest and poorest parents, as we will see in the next section, where we break down the welfare of current generations.

If the US government were to reduce MA our results suggest that it should be accompanied by an informal and formal care subsidy. The last row of Table 9 shows the effects of combining the policies  $MA \downarrow$  and IC and PP subsidies of the same magnitude as before. This combined policy decreases MA substantially, especially among low-income households. IC increases somewhat and is now primarily provided by low-productivity children. PP increases by a lot and a relatively substantial fraction of formal care costs are covered by children (10.3% compared to 2.0% under the status quo). The increase in the tax rate is modest, as gains from MA savings are large. There are almost no effects from changes in the labor supply on the government budget. Despite the cut in MA this combined policy brings about a large welfare gain even in the short run and thus looks like a very attractive policy option.

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<sup>53</sup>Cutler & Sheiner (1994) report the standard deviation of MA reimbursement rates to be about 10% of average nursing-home costs.



## 5.4 Welfare of current generations

So far we have focused on welfare implications for kids born into the economy. But what about the welfare of generations that are alive at the time of the reform? Policies that make large parts of the electorate worse off are unlikely to garner political support and would thus hardly be feasible.

Table 10 provides consumption equivalent variations (CEVs) for different sub-groups of the current population, ranked by overall desirability of the reforms. We present averages over CEVs within each group. Support for policies within each group in the table is remarkably uniform: We find that whenever the average CEV of a group is positive (negative), close to 100% (0%) among members of this group have a positive CEV and would thus vote for the policy. The table can thus be read as a snapshot of the political economy for policies.

The ranking of the policies follows closely the one we find from the ex-ante CEVs. Furthermore, both parent and kid generations agree on this ranking. The most preferred policy option is to offer both subsidies. When considering the effects of the subsidies separately we can see why. The IC subsidy is especially beneficial to low-productivity ( $\underline{\epsilon}$ ) parents but less so for high-productivity ( $\bar{\epsilon}$ ) ones, and vice versa, for the PP subsidy. When making the same comparison among children, we see that for the IC subsidy low-productivity kids also have a much larger gain than high-productivity kids, but the difference in terms of the PP subsidy is minor, primarily due to the higher tax rate of this subsidy. Combining both subsidies with a cut to MA yields surprisingly large gains in welfare despite the unpopularity of cutting MA. When only shrinking MA, there are welfare losses across the board. Unsurprisingly, low-productivity parents are especially hard-hit. These parents had made their savings plans counting on insurance by Medicaid and thus lack self-insurance through wealth. Informal caregiving does not increase enough to counter this effect; note that these poor elderly individuals have little to offer in exchange for care. Consumption drops as agents now have a larger need to self-insure (which is why wealth increases). The decrease in the payroll tax is insufficient to make up for the losses.

## 5.5 IC elasticities vis-a-vis the empirical literature

The model predicts fairly large behavioral responses of single disabled individuals to changes in relative prices of care. A back-of-the-envelope calculation tells us that per 1,000\$-increase

Table 10: Welfare of currently alive generations (CEV in %)

LTC policy	all	parent	kid	parent ( $\underline{\epsilon}$ )	parent ( $\bar{\epsilon}$ )	kid ( $\underline{\epsilon}$ )	kid ( $\bar{\epsilon}$ )
both $\uparrow$	1.59	2.75	1.15	3.18	2.36	1.39	0.90
MA $\downarrow$ , both $\uparrow$	1.35	2.32	0.97	2.36	2.28	1.13	0.82
$s_{ic}$ $\uparrow$	1.01	1.76	0.72	2.44	1.16	1.01	0.43
$s_{ic}^k$ $\uparrow$	0.74	1.28	0.53	1.68	0.92	0.73	0.33
$s_{pp}$ $\uparrow$	0.65	1.19	0.45	0.84	1.51	0.40	0.49
MA $\uparrow$	0.40	0.78	0.26	1.35	0.27	0.41	0.10
MA $\downarrow$	-0.46	-0.88	-0.30	-1.62	-0.22	-0.50	-0.11

Average over consumption-equivalent-variation measures by subgroups, ranked by desirability for the entire population ('all'). Parent and kid generations are divided into two productivity groups:  $\underline{\epsilon}$  is the productivity below the median and  $\bar{\epsilon}$  is productivity above the median. For each group, CEVs are weighted by the ergodic measure over families in the baseline model. Whenever the CEV for a group is positive (negative), we find that close to 100% (0%) of the group has a positive CEV and is thus in favor of the policy measure.

in the IC subsidy, there is a reduction of 6.8% in formal care.<sup>54</sup> The PP subsidy leads to a 1.7% increase in formal care per 1,000\$. How large are these responses compared to what we know from empirical work? Unfortunately, there are no estimates for the US for IC or PP subsidies, simply because such policies have never been tried in the US.

However, there is a number of studies that exploit variation in the generosity of the MA program, both across time and across US states. The estimates by Cutler & Sheiner (1994), who exploit cross-state variation, imply that a decrease in the MA reimbursement rate of 10% of the average nursing-home cost leads to 11% lower nursing-home use.<sup>55</sup> This is close to our counterfactual MA  $\downarrow$ , where a reduction of MA reimbursement rates by 8.3% ( $\Delta y_{ma}/(y_{ma} + p_{bc})$ ) leads to a 10% decline of formal care. Hoerger et al. (1996) find that lowering MA reimbursement by 10,000\$ per patient (in a lifetime) reduces nursing-home entry by about 15%. This again lines up quite well with our model prediction, when considering that disabled individuals typically stay in nursing homes for several years. Garber & MaCurdy (1993) find that nursing-home use is quite price-sensitive, studying the nursing-home discharge hazard at 20 days (when co-payments increase) and at 100 days (at which point Medicare stops paying). However, other studies fail to find significant effects of MA rules on nursing-home use, such as Grabowski & Gruber (2007), who exploit time variation in state MA rules; Norton & Kumar (2000), exploiting time variation in spousal impoverishment rules; and Reschovsky (1996),

<sup>54</sup>Formal care (FC=MA+PP) is 55.5% in the baseline calibration, being reduced to 38.9% in  $s_{ic}$   $\uparrow$ , a 29.9% change. Dividing this number by the subsidy amount, 4,375\$, one obtains the elasticity, 6.8%.

<sup>55</sup>To be precise, they estimate that decreasing the MA reimbursement rate by 4,60\$ (which amounts to 10% of the average nursing-home cost they report) entails a drop in the nursing-home utilization rate of 1.7 percentage points (relative to a mean of 15%).

who finds no effect of MA income and asset tests on nursing-home entry. We conclude that the elasticity of care choices from our counterfactuals  $MA \uparrow$  and  $MA \downarrow$  are at the upper end of the empirical estimates.

## 5.6 Discussion

Are our welfare results robust to features of reality that our model omits?

One concern is that in families with multiple children, children may interact strategically in the care decision.<sup>56</sup> In our setting, the kid generation makes up one decision unit. We thus implicitly assume that all children in the family share the marginal caregiver's opportunity costs of care. This resource pooling among siblings implies transfers among siblings, but we do not have information on such transfers in our data. However, the fact that parents favor caregiving children over their siblings when giving inter-vivos transfers and bequests shows that indeed substantial shifting of economic resources from non-caregiving to caregiving children takes place within the family. Thus we see our modeling strategy as a useful first approximation and leave more careful study of such interactions in a dynamic setting for future research.

A second concern regards the decision-making process in the family. In reality, parents may lose their say in the bargaining process when they have dementia and/or become extremely frail. We argued in Section 2.5 that most disabled persons do not seem to be in this situation; but if this state is perceived as especially risky, it might influence previous decisions significantly. Our current framework is too complex to accommodate more states of disability, which would be necessary to model a loss of decision-making capabilities with frailty. But we think that doing so is a promising avenue for future research. Having different levels of severity of disability, some linked to the loss of decision power, may help to explain that nursing-home use is increasing in the degree of frailty. This could go both through the bargaining channel and a potential technological advantage of nursing homes when it comes to the most severe forms of disability. Also, such a model may have parents with mild states of dependence spend down wealth more slowly, thus helping to address the retirement-savings puzzle present in our model. In terms of policy implications, however, our results should hardly change: the insurance, tax-distortion and MA channels are not affected, only the positive effects of IC subsidies that go through the family-commitment channel would be somewhat weakened.

Third, one may wonder what the omission of an explicit formal-home-care (FHC) option

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<sup>56</sup>For literature on “gaming” among siblings, we refer the reader to Sovinsky & Stern (2014) and the references therein.

means for the interpretation of our results. We argue that *qualitatively*, subsidies for FHC would act in the same way as for nursing-home care (NHC). In terms of the labor-wedge channel, a FHC subsidy is desirable since it reduces existing labor-supply distortions, just as a NHC subsidy is. In terms of the insurance, Medicaid and family-commitment channels, though, the FHC subsidy (just as the NHC subsidy) should be dominated by the informal-care subsidy, since it is less likely to be taken up by the poorest families. Assessing the merits of FHC subsidies *quantitatively* would require a theory of why some people choose FHC and others NHC; we leave this for further research.

Another potential omission of the model is that informal caregivers may lose human capital in addition to the contemporaneous opportunity costs of caregiving that we consider in our model. But this omission is probably not as large of a concern as one may first think. Heavy-helping caregivers are 48 years on average, and thus close to the end of their careers, and are also typically of low education (only 18% have a college degree). An arguably bigger concern is that a caregiver gives up the match quality of her job (i.e. she may lose a position that fits her skills well and that is hard to recover after a prolonged absence). Our model implicitly assumes that the IC policy is accompanied by some form of guarantee to return back to the same job at the same wage, as is the case in Germany. However, even with such a policy in place, there may be long-run wage losses to caregivers that our model cannot capture, such as losses in social-security pension benefits. A short-cut to address these issues in our model is to increase the opportunity cost from caregiving by lowering the gender-earnings gap, which is encoded in the parameter  $\beta$ . This scenario is also of interest per se in view of two trends: a rising female labor-market participation rate and the narrowing of the gender-earnings gap.

Table 11: High opportunity cost (low  $\beta$ )

LTC policy	IC	MA	PP	$\Delta\tau$	p25	p50	p75	short run	long run
new baseline	34.7%	37.0%	28.3%		\$52K	\$186K	\$399K		
$s_{ic} \uparrow$	47.3	29.0	23.6	0.12	45	174	387	0.33	0.18
$s_{ic}^k \uparrow$	47.5	28.8	23.7	-0.00	48	178	390	0.24	0.15
$s_{pp} \uparrow$	15.7	31.7	52.5	0.21	49	170	373	0.14	0.00
both $\uparrow$	31.8	24.7	43.5	0.25	41	160	365	0.50	0.22
MA $\uparrow$	31.1	42.5	26.4	0.20	41	176	393	0.08	-0.07
MA $\downarrow$	37.4	32.0	30.6	-0.18	67	196	404	-0.17	-0.00
MA $\downarrow$ , both $\uparrow$	32.8	21.3	45.1	0.15	49	165	368	0.38	0.20

Counterfactual policy experiments starting from a baseline with higher caregiver opportunity cost: lower  $\beta$  from 0.66 to 0.57, leaving all other parameters as under the calibrated baseline. Table 15 in the Online Appendix presents all results for the various policy experiments in this alternative specification. All columns are as defined in Table 9.

In Table 11, we consider a scenario in which we lower  $\beta$  from 0.66 to 0.57. This amounts to a two-third reduction of the gender-earnings gap.<sup>57</sup> We maintain all other parameters as in the baseline calibration. Taking this scenario as the new baseline, we then carry out the same counterfactuals as for the status quo (using the same changes to the subsidy and MA parameters as before). Table 11 shows the most important results. The level of IC in the new baseline is about 10 percentage points lower. The behavioral changes and the welfare effects induced by the different policies with respect to the new baseline are somewhat muted, but always go in the same direction as before. Thus, our results are robust.

There are also other trends that will make the situation for governments more challenging than our model has it: rising divorce rates, fast-rising nursing-home prices, and an increasing dependency ratio. For example, in present-day China most families have only one child and thus two sets of elderly parents depend on only one young family. Our model has nothing to say about how such conflicts are resolved. A rigorous treatment of such trends is clearly of interest, but is beyond the scope of the current paper.

## 6 Conclusions

We propose a dynamic non-cooperative framework for LTC decisions of families and use it to evaluate LTC policy options for the US. A key innovation is the availability of informal care, which is determined through intra-family bargaining. Our paper provides three important insights: First, the family margin matters strongly when it comes to evaluating LTC policies. Second, a non-means-tested IC subsidy does particularly well in insuring an aging population and in reducing Medicaid costs, labor supply distortions and the loss to tax revenue being rather small. Third, old-age health expenditures become less risky with the introduction of a family channel as LTC can also be produced at home.

We conclude by briefly discussing practical effects of the subsidies considered that go beyond our modeling 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. to wealthy individuals who can easily afford to pay for a private nursing home. 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 (that problem, however, may be already present with Medicaid). But, an increase in nursing-home demand from private

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<sup>57</sup>We define the gender-earnings gap as  $\beta/(1 - \beta) - 1$ , thus it decreases from 100% (baseline) to 33% (low  $\beta$ ).

agents may plausibly lead to more competition among formal-care providers. This would help to control the price of care, giving a rationale for supporting such a subsidy.

Our analysis tells us that an informal-care subsidy is an attractive policy option. However, such a subsidy requires a disability-certification scheme in order to deter families from untruthfully claiming disability; this form of moral hazard is less of an issue when the benefit is tied to entry into a nursing home. There are certainly costs and difficulties of implementing such tests. However, they are probably not much higher than those associated with the means tests currently in place, which are also subject to moral hazard. A disability-certification scheme 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, where a public disability-certification scheme was put in place when public LTC insurance was introduced.

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## A Theory appendix

### A.1 Details on the HJBs and boundary conditions

We define the diagonal elements of the income hazard matrix as  $h_\epsilon(\epsilon_i, \epsilon_i) = -\sum_{j \neq i} h_\epsilon(\epsilon_i, \epsilon_j)$  for notational convenience. The jump terms in the HJB, Equation (3), are then

$$\begin{aligned}
 J^i(z) = & \underbrace{\sum_{m=1}^{N^\epsilon} h^\epsilon(\epsilon^k, \epsilon_m) V^i(\cdot, \epsilon_m, \epsilon^p, j^k)}_{\text{kid's productivity risk}} + \underbrace{(1-s)\delta_s(z)[V^i(a^k, a^p, 1, \cdot) - V^i(z)]}_{\text{LTC risk}} \quad (21) \\
 & + \underbrace{\delta_d(z)[(\alpha^p)^{\mathbb{I}\{i=p\}} Z(a^k + a^p, \epsilon^k, j^k) - V^i(z)]}_{\text{death risk}} \\
 & + \underbrace{\delta_m(z) \int V^i(a^k, \max\{a^p - M, 0\}, \cdot) dF_m(M)}_{\text{medical-spending shocks}},
 \end{aligned}$$

where  $\mathbb{I}\{\cdot\}$  is the indicator function and where  $Z(a^k, \epsilon^k, j^k)$  is the value for the kid generation when parents are dead and kids have wealth  $a^k$ , productivity  $\epsilon^k$ , and age  $j^k$ .  $Z$  obeys the following HJB, which is standard for consumption-savings problems:

$$\begin{aligned}
 \rho Z(a^k, \epsilon^k, j^k) = & Z_j(a^k, \epsilon^k, j^k) + \max_{c^k \geq 0} \left\{ u^k(c^k) + [y(\epsilon^k, j^k) + r a^k - c^k] Z_a(a^k, \epsilon^k, j^k) \right\} \quad (22) \\
 & + \sum_{m=1}^{N^\epsilon} h^\epsilon(\epsilon^k, \epsilon_m) Z(a^k, \epsilon_m, j^k),
 \end{aligned}$$

where subscripts to  $Z$  denote partial derivatives. At age  $j_{ret}$ , the kid generation splits up into  $(1 + \nu)$  new parent households and is matched to a new kid with the same productivity and zero wealth. This imposes the following boundary condition:

$$Z(a, \epsilon, j_{ret}) = (1 + \nu) V^p\left(0, \frac{a}{1 + \nu}, 0, \epsilon, \epsilon, j_{ret}\right) \quad \forall a, \epsilon. \quad (23)$$

Finally, the fact that parents die with certainty at  $j_{dth}$  imposes the boundary conditions

$$V^i(a^p, a^k, s, \epsilon^k, \epsilon^p, j_{ret}) = (\alpha^p)^{\mathbb{I}\{i=p\}} Z(a^k + a^p, \epsilon^k, j_{ret}) \quad \forall a^p, a^k, s, \epsilon^k, \epsilon^p, \quad \text{for } i \in \{k, p\}. \quad (24)$$

## A.2 Government: Taxation and budget constraint

In all of the following,  $\lambda(z)$  denotes the stationary measure of families over the state space. Kids with dead parents are included in this measure, making the obvious adjustments. The government's budget constraint is as follows:

$$\begin{aligned}
& \underbrace{\int [T^p(z) + T^k(z, h(z)) + \nu T^k(z, 0)] d\lambda(z)}_{\text{tax revenue}} \tag{25} \\
&= \underbrace{\int s(h(z)s_{ic} + (1-h(z))[(1-m(z))s_{pp} + m(z)(p_{bc} + y_{ma})]) d\lambda(z)}_{\text{LTC spending on widows}} \\
&+ \underbrace{\int (1-s)s_m(z)[\iota s_{ic} + (1-\iota)s_{pp}] d\lambda(z)}_{\text{LTC spending on husbands}} + \underbrace{\int y_p(\epsilon^p)n^p(j^p, \epsilon^p, s) d\lambda(z)}_{\text{SS benefits}} \\
&+ \underbrace{\int \int [\max\{M - a^p, 0\} dF_m(M)] \delta_m(z) d\lambda(z)}_{\text{means-tested benefits covering medical expenditures}} + \underbrace{G}_{\text{other expenditures}}.
\end{aligned}$$

Tax revenues consist of the sum over parent's and kid's tax payments, weighted by the stationary measure  $\lambda$  over families. Note that the  $\nu$  infra-marginal kid households never give informal care, but for the marginal kid household the IC decisions  $h(z)$  matters. Government spending consists of the following items: (i) LTC subsidies and Medicaid spending for widows in households with  $s = 1$ , which depend on the IC and MA decisions,  $h$  and  $m$ , (ii) LTC subsidies to disabled husbands in households with  $s = 0$ , (iii) spending for households that do not have enough wealth to pay for medical shocks  $M$ , and (iv) other government expenditures,  $G$ , including social-security benefit payments (since we do not consider changes to demography in the counterfactuals and the labor-productivity process is exogenous, SS benefit payments are constant across all scenarios).

## A.3 Equilibrium Definition

A recursive equilibrium consists of value functions for the kid,  $V^k$ , the parent,  $V^p$ , kids with dead parents,  $Z$ ; policy rules for the kids,  $\{g^k, c^k\}$ , the parent,  $\{g^p, m, c^p\}$ , kids without parents,  $\tilde{c}^k$ , an informal-care rule,  $h$ , and an informal-care transfer function,  $Q^*$ ; prices  $\{w, p_{bc}\}$ ; a government policy,  $\{s_{ic}, s_{pp}\}$ ; and a stationary measure  $\lambda(z)$  over families such that:

1. Both kid and parent are best-responding to the other, i.e. the value functions  $V^k$  and  $V^p$

satisfy (3)- (12) taking as given the policy rules by the other player. Also, the maxima in (5)- (7) are attained by the policies  $c^k, c^p, m, g^p, g^k$ .

2. The value function  $Z$  satisfies (22), the maximum being attained by  $\tilde{c}^k$ .
3. The value functions  $V^p, V^k, W$  jointly satisfy Equations (21)-(24).
4. The informal-care decision rule,  $h$ , and the transfer rule,  $Q^*$ , are the Nash-bargaining solution between kid and parent, i.e. they satisfy (10)-(12).
5. Firms maximize profits given prices, i.e.  $L_y$  and  $L_f$  attain the maximum in (13) and (14), respectively.
6. Markets clear, i.e.

$$\int y(j^k, \epsilon^k)[1 + \nu - (1 - \beta)h(z)]d\lambda(z) = L_y + L_f \quad (\text{labor})$$

$$G + \int [c^p + c^k + r(a^p + a^k) + my_{ma} + \delta_m(z) \int M dF_m(M)]d\lambda(z) = A_y L_y \quad (\text{consumption good})$$

$$\int s[1 - h(z)] + (1 - s)s_m(1 - \iota)d\lambda(z) = A_f L_f \quad (\text{formal care})$$

7. The government's budget is balanced, i.e. (25) holds.
8.  $\lambda$  is the ergodic density over families given the law of motion induced by optimal decisions.

In the game between parents and kids, we restrict attention to the equilibrium that arises as the limit of a finite dynasty. A *finite dynasty* is one in which there exists a final parent generation that has no kids but faces otherwise the same physical environment as the other generations.