Medicaid's Long-Term Care Programs and the Macroeconomy

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Abstract

In the face of an ageing population, the demand for long-term care services is expected to increase in the United States for the next several decades. The Medicaid program is the largest payer of formal long-term care in the United States, and since 1999 there has been a growing effort at the federal level to increase coverage for formal care in the home by granting states more authority over their programs' eligibility rules. However, benefit expansions for the aged population have yet to be widely implemented as state-level policy makers cite concerns over the cost of the programs. In this paper, I calibrate an overlapping-generations model to the U.S. economy and quantify the fiscal and welfare implications of the eligibility rules that govern Medicaid's care programs. I find that the costs associated with expanding home care benefits are partially mitigated by individuals substituting out of institutional care. The substitution is most prevalent among elderly individuals with marginally higher incomes that gain access to Medicaid through a spend-down rule. Finally, expanding home care benefits to the aged population induces a heterogenous response regarding informal care provision that depends on household demographics.

JEL Classification: E21, E62, H51, I18, I38, J26

1 Introduction

Long-term care (LTC)[1] encapsulates the range of medical and social services designed to aid individuals with disabilities or chronic care needs. In 2012, 8.4 million individuals in the U.S. received care in a formal setting either in the home or in an institution (Harris-Kojetin L and Park-Lee E (2013)). An additional 34.2 million individuals reported providing un-paid, informal care, to an adult over the age of 50 (Hunt and Reinhard (2015)). In 2014 the United States spent $313 billion (2.0% of GDP) on formal long-term care while the estimated economic value of informal care was $346 billion.[2] The demand for long-term care is expected to rise as the share of the U.S. population aged 65+ is projected to increase from 15% in 2015 to 23% in 2060 (U.S. Census). This demographic shift will place a growing amount of pressure on both informal caregivers' time and the public programs that provide financing for formal care. Medicaid is now the largest payer of long-term care and pays for 52% of all expenditures.[3] Medicaid provides home and institutional long-term services and support to qualifying individuals. Individuals qualify for benefits by meeting financial and functional (health) eligibility requirements. While institutionalized care is one of Medicaid's mandatory benefits, coverage of home and community based services (HCBS) is an option left up to the states. Since 1999, the federal government has renewed its effort to promote the availability of home and community based care at the state level by giving states more authority over their care programs' eligibility rules and increasing federal matching funds for home care expenses. However, a 2016 analysis of states' long-term care programs, conducted for the Department for Health and Human Services, found that home care benefits are still

[1] Also known as Long-term services and support (LTSS)

[2] Estimate for informal LTSS follows the procedure in Arno et al. (1999). $346=(34.2 m)*(17.9 hrs./wk.)*(52 wks/year)*($10.87), where $10.87 is the median hourly earnings of a home health aid in the U.S. in 2016 (BLS). Arno et al. (1999) estimated the economic value at $196 billion in 1997 and Reinhard et al. (2015) estimates it at $470 billion in 2013.

[3] In this paper I focus on long-term care episodes that last longer than 100 days. Medicare will pay for some skilled nursing or home care for aged individuals for up to 100 days following a qualified acute care hospitalization. For this reason I omit Medicare expenditures from the statistics.

not broadly available to the aged population. The tepid rate of benefit expansion for the aged population stems from policy officials' concerns over the increase in costs associated with more generous eligibility rules (Casanova et al. (2016)). In this paper, I use a calibrated structural model to quantify the welfare and fiscal implications of the eligibility rules that govern Medicaid's long-term care programs for the aged population.

In 1983, states gained the ability to apply for waiver programs through section 1915(c) of the Social Security Act (SSA). These waivers allow states to offer home and community-based care to individuals with an institutional level-of-care need. Waiver programs became more common following the Olmstead v. L.C. Supreme Court decision in 1999 that mandated, under certain conditions, home care benefits be available for mentally disabled individuals. In 2005, following the passage of the Deficit Reduction Act, states were permitted to extend home care benefits to individuals with less than an institutional level-of-care need through a State Plan Amendment (section 1915(i) of the SSA). In 2010, the Affordable Care Act continued to promote home care programs through the Community First Choice program (section 1915(k) of the SSA) that increased federal matching funds for home care expenditures. Following these expansions, Medicaid's share of aggregate long-term care expenditures has increased by 11 percentage points since 1999. However, the majority of the increased spending has been focused on individuals with developmental, intellectual, and physical disabilities. As long-term care expenditures make up one-third of all Medicaid dollars and the program accounts for 16.8% of states' self-funded general fund budgets, it is important for policy makers to understand how expanding home care benefits to the aged population would impact care utilization and the size of the Medicaid program (National Health Expenditures, 2014).

Expanding home care benefits is often referred to as reducing the institutional bias in the Medicaid program. The argument for doing so is twofold. First, survey evidence finds that aged individuals prefer to remain in their home/community rather than enter

an institution (Wolff et al. (2008)). Second, Medicaid's mandatory nursing home benefit absent a benefit for home care may result in over-utilization of nursing home beds among the Medicaid population. As home care benefits are financially less costly, a reduction in nursing home beneficiaries as individuals substitute out of institutional care and into formal home care would reduce the cost of Medicaid's long-term care programs. Using Medicaid claims data, Guo et al. (2015) found that a $1,000 increase in home care expenditures is associated with a $351 reduction in nursing home expenditures at the state level.

In this paper, I calibrate an overlapping-generations model and quantify the welfare and fiscal implications of the eligibility rules concerning Medicaid's long-term care programs. Specifically, I focus on the functional eligibility margin that pertains to an individual's health status. I do this because it is the most common policy margin through which Medicaid's care programs extend benefits to new demographic groups. While states have the authority to vary their financial eligibility rules, they are often constrained by federal regulations.[4] As such, the functional eligibility rules are the relevant policy margin regarding Medicaid's provision of home and community based care to the aged population. In the model, a household is comprised of a retired parent and an adult child. The parent faces long-term health risk in old age and makes a decision regarding their care setting. Individuals can receive care in a nursing home or in their private residence. Home care can be provided informally by the parent's adult child or formally via a paid home health aid. The parent's health and financial status determines their eligibility for Medicaid benefits, which differ by care setting (institutional care vs. home care). To my knowledge, this is the first paper to address the variability in care needs in a structural setting that distinguishes between the three aforementioned care settings. This approach allows me to incorporate Medicaid's functional eligibility rules and discuss their impact on care utilization, Medicaid expenditures, and informal care provision.

I find that the cost of expanding home care benefits to marginally healthier retirees

[4]Section 1915(i) of the Social Security Act limits the income threshold for home care benefits to 150% of the federal poverty line. States are free to lower the threshold but cannot exceed it.

is partially offset by a substitution across care settings. In my calibrated model, I find that nursing home expenditures fall by $808 for every additional $1,000 spent on formal home care. Critically, the cost reduction stemming from substitution across care settings is driven by marginally higher income elderly that gain access to Medicaid benefits through the optional spend-down rule. Absent this eligibility pathway, this cost reduction channel may be limited. This cost reduction is larger than the one found in Guo et al. (2015) for two reasons. First, I focus exclusively on the aged population and do not address long-term care services provided by Medicaid to the non-aged disabled population. Second, the counterfactual exercise conducted in this paper corresponds to a targeted expansion among the heaviest users of Medicaid financed nursing homes. I also find that inducing a larger share of the elderly population to remain in the community raises the government's spending on other non-Medicaid welfare programs that serve the indigent population. The reform's impact on tax revenue is modest. The program's expansion reduces per-capita informal care provision among those households directly affected by the reform but induces higher rates of informal care among private-pay households. From a behind the veil perspective the expansion's benefit to the median new retiree and median newly born adult child are 0.9% and 0.3% of lifetime consumption respectively.

The rest of the paper is organized as follows. Section 2 provides a brief overview of the related literature. Section 3 introduces the Medicaid program and its role in the long-term care market. In this section I also use data from the National Long-Term Care Survey (NLTCS) to document patterns in care utilization among the aged population in the United States. In section 4 I develop a structural model and discuss its benchmark calibration. Section 5 presents the results of the counterfactual policy exercise. Section 6 concludes.

2 Literature Overview

To address the welfare and fiscal implications of long-term care health policy I combine the recent macro-health literature with the long-standing empirical literature focused on individuals' long-term care decisions. It is been well documented that aged individuals prefer to remain in their home/community rather than enter an institution. Additionally, elderly community residents prefer to receive care from their spouse or other family members rather than from a home health aid (Wolff et al. (2008)). The direct welfare effects of allowing individuals the option to remain in their home was one of the principle arguments that led to the passage of the 1999 Olmstead v. L.C. Supreme Court decision that mandated states provide home care benefits to the disabled population. In addition to the care recipients themselves, changes in public policy concerning long-term care will also have effects on informal caregivers. The cost of providing informal care is substantial. In 2004, the average caregiver provided 36 hours of care per week and provided assistance with 4.2 IADLs and at least one ADL (NLTCS).[5] Unsurprisingly, a large proportion of caregivers find their tasks difficult and half claim to have no choice in their caregiving responsibilities (Hunt and Reinhard (2015)). Outside of the care duties themselves, providing informal care affects caregivers leisure time, labor supply, and earnings. The evidence suggests that caregivers reduce their labor supply on the intensive margin and that labor force participation appears to only be affected amongst the caregivers providing the most intensive levels of care (Ettner (1995), Lilly et al. (2007), and Løken et al. (2014)).

The Federal government's push towards broader coverage of home and community-based care through the Medicaid program has been met with concerns over the financial costs of doing so at the state level (Casanova et al. (2016)). Muramatsu et al. (2007) found that increasing states' funding for home health care reduced the probability that an elderly

[5] ADLs include: bathing, dressing, grooming, mouth care, using the toilet, walking, climbing stairs, eating, and transferring from a bed to a chair. IADLs include: shopping, cooking, managing medications, using the phone, housework, laundry, driving or using public transportation, and managing finances.

individual would enter a nursing home. Using state-level expenditure data, Kaye et al. (2009) finds evidence that an increase in home and community-based care spending is associated with short term increases in total long-term care expenditures but long-run cost savings. Guo et al. (2015) used Medicaid claims data to study the causal impact of increased Medicaid home care spending on institutionalized care utilization and expenditures. They found that for every $1,000 spent on home care in the Medicaid program, 2.75 days of nursing home use were avoided and total nursing home expenses on those over the age of 65 were reduced by $351. This paper extends the literature by developing a dynamic structural model of individuals' long-term care decisions in the presence of nursing home care, formal home care, and informal care. I find quantitatively similar results.

To fully capture the effects of changes in public policy on care utilization patterns, it is important to consider all forms of long-term services and support (LTSS). There is an extensive literature on the substitutability of various forms of LTSS (nursing homes, formal home care, and informal care).[6] The main findings suggest that formal paid home care is a substitute for informal care provided by family. Bonsang (2009) finds that as a care recipient's health declines, the substitutability of informal or formal home care for formal nursing services decreases. This is consistent with the fact that as health conditions worsen, the need for more technical medical treatment increases. However, informal caregivers have been documented providing even basic medical care (such as injections, feeding tubes, and catheter care), suggesting that it is not until care needs are quite severe that formal nursing care becomes a necessity (Hunt and Reinhard (2015)). By exploring the relationship between informal and nursing home care, Mommaerts (2016) finds that states with more restrictive Medicaid eligibility rules for nursing home care exhibit higher rates of co-habitation between elderly adults and their children (a proxy for informal caregiving).[7]

[6]Ettner (1994), Pezzin et al. (1996), Van Houtven and Norton (2004), Charles and Sevak (2005), Grabowski and Gruber (2007), Muramatsu et al. (2007), Bolin et al. (2008), Bonsang (2009), Goda et al. (2011), and Mommaerts (2016)

[7]Specifically, Mommaerts (2016) considers the variation in states' spend-down rules that permit higher

A growing body of literature is concerned with the welfare and macroeconomic implications of health policy and the long-term care risk faced by the elderly population.[8] Barczyk and Kredler (2017) is most closely related to this paper. They study the impact of formal care and informal care subsidies on welfare and the size of the Medicaid program. Their main contribution was the inclusion of informal care into the agent's choice set. They calibrate a dynamic non-cooperative model of long-term care decisions that is able to replicate a large variety of care arrangements within the family structure. Agent's behavioral response, regarding informal care utilization, following a change in care subsidies is quantitatively significant. They find that welfare can be improved when both formal and informal care subsidies are raised even when paired with a cut in Medicaid benefits. For their purpose, they group formal home care and nursing home care together and treat the need for care as binary. In this paper, I expand along these two dimensions by distinguishing between formal home care and nursing home care and allowing individuals' health status to vary beyond two states. This is important as I am interested in the affects of Medicaid's eligibility rules which differ by care setting and the health status of the individual. Moreover, quantifying the effects of a Medicaid expansion necessitates a finer spectrum of long-term care needs as observed in the data.[9]

This paper also relates to the literature on late in life medical expense risk and its impact on savings behavior (Palumbo (1999), De Nardi et al. (2010), and Kopecky and Koreshkova (2014)). Kopecky and Koreshkova (2014) calibrates a general equilibrium life-cycle model to study how medical and nursing home expense risk impacts aggregate wealth and inequality in the presence of public insurance programs (Medicare and Medicaid). They find that the risk surrounding nursing home expenses alone accounts for 3% of aggregate

income individuals, who otherwise would be eligible for Medicaid, to gain coverage by allowing then to deduct medical expenses from their qualifying income.

[8]Braun et al. (2016), De Nardi et al. (2016), Hansen et al. (2014), Janicki (2014), Kitao (2014), Attanasio et al. (2010)

[9]Home care recipients receive on average 36 hours of care per week; however, the standard deviation is 45 hours of care (median is 16 hours of care) (NLTCS, 2004).

wealth via the precautionary savings channel. I extend this line of work by distinguishing institutionalized from non-institutionalized long-term care and allowing individuals to receive care informally via their adult child. This distinction is important for three reasons. First, formal and informal home and community based care is the primary setting through which individuals receive long-term care. Second, eligibility for Medicaid's long-term care benefits depend on the type of care being requested. Third, while formal home care is typically less expensive than institutionalized care, expenditures on home and community-based care at the aggregate level now exceed those for nursing homes.

3 Medicaid and Long-Term Care Utilization

This section describes some of the salient features of Medicaid's eligibility rules concerning its provision of institutional and non-institutional long-term care. The eligibility rules governing access to long-term care are often distinct from those determining standard Medicaid eligibility. On the financial side, states do this by adopting "special income rules" and operating optional home and community-based care waiver programs that allow them to provide coverage to specific segments of the population that would otherwise only be eligible for institutional care. Moreover, states also impose requirements regarding individuals' health status by setting functional eligibility thresholds. Functional eligibility entails a determination of needs/level-of-care that an individual requires. This often includes an assessment of cognitive ability, need of assistance in performing Activities of Daily Living (ADLs) or Instrumental ADLs (IADLs), as well as additional clinical characteristics specific to individuals. The functional eligibility threshold for both institutional and non-institutional care vary substantially across states, a well known policy concern (Harrington et al. (2009), and Hendrickson and Kyzr-Sheeley (2008)).

There are two dimensions to an individual's financial eligibility: (1) income and (2) assets. On the intensive margin most states (44) have adopted Medicaid's "special income

rule" to provide benefits to those with incomes up to 222% of the Federal Poverty Line (FPL) (300% of the Supplemental Security Income (SSI) threshold, $2,199 in 2015). The asset test is also fairly standardized across states at $2,000 for individuals and $3,000 for couples. However, states that choose to provide home and community based care through a State Plan Amendment (1915(i)) can only do so as long as the individual's income falls bellow 150% of the FPL. For individuals with a spouse, there are additional spousal impoverishment rules that determine how much of their assets their spouse is allowed to retain should they enter a nursing facility. These thresholds range from $23,844-$119,220 in liquid assets. Notably, states are required by law to "claw back" the cost of care from estates following the death of both spouses.[10] States have the option of operating a Medically Needy Program (MNP) that allows individuals with higher incomes (typically above 222% FPL) to gain eligibility by spending down their income to the Medically Needy Income Level (MNIL) (average 74% of the FPL).[11]

Distinct from eligibility, but also important for individuals making care decisions, is the 'generosity' of Medicaid's LTSS benefits. This comes from the degree of cost sharing within the programs. Individuals qualifying for institutional care are only permitted to retain a "Personal Needs Allowance", ranging from $30-$105/month. For those individuals receiving home care benefits via Medicaid, their cost sharing comes in the form of a "Maintenance Needs Allowance" (MNA). The MNA ranges from $600-$2,199 per month with 16 states having thresholds of less than 100% of the federal poverty line (FPL), 13 states with thresholds between 100%-222% of the FPL, and 18 states with thresholds at 222% of the FPL. The MNA is higher than the PNA to allow community residents to pay for the higher costs associated with remaining in their residence.

Functional criteria for institutional care and home care varies substantially across

[10]Households are not allowed to divert liquid wealth into a Miller Trust as they can only be used to decrease countable *income* and not assets.

[11]There are also a few 209(b) states that operate a MNP through a separate channel. In total, 33 states allowed individuals to spend down their income in 2009.

states. While the determination of needs assessments range in their complexity, they typically include the patient's ability to perform various IADLs and ADLs.[12] For simplicity, in table 1 I grouped states whose assessment criteria explicitly mentions a minimum number of ADLs an individual must have difficulty completing without assistance to be eligible for nursing home care. States range from requiring assistance with 2-4 IADL/ADLs and some states go further by requiring the necessity for 24 hour care. States' non-institutional care eligibility standards follow the same format as those for institutional care (income test, asset test, and functional status) but vary depending on how states choose to provide home care benefits. In 2007 the per capita HCBS participation rate among the Medicaid population ranged from 3.2 to 15.3 per 1,000 individuals at the state level.

Table 1: Nursing Home Level of Care Assessment - *Minimum* # of ADLs

State	2+ ADLs	3+ ADLs	4+ ADLs
Colorado	X		
Iowa	X		
Louisiana	X		
New Hampshire	X		
Ohio	X		
South Carolina	X		
Arkansas		X	
Connecticut		X	
Kansas		X	
Nebraska		X	
Nevada		X	
Washington		X	
Hawaii			X
Minnesota			X

Medicaid's coverage of home and community-based services (HCBS) began in 1981 following the passage of the Omnibus Budget Reconciliation Act and in 1983 when Congress added Section 1915(c) to the Social Security Act. This allowed states to gain waiver from the federal government to provide HCBS to individuals who would otherwise only be eligible for

[12] A more detailed description of how states define their Level of Care threshold can be found in Hendrickson and Kyzr-Sheeley (2008)

institutionalized care. The waiver program became more common following the Olmstead v. L.C. Supreme Court decision in 1999 that mandated, under certain conditions, HCBS be available for disabled individuals. In 2005 the Deficit Reduction Act created the 1915(i) state plan amendment option that allows states to offer HCBS to targeted populations with needs lower than an institutional level of care and incomes up to 150% of the federal poverty line. At the same time, states gained the ability to expand coverage to include personal assistance services through 1915(j) waivers.[13] Finally in 2010 the Affordable Care Act expanded states HCBS options through the 1915(k) Community First Choice (CFC) state plan by increasing the federal matching funds used to pay for these services by six percentage points for participating states.[14] In summary, states legal capacity to provide HCBS to their residents through the Medicaid program has grown substantially over the past 30 years.

3.1 Long-Term Care Utilization

In this section I use the 1994, 1999, and 2004 waves of the NLTCS to document care utilization patterns across individuals aged 65 and older. The National Long-Term Care Survey (NLTCS)[15] is a nationally representative longitudinal survey of the Medicare population (aged 65+). It includes individuals residing in institutions as well as the community, including non-impaired individuals. The survey has a longitudinal component that allows me to observe individuals health and care decisions over time. Individuals in the NLTCS sample are given an initial screening interview and placed into one of three categories: (1) Non-disabled in the community (commonly referred to as "screen-outs"), (2) disabled and in the community, and (3) institutionalized. Disabled individuals in the community or living in an institution are given an extended "community" or "institutional" surveys that contain

[13]This includes but is not limited to: meal preparation, medication management, the ability to hire relatives, and purchase products and services that increase their level of independence.

[14]A few states use 1115 demonstration waivers to provide HCBS in place of 1915(c) waivers.

[15]The NLTCS (National Long-Term Care Study) is sponsored by the National Institute of Aging and was conducted by the Duke University Center for Demographic Studies under Grant No. U01-AG007198.

more information about their disabilities, care utilization, and financial status. Additionally the 1999 and 2004 survey waves included a caregiver survey that provides detailed information on both paid and non-paid caregivers. Using this data I document facts concerning care utilization among the Medicare population and use them to inform the structural model developed in section 4.

Individuals residing in the community that receive at least one hour of either unpaid or paid care are determined to be home care recipients/users. I consider the use of home care on both the extensive and intensive margins (hours of care per week). I refer to care provided by any uncompensated individual as unpaid or informal. Any care provided by an individual receiving compensation for their services is referred to as paid or formal home care. Demographic characteristics include individuals' race, sex, age, education, marital status, number of children, household income, home ownership status, and rural/urban community. I summarize community residents health status into three components. The number of ADLs and IADLs an individual requires assistance to complete and a binary indicator for cognitive impairment. A sub-set of the sample was given a cognitive assessment consisting of ten questions. Individuals who responded incorrectly on at least five are coded as cognitively impaired as done in Robinson (2002). To limit a reduction in the sample size I include a dummy control that takes on a value of one if the individual was not given the assessment (following Ettner (1994)). An individual's Medicaid status is identified by either the individual having a valid Medicaid card or having at least some medical expenses covered by the program within the last year. Finally, for those residents receiving paid care in the home or in an institution I document their source of payment. Individuals may pay out-of-pocket, through family/friend contributions, private insurance, Medicaid, or other.[16] Summary statistics, by year, for community and institutionalized residents are found in appendix A.

[16]The "other" category consists of Medicare, veterans' benefits, and other state/local government programs.

I begin by estimating care utilization via OLS and restricting the sample to all community residents, regardless of whether they receive any form of care.[17] For this reason I refer to the results in table 2 as the unconditional intensive margin of care utilization. Column 1 of table 2 shows the results for total care hours, column 2 for paid (formal) hours, and columns 3 and 4 both concern unpaid (informal) hours. An increase in care needs, such as assistance with ADLs and IADLs, results in more hours of care in both formal and informal settings. Individuals suffering from cognitive impairment use more informal care; however, I find no evidence that they increase paid care hours. This may be attributable to the sample selection process and the fact that those with more severe cognitive impairment enter institutions. Married individuals and those with more children tend to use more informal care and less formal care. Individuals that receive at least partial financing through Medicaid use similar amounts of care as those who do not; however, the distribution of their care differs. Those individuals being subsidized by Medicaid's home care programs use more hours of paid care and less unpaid care. This result was first documented in Ettner (1994). Column 4 includes a dummy variable control that takes on a value of one if the individual receives paid care, regardless of their source of payment. The coefficient on the payer being Medicaid is relative to other sources of payment in column 4. This suggests that individuals receiving a Medicaid subsidy utilize more paid care and less unpaid care relative to other paid care community residents, holding their health and demographic characteristics constant. This may be attributable to individuals substituting out of informal care and into formal care in response to a home care subsidy. Additionally, informal caregivers may increase their provision of care when aged individuals are required to pay out-of-pocket for additional care.

[17] All regressions are weighted using the NLTCS weights.

Table 2: Home Care Utilization - *Unconditional Intensive Margin*

	Home Care Hours	Paid Hours	Unpaid Hours	
	(1)	(2)	(3)	(4)
Black	0.728	-1.309**	2.038	1.731
Female	-0.223	0.437	-0.660	-0.391
Rural Area	0.416	-0.459	0.874	0.832
Age	-0.068	0.053***	-0.121**	-0.085*
Number of ADLs	4.136***	1.022***	3.114***	3.406***
Number of IADLs	6.595***	0.921***	5.674***	6.025***
Cognitively Impaired	10.885***	2.757	8.127***	7.918***
No Cog. Assessment	4.043***	1.637***	2.406***	2.117**
Married	1.456**	-0.978***	2.434***	2.027***
Number of Children	0.293**	-0.154***	0.446***	0.392***
< High School	0.274	-1.048***	1.321	1.112
College	0.654	0.583**	0.070	0.512
Annual Income	0.034**	0.007	0.026*	0.025
Top Income Bracket	-0.435	1.041	-1.476	-1.185
Own Home	1.905***	-1.168***	3.074***	2.293***
Medicaid Status	-0.756	-0.220	-0.536	-0.661
Payer: Medicaid	3.896	14.831***	-10.935***	-3.690*
Paid Home Care				-10.139***
Year=1994	0.000	0.000	0.000	0.000
Year=1999	-3.631***	-0.875**	-2.756***	-3.362***
Year=2004	-0.462	-0.159	-0.304	-1.242*
Constant	-0.962	-2.917*	1.955	0.999
Observations	11,279	11,279	11,279	11,279
Adjusted R^2	0.403	0.119	0.352	0.363

Standard errors are clustered at the state level

* p<0.10, ** p<0.05, *** p<0.01

In table 3 I present the results regarding the intensive margin of care utilization *conditional* on individuals receiving care. In contrast to the results presented in table 2, I find no evidence that the source of payment for formal home care affects the number of hours of care received either formally or informally. This suggests that the results found in table 2 may be driven by individuals' response on the extensive margin.

Table 3: Home Care Utilization - *Conditional Intensive Margin*

	Home Care Hours	Paid Hours	Unpaid Hours	
	(1)	(2)	(3)	(4)
Black	1.590	-5.347*	3.153	2.821
Female	-0.778	2.266	-2.447*	-2.004
Rural Area	0.910	-2.183	1.705	1.565
Age	-0.074	0.111	-0.194*	-0.156
Number of ADLs	5.222***	3.116***	4.285***	4.530***
Number of IADLs	6.164***	2.185***	5.458***	5.689***
Cognitively Impaired	12.781***	14.671**	8.860***	8.646***
No Cog. Assessment	6.859***	9.007***	4.110**	3.936**
Married	1.936	-4.731***	2.004	1.807
Number of Children	0.624**	-0.708**	0.697**	0.671**
< High School	0.133	-3.887	1.206	0.925
College	0.569	-1.699	-0.089	0.480
Annual Income	0.068*	0.046	0.056	0.051
Top Income Bracket	-0.049	4.210	-2.167	-1.539
Own Home	3.202**	0.404	4.433***	3.515***
Medicaid Status	-0.379	3.014	-0.190	-0.463
Payer: Medicaid	2.859	1.095	-7.848***	-1.418
Paid Home Care				-8.791***
Year=1994	0.000	0.000	0.000	0.000
Year=1999	-5.176***	0.388	-4.177**	-5.003***
Year=2004	-0.795	6.260***	0.431	-0.982
Constant	-3.995	-11.491	6.975	6.053
Observations	5,188	1,812	4,419	4,419
Adjusted R^2	0.287	0.156	0.245	0.251

Standard errors are clustered at the state level

* p<0.10, ** p<0.05, *** p<0.01

To estimate the extensive margin for care I run individual logit models for home care, formal home care, informal home care, and nursing home care utilization. The results are broadly consistent with those in table 2. However, cognitive impairment is far more prevalent among the institutionalized population, relative to community residents. As such, cognitive impairment lowers the likelihood an individual receives home care but increases the probability of them residing in a nursing home. I find that the impact of Medicaid's role as a payer for long-term care is distinct from other financial sources. Having Medicaid as a payer increases the probability that an individual receives paid home care or nursing home care,

but lowers the probability of an individual receiving care informally or in the community in general. This suggests that individuals may substitute away from informal care and into either exclusively paid home care or nursing home care upon receipt of Medicaid benefits.

Table 4: Home Care Utilization - *Extensive Margin*
Individual Logit Models

	Care Options			
	Home Care	Unpaid Care	Paid Care	Nursing Home
Black	0.515***	0.539***	0.391***	-0.698***
Female	0.226***	0.274***	0.310**	-0.378***
Age	0.020***	0.020***	0.011	0.049***
Number of ADLs	0.415***	0.446***	0.129***	0.730***
Cognitively Impaired	-0.463***	-0.255	-1.236***	1.870***
No Cog. Assessment	-0.064	0.046	-0.479***	1.122***
Married	0.905***	1.100***	0.260*	-1.505***
Number of Children	0.045***	0.061***	-0.029	-0.084***
< High School	0.510***	0.519***	0.327**	-0.438***
College	-0.103	-0.140*	0.211*	-0.125
Annual Income	-0.013***	-0.010***	-0.024***	0.022***
Top Income Bracket	-0.459**	-0.390**	-0.102	0.724***
Own Home	0.706***	0.737***	0.244*	-2.594***
Medicaid Status	0.007	-0.016	0.101	0.784***
Payer: Out-of-pocket	2.876***	0.203**	5.840***	-0.890***
Payer: Insurance	1.652***	0.512*	4.789***	-0.693**
Payer: Family	1.419***	0.742***	4.801***	-1.570***
Payer: Medicaid	-0.939***	-1.464***	2.058***	1.085***
Payer: Other	1.898***	0.663***	4.337***	-1.165***
Year=1994				
Year=1999	-0.087	-0.207***	-0.079	-0.882***
Year=2004	0.047	-0.116*	0.123	-1.342***
Observations	13107	13107	13107	13107
Pseudo R^2	0.234	0.189	0.597	0.638

Marginal effects
Standard errors are clustered at the state level
* p<0.10, ** p<0.05, *** p<0.01

Finally, I consider the role of the payer in individuals' dynamic long-term care decisions. Using a multinomial logit model I study the determinants of individuals' care decisions over time. I condition my sample to individuals I observe in more than one wave of

the NLTCS. I estimate a multinomial logit using their current care setting as the dependent variable (no care, unpaid care only, paid care, and nursing home care). I control for individuals' current health and demographic characteristics in addition to their previous care setting and payer status (who paid for their past care). Results are presented in table 5. I find that individuals health characteristics (ADLs/IADLs and cognitive impairment) have similar effects for unpaid and paid care options. As individuals' health declines the likelihood of them choosing to receive care in an institutional setting increases. Married individuals are more likely to use informal/unpaid care and less likely to enter an institution. I find no evidence that the source of payment for past care has an impact on individuals current care setting with the exception of Medicaid. Those with care at least partially covered by Medicaid in the past are more likely to receive paid home care or remain in a nursing home five years later. This finding is in line with Ettner (1994) and Pezzin et al. (1996) that showed individuals receiving Medicaid home health benefits delay entry into a nursing home.

Table 5: Home Care Utilization - *Extensive Margin*
Multinomial Logit

	Care Options			
	No Care	Unpaid Care Only	Paid Care	Nursing Home
Unpaid Care (t-1)	0.000	1.207***	1.114***	0.812***
Paid Care (t-1)	0.000	1.164**	2.115***	1.176**
Nursing Home Care (t-1)	0.000	-0.874	1.116*	2.830***
Black	0.000	0.095	-0.902***	-0.470
Female	0.000	0.216**	0.358**	0.047
Age	0.000	0.060***	0.085***	0.112***
Number of ADLs	0.000	0.873***	0.970***	1.380***
Cognitively Impaired	0.000	1.704***	1.582***	2.396***
No Cog. Assessment	0.000	0.341**	0.122	0.983***
Married	0.000	0.950***	0.209	-1.094***
Number of Children	0.000	0.005	-0.048	-0.084
< High School	0.000	0.423***	0.151	-0.413
College	0.000	-0.224	0.305**	-0.364
Annual Income	0.000	-0.001	-0.007*	0.019***
Top Income Bracket	0.000	-0.636	0.638	0.374
Own Home	0.000	0.162*	-0.570***	-2.374***
Medicaid Status	0.000	0.197	0.645***	1.412***
Payer: Out-of-pocket (t-1)	0.000	-0.337	-0.095	0.046
Payer: Insurance (t-1)	0.000	0.263	-0.107	-0.067
Payer: Family (t-1)	0.000	-1.505	-1.165	-0.149
Payer: Medicaid (t-1)	0.000	1.192	1.602**	1.869***
Payer: Other (t-1)	0.000	-0.743	-0.383	-0.412
Year=1994	0.000	0.000	0.000	0.000
Year=2004	0.000	0.158	-0.256	-0.545***
Observations		4,395		
Pseudo R^2		0.427		

Marginal effects

(d) for discrete change of dummy variable from 0 to 1

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

In summary, I find that non-institutionalized individuals receiving a Medicaid subsidy for home care use informal care less frequently than their non-subsidized counterparts. Moreover, individuals that received Medicaid long-term care benefits in the past are more likely to use formal home care or nursing home care five years later. The same cannot be said for formal care recipients with other sources of payment. Additionally, I find no evidence

that the Medicaid subsidy increases the total number of hours of care received by community residents. This suggests that individuals with long-term care needs are receiving the care they require, and in response to Medicaid's home care subsidy they reallocate care hours from informal to formal home care.

4 The Model and Policy Experiments

4.1 Model Overview

The model is a small open economy populated with overlapping generations. Households are comprised of a retired parent and their adult child. Throughout retirement, parents receive Social Security payments and face long-term health risk. Parents make a consumption/savings and care decision in each period, taking any informal care provided by their child as given.[18] Parents either pay out-of-pocket for their care or receive benefits from Medicaid depending on their eligibility. Children face earnings risk during their career and divide their time endowment between labor, leisure, and providing informal care to their aged parent.

Households

The life-cycle of an individual is comprised of two stages: (1) career (kid) and (2) retirement (parent). Individuals enter the economy at age $j = 1$, retire exogenously at age j_r, and live for a maximum of J periods. For simplicity I assume each individual has exactly one kid at age j_r.[19] Individuals make a consumption/savings decision in each period. During their career individuals divide their time between market work (n), leisure (l), and providing informal care (IC) to their retired parent. Individuals face earnings risk during their career via stochastic labor productivity. Retired individuals (parents) face uncertainty

[18] Byrne et al. (2009) points out that while only allowing for one child caregiver simplifies the model, it also abstracts away from the dynamics within the younger generation. I leave this area to future work and focus in this paper on single retirees with only one child.

[19] This is consistent with the empirical observation that among families with multiple children, one child typically takes on the role of primary caregiver (Barczyk and Kredler (2017)).

over their longevity and health status. In the event that their health deteriorates, retired individuals make long-term care decisions. Individuals gain utility from consumption and leisure. Children are altruistic and care about their parent's welfare when making decisions regarding their provision of informal care. Additionally, retired individuals prefer to receive care from their adult child, rather than a home health aid or in an institution. All individuals discount future utility at rate β.

The kid's budget constraint during their career is given by:

$$(1+\tau_c)c + a' = w\epsilon(z,j)(H - l - IC) + (1+r)a - \tau(y^{tax}) + T^W + \mathbb{1}_{[j_k = j_d - j_r + 1]}b$$

where $\epsilon(z,j)$ is their labor productivity that depends on an idiosyncratic component, z and a deterministic age component, j. Individuals save via a risk-free asset (a) that pays a return (r) in each period. Individuals pay a progressive income tax ($\tau(y^{tax})$) and a proportional consumption tax (τ_c) in each period and may be eligible for a welfare transfer, T^W. In the event that a kid's parent dies at age j_d they inherit their wealth in that period via a bequest b.

Retired individuals receive a fixed pension, $S(z_r)$, in every period via a Social Security program commiserate with their productivity level at retirement (z_r).[20] In the event that a retired individual requires long-term care, they decide whether to receive care in the home ($inst = 0$) or in an institution ($inst = 1$). If they decide to remain in the home they may need to supplement any informal care provided by their child with paid care. A retired individual's period budget constraint is given by:

$$(1+\tau_c)c + a' + ltc(IC, inst, h, Med) = S(z_r) + (1+r)a + T^M(y, a, h, inst) - \tau(y^{tax}) + T^W$$

where $ltc(IC, inst, h, Med)$ is the cost of long-term care. IC denotes the number of hours provided informally via their child, $inst$ is an indicator denoting the institution-

[20]Social Security benefits increase with average career earnings. I proxy for this with an individual's productivity level at retirement to reduce the size of the state space.

alization of the individual, h denotes their health status, and Med is an indicator for the individual's Medicaid status. They may receive a transfer via Medicaid if they are eligible for aid given their income, assets, health status, and type of long-term care being received. Non-institutionalized retirees may also be eligible for additional welfare benefits, T^W.

Health and Long-Term Services and Support

Once and individual retires at age $j = j_r$ they face uncertainty over their health status h. Individuals' health status, $h \in \{h_1, ..., h_n\}$, represents their need for long-term care. This includes cognitive impairment, the number of activities of daily living (ADLs) and instrumental ADLs that the household has difficulty completing on their own. The households' health status follows a discrete Markov process dependent on their current health status and age with transition probabilities $\pi_h(h'|h, j)$. An individual's health status determines their level-of-care ($LOC(h)$) that is measured in hours of care. Aged individuals face uncertain longevity that is dependent on their age and health status, $\phi(h, j)$.

Given their health status, individuals may need to make a long-term care decision. They can choose between either remaining in the home or entering an institutionalized care facility (nursing home). Individuals that opt to remain in their home may receive care from their adult child. If the informal care provided by the adult child is insufficient for the parent's level-of-care needs, the parent must supplement their care with paid help from a professional home health aid conditional on them remaining in the community.

Institutions provide around-the-clock care and provide both medical services as well as room and board to their residents. Following Kopecky and Koreshkova (2014) and Barczyk and Kredler (2017) I distinguish between these two services. All institutionalized residents receive the same amount of medical care regardless of their source of payment (out-of-pocket or Medicaid).[21] Medical services are provided at a fixed cost and are independent of the level-of-care needed by the resident. The total cost of institutionalized care includes

[21]Regulations prohibit nursing homes from discriminating based on source of payment (Lin (2015)).

the cost of medical services and the consumption of the resident, regardless of their source of payment. This allows for a distribution of private-pay nursing home expenditures. Informal care provided by an adult child is financially costless to the parent; however, it decreases the amount of time the child can dedicate to work and/or leisure. This decrease in allocatable hours reduces the child's utility through lower consumption via lower labor earning and/or a reduction in leisure. Formal home care is available to individuals at a fixed hourly rate. Long-term care expenditures depend on an individual's Medicaid status ($Med = 1$ if eligible for Medicaid's benefits). I allow Medicaid and private-pay individuals to face different prices in both the home care and nursing home sectors: $\{p_f^p, p_f^m, p_{inst}^p, p_{inst}^m\}$. The resulting financial cost of long-term care can be expressed as follows:

$$\begin{aligned} ltc(IC, inst, h, Med) = & \mathbb{1}_{[inst=1]}\Big[\mathbb{1}_{[Med=0]}p_{inst}^p + \mathbb{1}_{[Med=1]}p_{inst}^m\Big] + \\ & \mathbb{1}_{[inst=0]}\Big[\mathbb{1}_{[Med=0]}(LOC(h) - IC)p_f^p + \\ & \mathbb{1}_{[Med=1]}(LOC(h) - IC)p_f^m\Big] \end{aligned}$$

Firms

There are three production sectors in the economy: (1) goods sector (Y), (2) formal home care sector (FC), and (3) nursing home sector (NH). Each sector has access to a production technology that is linear in efficiency units of labor. Consumption goods are used as the numeraire in the economy.

$$Y = A_g N_g$$

$$FC = A_f N_f$$

$$NH = A_{inst} N_{inst}$$

In equilibrium, firms operate at zero profit:

$$\Pi_f = \zeta_f^p p_f^p A_f N_f + \zeta_f^m p_f^m A_f N_f - w_f N_f = 0$$

$$\Pi_{inst} = \zeta_{inst}^p p_{inst}^p A_{inst} N_{inst} + \zeta_{inst}^m p_{inst}^m A_{inst} N_{inst} - w_{inst} N_{inst} = 0$$

where $\{\zeta_f^p, \zeta_f^m, \zeta_{inst}^p, \zeta_{inst}^m\}$ are the shares of home care hours and nursing home residents that either receive Medicaid benefits or pay out-of-pocket for their care. Firms take Medicaid's reimbursement rates and individuals' care demands as given. The private-pay rates, p_f^p and p_{inst}^p, adjust to ensure profits equal zero in each period. As labor is freely mobile across sectors, in equilibrium, the wages will equalize.

Government

The government operates a program similar to Medicaid and a pay-as-you-go social security system. As I focus on long-term health shocks, I omit Medicare's role as a provider of long-term care in the model. Medicare only covers home health and skilled nursing care for short term episodes (maximum of 100 days) following a qualified acute care hospitalization. In the model, the government levies a proportional tax on consumption (τ_c) and a progressive tax on labor and asset income ($\tau(y^{tax})$). Additionally, any accidental bequest, b, in excess of $\bar{b}$ is collected as an estate tax.[22] Households receive social security income, $S(z_r)$, once they reach retirement age j_r. Benefits are increasing in their final labor productivity level at retirement, z_r.

Individuals in need of care may be eligible for Medicaid benefits if they meet the eligibility requirements. Eligibility comes in two parts: (1) functional eligibility and (2) financial eligibility. Functional eligibility refers to the medical necessity of receiving long-term care (either in a home or institutional setting). Functional eligibility differs depending on the type of care being requested. Most states have the same functional eligibility standard

[22]This ensures the distribution of households across states is stationary in equilibrium.

for both home and institutional care settings, though some states have looser/stricter criteria for home care (MACPAC (2016b)). In the model functional eligibility differs by the type of care, $\{h^I, h^H\}$, and relates to the minimum level-of-care needed by the individual. Financial eligibility is possible via two channels. Both channels require the individual to meet an asset test: $a < \bar{a}$. Individuals gain access through the standard eligibility pathway if their after-tax income falls below a threshold: $y^{tax} < \bar{y}$. The second pathway is known as the spend-down rule. Individuals with higher incomes that preclude them from being eligible via the standard pathway can become eligible if their medical expenditures lower their disposable income enough to meet the spend-down income threshold: $y^{tax} - ltc(IC, inst, h, Med) < \bar{y}^{SD}$.

Medicaid benefits are based on an individual's choice of care setting, the cost of care, their functional eligibility status, and financial eligibility status. Eligible individuals are subject to a cost sharing requirement that differs by care setting. Institutionalized individuals receiving Medicaid benefits are required to relinquish their after-tax income to the government in exchange for room and board benefits $\underline{y}_{inst}$. Individuals remaining in their home are permitted to retain a monthly Maintenance Needs Allowance (MNA) ($\underline{y}^{MNA}$). Any income in excess of $\underline{y}^{MNA}$ is used to pay for the cost of care, Medicaid then pays for the rest. Should an individual's income fall below the MNA amount, the Medicaid program pays for the cost of care and the individual is permitted to retain their disposable income. For notational simplicity, I suppress the dependence of an individual's long-term care cost (ltc) on informal care hours, care setting, health status, and Medicaid status; furthermore, I define after-tax income as $\hat{y}^{tax} \equiv y^{tax} - \tau(y^{tax})$. The Medicaid benefit, $T^M(y^{tax}, a, h, inst)$, can be summarized as follows for individuals residing in an institution or in the community:

$$T^M(inst=1) = \begin{cases} \underline{y}_{inst} + p^m_{inst} - \hat{y}^{tax} & \text{if} \quad (h \geq h^I) \\ & \text{and } (y^{tax} < \bar{y}) \\ & \text{and } (a < \bar{a}) \\ \underline{y}_{inst} + p^m_{inst} - \hat{y}^{tax} & \text{if} \quad (h \geq h^I) \\ & \text{and } (y^{tax} - p^p_{inst} < \bar{y}^{SD}) \\ & \text{and } (a < \bar{a}) \\ 0 & \text{otherwise} \end{cases}$$

$$T^M(inst=0) = \begin{cases} ltc - \max(\hat{y}^{tax} - \underline{y}^{MNA}, 0) & \text{if} \quad (h \geq h^H) \\ & \text{and } (y^{tax} < \bar{y}) \\ & \text{and } (a < \bar{a}) \\ ltc - \max(\hat{y}^{tax} - \min\{\bar{y}^{SD}, \underline{y}^{MNA}\}, 0) & \text{if} \quad (h \geq h^H) \\ & \text{and } (y^{tax} - ltc < \bar{y}^{SD}) \\ & \text{and } (a < \bar{a}) \\ 0 & \text{otherwise} \end{cases}$$

In addition to Medicaid, the government finances a consumption floor,$\underline{c}$, via a lump-sum transfer, T^W, that captures the role of other government welfare programs such as Supplemental Security Income (SSI), Social Security Disability Insurance (SSDI), and the Supplemental Nutrition Assistance Program (SNAP). As per the rules governing SSI benefits, institutionalized individuals are ineligible for additional assistance.[23]

$$T^W = \max\left[0, \mathbb{1}_{\{inst=0\}}\left[\underline{c} - \left(\hat{y}^{tax} + a - ltc + T^M\right)\right]\right]$$

The government runs a balanced budget in each period.

$$G + SS + MT = CT + IT + ET$$

where G is unproductive government spending, SS is social security transfers, MT

[23]Those residents residing in an institution for more than 90 days, and have Medicaid paying for more than half of their care, SSI benefits are limited to \$30 per month. For simplicity I restrict institutionalized residents from collecting any welfare benefits apart from Medicaid in the model.

are means tested transfers, CT are consumption tax receipts, IT are income tax receipts, and ET are estate tax receipts.

Households's Problem

The household problem is divided between the parent's problem and the kid's problem. The parent's state space consists of their age (j_p), asset holdings (a_p), health status (h), productivity level (z_r), kid's asset holding (a_k), and their kid's productivity level (z).[24]. The nature of the parents problem depends on their health status. Healthy parents make a consumption/savings decision in each period. Parents with long-term care needs make decisions regarding the setting in which they will receive care. Parents take their kid's response regarding their provision of informal care as given.

$$V^p(j_p, a_p, h, z_r, a_k, z) = \max_{a'_p, inst, c_p} \Bigg\{ u^p(c_p, 1, IC, inst) + \beta\phi(h, j_p)\mathbb{E}_{\{z', h'|z,h,j_p\}}\Big[V^p(j_p+1, a'_p, h', z_r, a'_k, z')\Big] \Bigg\}$$

Subject to:

$$(1+\tau_c)c + a' + ltc(IC, inst, h, Med) = y^{tax} + a + T^M(y^{tax}, a, h, inst) - \tau(y^{tax}) + T^W$$

$$y^{tax} = S(z_r) + ra$$

The kid's problem differs depending on if their parent is still alive. In the event that the kid's parent has died, their set of state variables includes their age (j_k), asset holding (a_k), stochastic productivity state (z), parent's bequest (b), and parent's age of death (j_d). Should the parent still be living, the state space is identical to their living parent's state (defined above). The kid optimally saves and allocates their time endowment between labor,

[24] $j_k \in [1, j_r - 1]$ and $j_p = j_k + j_r - 1$

leisure, and providing informal care to their parent in each period.

$$V^k(j_k, a_k, z, z_r, a_p, h) = \max_{a'_k, l, IC, c_k} \Bigg\{ u^k\big[c_k, l_k, u^p\big] + \beta \Bigg[\phi(h, j_p) \mathbb{E}_{\{z', h'|z, h, j_k\}} \Big[V^k(j_k + 1, a'_k, z', z_r, a'_p, h') \Big] + \Big(1 - \phi(h, j_p)\Big) \mathbb{E}_{\{z'|z\}} \Big[V^s(j_k + 1, a'_k, z', b, j_k + 1) \Big] \Bigg] \Bigg\}$$

Subject to:

$$(1 + \tau_c)c + a' = y^{tax} + a - \tau(y^{tax}) + T^W$$

$$y^{tax} = w\epsilon(z, j)(H - l - IC) + ra$$

$$b = a_p$$

$$j_d = j_k + J_r$$

where $V^s(\cdot)$ denotes the kid's value function after their parent has died.

$$V^s(j_k, a_k, z, b, j_d) = \max_{a'_k, l, c_k} \Bigg\{ u^k\big[c_k, l_k\big] + \beta \mathbb{E}_{\{z'|z\}} \Big[V^s(j_k + 1, a'_k, z', b, j_d) \Big] \Bigg\}$$

Subject to:

$$(1 + \tau_c)c + a' = y^{tax} + a - \tau(y^{tax}) + T^W + \mathbb{1}_{\{j_k = j_d - j_r + 1\}} \tau_b(b)$$

$$y^{tax} = w\epsilon(z, j)(1 - l) + ra$$

4.2 Calibration

Demographics and Preferences

I set a model period to 1 year. Households enter the economy at age 35, retire at age 65, and die by age 95. Each generation is born with measure $\frac{1}{60}$. All individuals

are matched with their newly retired parent upon entering the economy. Preferences over consumption and leisure are non-separable.

$$u^k(c, l, u^p) = \frac{\left(c^\gamma l^{1-\gamma}\right)^{1-\sigma}}{1-\sigma} + \eta u^p$$

$$u^p(c, l, IC, inst) = \frac{\left(c^\gamma l^{1-\gamma}\right)^{1-\sigma}}{1-\sigma} + \mathbb{1}_{[inst=0, h\neq 1]} \frac{\theta}{\sqrt{LOC(h)}} IC$$

where the kid is altruistic and the parent receives utility from the home care they receive from their adult child should they receive care in their residence. The parent's marginal utility with respect to informal care hours is decreasing in their level-of-care needs. This is consistent with survey evidence that elderly individuals' preference for home care decreases as their health declines. This could be due to their desire or need for more specialized care or altruism towards their caregiver's welfare.

Individuals constant relative risk aversion, σ, is set exogenously to 2. Individuals can choose to work full-time or part time and I calibrate γ to the share of the working-age population working full time (82%). The kid's altruism parameter, η, targets the share of home care provided informally by adult children to single retirees (61%). The parent's preference for informal home care, θ, targets the fraction of the aged population that reside in a nursing home (4.1%). Finally, individuals discount future utility at rate β. I calibrate the annual discount factor such that median wealth among the population aged 70-75 matches the observed empirical moment following Barczyk and Kredler (2017) ($178,600).

Technology

The goods firms' technology is linear in efficiency units of labor. Productivity in the goods sector, A_g, is scaled such that the median labor income in the model matches the median household income among the 35-64 year-old demographic in 2004 ($60,738). Calibrating productivity in the formal home care and nursing home sectors, A_f and A_{inst},

is analogous to calibrating the average home care and nursing home care price, $\bar{p}_f$ and $\bar{p}_{inst}$. In 2015 the median rate private-pay rate for homemaking services or home health aid services was \$20 per hour (Genworth (2015)). I set $\bar{p}_f = \$19.00$ to account for the fact that the average rate is decreased by the lower Medicaid reimbursement rate. As nursing home expenditures are comprised of medical and room and board services, I calibrate $\bar{p}_{inst}$ such that median private-pay expenditures, $p^p_{inst} + \bar{c}^p_{inst}$, match the reported value in Genworth (2015) (\$91,250).

Labor Productivity

Households' labor productivity, $\epsilon(j, z)$, is comprised of two parts. The first part is a deterministic age profile. The second is a stochastic component following a discrete Markov process with transition probabilities: $\pi_z(z'|z)$. Kid's inherit their parent's final productivity level upon retirement. This structure allows for intergenerational persistence in labor earnings. I use the following specification from Kopecky and Koreshkova (2014) for individuals' labor productivity:

$$\log \epsilon(j, z) = \beta_1 j + \beta_2 j^2 + \beta_3 j^3 + z$$

where $\{\beta_1, \beta_2, \beta_3\} = \{4.8x10^{-2}, -8.06x10^{-4}, -6.46x10^{-7}\}$, and $z \in \{z_1, ... z_5\} =$ { -3.5, -0.33, 0, 0.68, 2.4 }.

Health Status and Expenditures

Individuals' health status can take on one of seven values, conditional on them staying alive, as defined in Robinson (2002) and Friedberg et al. (2015): (1) healthy, (2) difficulty performing at least one IADL but able to perform all ADLs, (3) unable to perform one ADL, (4) unable to perform 2 ADLs, (5) unable to perform 3 ADLs, (6) unable to perform 1 ADL and is cognitively impaired, and (7) unable to perform 2 or more ADLs and is cognitively impaired. The probability that an individual enters health state h' given

their current age, j, and health status, h, is $\pi_h(h'|h,j)$. I use estimates from Friedberg et al. (2015) based on the actuarial model developed in Robinson (2002). I use the same model to compute survival probabilities conditional on an individual's age and health status, $\phi(h,j)$. The actuarial model of long-term care risk, from Robinson (2002), has a rich pedigree and has been widely implemented in industry and the academic literature concerned with private long-term care insurance (Brown and Finkelstein (2004), Brown and Finkelstein (2008)). Using a finer grid of health states allows me to better capture the risk associated with long-term care needs and variety of care arrangements observed in the data.

An individual's health status determines their level-of-care needs: $LOC(h)$. Healthy individuals require zero hours of care. I set the care needs of individuals with intermediate health ailments ($h \in \{2,...,6\}$) to the average hours of home care received by individuals in the 2004 wave of the NLTCS. Finally, for individuals with severe health care needs ($h = 7$) I set their level-of-care needs to 16 hours per day to represent the need for care during all waking hours. I use a higher value to account for the fact that 43% of individuals in this health state reside in an institution. Table 6 shows weekly care hours required in a home care setting by health status:

Table 6: Level-of-Care Calibration

Health Status (h)	Healthy ($h=1$)	$h=2$	$h=3$	$h=4$	$h=5$	$h=6$	$h=7$
Hours of Care (per week)	0.0	17.9	15.3	21.3	48.5	61.2	112.0

Source: Author calculations using the 2004 wave of the NLTCS.

Expenditures on home care are based on the number of hours of formal care received. The unit price per hour depends on the resident's Medicaid status. Those paying out-of-pocket for their care pay p_f^p per hour of care. In equilibrium p_f^p adjusts to balance the home care firms' budget constraint. Residents receiving home care through the Medicaid program engage in cost sharing. Medicaid home care beneficiaries are permitted to retain $\underline{y}^{MNA}$ in each period and Medicaid covers the remainder of their expenses at rate p_f^m. Medicaid's

hourly reimbursement rate, p_f^m, is calibrated such that the private-pay markup, γ_f, in the benchmark economy matches the observed markup in the 2004 wave of the NLTCS. The average price per hour paid for aid in the home for private-pay residents was \$12.72/hr. while it was \$8.58/hr. among those receiving support from Medicaid.[25] In the benchmark economy I require

$$\frac{p_f^p}{p_f^m} = \gamma_f = 1.49$$

and in subsequent counterfactual exercises I keep p_f^m fixed and allow p_f^p to adjust to balance the home care firm's budget constraint.

The cost of residing in a nursing home includes the non-consumption medical services provided by the nursing home firm and the cost of room and board (consumption of nursing home residents). Nursing home residents paying out-of-pocket for their care pay p_{inst}^p for their medical services and are free to choose their level of consumption, c. In equilibrium p_{inst}^p adjusts to balance the nursing home firms' budget constraint. Residents receiving Medicaid benefits which cover the cost of their medical care and room and board. The nursing home firm receives p_{inst}^m for each Medicaid resident. I calibrate p_{inst}^m such that the private-pay markup over the Medicaid reimbursement rate matches the data. In 2002 the average Medicaid per diem reimbursement rate for a nursing home was \$117.16 (Harrington et al. (2006)). This translates to \$54,545 annually in 2015\$. The median private-pay rate in 2015 was \$250, yielding a median annual rate of \$91,250 (Genworth (2015)). The private-pay rate is determined in equilibrium as it depends on the population receiving Medicaid benefits relative to the population paying out-of-pocket for their care. In order to calibrate p_{inst}^m I require that:

$$\frac{p_{inst}^p + \bar{c}_{inst}^p}{p_{inst}^m + \bar{c}_{inst}^m} = \gamma_{inst} = 1.67$$

[25] A low sample size due to non-response results in wide 95% confidence intervals, [\$11.17,\$14.27] and [\$6.63,\$10.54], for private-pay and Medicaid residents respectively.

where $\bar{c}^m_{inst}$ and $\bar{c}^p_{inst}$ are the median consumption levels among Medicaid and private-pay nursing home residents in the benchmark economy. In subsequent counterfactuals, p^m_{inst} is fixed and p^p_{inst} adjusts to ensure the nursing home firms' budget constraint is satisfied.

Government

Consistent with Kopecky and Koreshkova (2014) and Barczyk and Kredler (2017) the progressive income tax, $\tau(y^{tax})$, takes on the following form:

$$\tau(y^{tax}) = \kappa_0\big(y^{tax} - ((y^{tax})^{-\kappa_1} + \kappa_2)^{-\frac{1}{\kappa_1}}\big) + \tau_{ss}\min\{y^{ss}, y^{tax}\}$$

where $y = w\epsilon(j,z)n$ if $j < j_r$ and $y = S(z_r)$ if $j \geq j_r$. The first term is the income tax function from Gouveia and Strauss (1994) and the second term is the proportional social security payroll tax ($\tau_{ss} = 0.124$) levied on earnings up to the earnings cap: $y^{ss} = \$76,200$. The income tax function, following Gouveia and Strauss (1994), uses parameters $\{\kappa_0, \kappa_1, \kappa_2\} = \{0.258, 0.768, 0.031\}$. Finally a proportional tax is levied on consumption, $\tau_c = 0.057$ (as in Barro and Barnes (2016)).

The social security payment function, $S(z_r)$, can take on one of five values commiserate with the individual's productivity level upon retirement. The average earnings of an individual who worked full time throughout their career for each productivity level are: {\$1,822, \$43,366, \$60,321, \$119,066, \$664,928}. Using the Social Security Administration's benefit formula based on individuals indexed average life-time earnings, the corresponding benefits are as follows: {\$1,644, \$20,040, \$25,464, \$31,668, \$31,668}. The highest two productivity types receive the maximum allowable social security benefit. This calibration yields an average replacement rate of 39.2% of average career earnings.

There are two means-tested welfare programs in the model. The first is a general consumption floor that provides financial assistance to individuals residing in the community whose net resources fall bellow $\underline{c}$. This consumption floor is set at the 2015 SSI benefit rate, \$8,796, which is 14.6% of median earnings among the working-age population and consistent

with figures used in the literature (Kopecky and Koreshkova (2014)). The Medicaid program entails the following parameters: $\{p^m_{inst}, p^m_f, \bar{y}, \bar{y}^{SD}, \underline{y}^{MNA}, \underline{y}^{inst}, \bar{a}, h^I, h^H\}$.

The Medicaid reimbursement rates, p^m_{inst} and p^m_f, target each market's private pay markup as discussed in the previous section. Medicaid's income threshold, $\bar{y}$, is set at 222% of the federal poverty line ($26,388 per year in 2015). The income threshold via the spend-down rules are lower than the standard eligibility pathway in states not using a special income rule and $\bar{y}^{SD}$ is set at 49% of the federal poverty line ($5,796) (Cornachione et al. (2015)). The maintenance needs allowance ($\underline{y}^{MNA}$) varies across states as discussed in section 3 from below 100% of the poverty line to 222%. I choose an intermediate value of 150% of the poverty line for the benchmark economy ($17,830). This is the maximum income threshold permitted via section 1915(i) of the Social Security Act. The most common asset test, $\bar{a}$, for households is $3,000. The room and board benefit provided by Medicaid, $\underline{y}^{inst}$, targets the share of aggregate nursing home expenditure covered by Medicaid (41%).

The functional eligibility criteria are set initially at $h^I = 5$ and $h^H = 6$ to represent a state Medicaid program that has not yet expanded their HCBS benefits to the aged population through a State Plan Amendment or Community First Choice program (sections 1915(i) and 1915(k) of the Social Security Act). I allow Medicaid to cover home care for individuals with higher than an institutional level-of-care if the costs of doing so are lower than the price of nursing home care. This is consistent with state programs that offer limited HCBS through 1915(c) waiver programs.

4.3 Numerical Algorithm

In this section I briefly describe the numerical procedure used to solve for the benchmark equilibrium. I first guess private-pay care prices, $\{p^p_f, p^p_{inst}\}$, and the value function for parents at age $j_p = j_r$: $V^p_0(x_{j_r})$.[26] Using this information I first solve the single kid's problem

[26]To guess the value function, I solve a version of the model absent kids and the availability of informal care.

followed by the household's problem as described in section 4.1 via backward induction. I solve both agent's problem (parent and kid) for the case in which the parent chooses nursing home care and home care separately, whichever yields the highest value for the parent is chosen. I solve for the agent's consumption/savings decision in two stages: (stage 1) the parent takes the kid's savings and informal care choice as given and then optimally chooses their savings level, (stage 2) the kid optimally chooses savings and informal care provision given their parent's optimal savings response. I update the value function guess $V_0^p(x_{j_r}) = V^p(x_{j_r})$ until it converges. The asset grid consists of 40 non-linearly spaced points. The Medicaid program's means testing results in a non-monotonic savings policy function. I solve for the agents' optimal savings decision via brute force grid search for asset holds less than or equal to the means test. For those with asset holdings above the means test, I exploit the policy function's monotonicity and employ the divide and conquer algorithm developed in Gordon and Qiu (2017). I solve for the invariant distributions, $\{\mu, \hat{\mu}\}$, of individuals across states, $\{x, \hat{x}\}$, non-stochastically using the agent's savings policy functions and the two stochastic transition probability matrices $\{\pi(z'|z), \pi(h'|h, j)\}$. I compute the implied private-pay prices, $\{p_f^p, p_{inst}^p\}$, that clear the home care and nursing home care firms' budget constraints. I iterate until the private-pay rates converge.

4.4 Benchmark Economy

The benchmark economy is calibrated to the U.S. population and a set of common state-level Medicaid eligibility rules (see section 4.2 for details). A list of parameters can be found in table 7 along with their associated empirical and model generated moments where applicable.

Table 7: Parameters

Parameter	Value	Target (Data)	Model Moment
β	0.975	Median wealth among 70-75 age group = \$178,600[a]	\$175,000
σ	2.0	exogenous	—
γ	0.26	Fraction of workers full-time = 0.82	0.83
η	0.25	Informal care hours share of total home hours = 0.61	0.69
θ	$2.5 * 10^{-6}$	Share of aged in NH = 0.04	0.03
$\underline{c}$	\$8,796	exogenous (avg. SSI benefits)	—
$\underline{y}^{inst}$	\$14,000	Medicaid's share of nursing home expenditures = 0.41	0.20
p_f^m	\$13.33	Private-pay home care mark-up (γ_f) = 1.49	1.49
p_{inst}^m	\$39,735	Private-pay nursing home mark-up (γ_{inst}) = 1.67	1.67
A_g	15.98	Median Income = \$60,738	\$60,738
A_f	0.84	Private-pay cost of formal home care = \$20.00/hour	\$19.91/hour
A_{inst}	$3.9 * 10^{-4}$	Private pay nursing home expenditures = \$91,250	\$88,734

[a]Source: Barczyk and Kredler (2017)

The benchmark calibration captures both targeted and non-targeted aspects of the U.S. economy well. The median private-pay nursing home expense is targeted in the calibration; however, the distribution is not. Table 8 shows the distribution of private-pay nursing home expenditures in the model and those found in the data. The variation in expenditure is driven by the consumption (non-medical) component of nursing home services. Medicaid's expenditure among nursing home residents accounts for 20% of total nursing home expenses in the model. This is lower than the 41% observed in the data. This is driven by the high average private-pay nursing home expenditures in the model (\$184,500). This is driven up due to the lack of an extrinsic incentive in the model for the frail and elderly to hold onto assets as they near the end of their life.

Table 8: Distribution of Private-Pay Nursing Home (NH) Expenditures (thou. 2015\$)

	min	25^{th} pct.	50^{th} pct.	99^{th} pct.
NH Expenditures (model)	42.1	67.4	88.7	542.4
NH Expenditures (Genworth (2015))	32.9	—	91.2	458.9
NH Expenditures (Barczyk and Kredler (2017))[a]	—	62.6	95.5	356.5

[a]Figures are converted into 2015\$ using a 7.0% inflation rate as found in Stewart et al. (2009) regarding the rise in private-pay nursing home costs.

In the benchmark economy 2.7% of the aged population reside in a nursing home and 19.0% receive care in their home. Medicaid covers 17% of all long-term care expenditures in the benchmark calibration. This is lower than Medicaid's share of aggregate long-term care expenditures (43%) due to the presence of readily available private-pay home care services in the model economy and high consumption levels among private-pay nursing home residents (MACPAC (2016a)). Approximately half of nursing home residents recieve financial support from the Medicaid program (47%), this is marginally lower than the 59% observed in the data (59%, Barczyk and Kredler (2017)). Additionally, 80% of Medicaid expenditures in the model come from nursing home beneficiaries as compared to 65% in 2004 (Burwell et al. (2016)).

Parents residing in the community receive a mix of formal and informal home care. In the benchmark economy, those with mild care needs (less than 20 hours per week) predominantly receive care informally via their adult child (62% of care hours) while those with more than 40 hours per week of care needs receive 42% of care informally. In the 2004 wave of the NLTCS the share of home care hours coming from informal sources is relatively constant across the distribution of total home care hours (correlation: -0.05); however, the share declines as health conditions worsen. Informal care's share of home hours falls from 78% for those with mild health conditions (corresponding to health status h_2 and h_3) to 62% for those with more severe health problems (corresponding to health status h_5, h_6, and h_7).

Distinct from previous literature, this model incorporates a distribution of long-term care needs for those residents that remain in the community. In Barczyk and Kredler (2017), aged parents are defined as disabled if they require 20 hours of care or more in a given week. This is similar to the 18 hours of care received by the median individual in the Medicare population observed in 2004. However, the distribution of care is skewed to the right with the top 10% of care recipients receiving at least 80 hours of care per week. In the model, adult children provide between 5 and 49 hours of care per week to their ailing

parent with the median child providing 15 hours per week. As I only allow for retirees to receive informal care from one individual I do not capture the right tail of the distribution of informal care hours observed in the NLTCS as these individuals are often receiving support from more than one individual.

I allow individuals to choose between full-time and part-time work. In table 9 I segment the population into labor productivity and parental health status conditional on the parent residing in the community (non-nursing home residents). Each cell represents the share of the sub-population of households that has a kid working full-time. Individuals' labor supply is non-monotonic in their labor productivity for children with marginally healthier parents. Children's time endowment is optimally distributed across labor, leisure, and providing informal care to their parents. Additionally, part-time work is most prevalent among individuals with parents that have high care needs (cognitive impairment or incapable of performing at least three ADLs), especially among households with low-income children.

Table 9: Fraction of Adult Children Working Full-Time

Kid's Labor	Health Status							
Productivity	h_1	h_2	h_3	h_4	h_5	h_6	h_7	Average
z_1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
z_2	0.75	0.50	0.49	0.51	0.28	0.18	0.16	0.69
z_3	0.86	0.59	0.56	0.56	0.39	0.25	0.22	0.79
z_4	0.67	0.40	0.37	0.37	0.37	0.22	0.30	0.61
z_5	0.82	0.67	0.64	0.63	0.52	0.45	0.54	0.78
Average	0.74	0.50	0.48	0.48	0.42	0.38	0.44	

5 Counterfactual Policy Experiments

In this section I conduct a counterfactual policy experiment regarding the functional eligibility requirements for home care within the Medicaid program. In the benchmark economy, described in the previous section, individuals were required to have a health status of h_6 in order to be eligible for home care. In the counterfactual experiment I lower the functional

eligibility threshold, h^H, to h_5 from h_6 such that the functional eligibility requirements for institutional care and home care are identical ($h^H = h^I = h_5$). This expansion extends home care benefits to 1.7% of the aged population corresponding to individuals that require assistance with three activities of daily living. I present the reform's impact on aggregate economic moments in the model in table 10.

Table 10: Aggregate Effects of Lower Home Care Functional Eligibility Requirements

Metric	Benchmark Value	Counterfactual Value	Counterfactual Relative to Benchmark
Private-pay NH cost (median)	88,734	91,023	102.6
Private-pay home care cost	19.91	20.91	105.0
Median wealth (age 70-75)	175,000	175,000	100.0
NH population	2.7%	2.4%	88.7
Share of home care informal	69%	67%	97.1
Labor supply (share full-time)	83.1%	83.0%	99.8
Efficiency units of labor	1,329	1,325	99.7
Per-Capita Aggregates			
Home care hours	57	59	104.5
Informal home care hours	32	40	123.5
Total NH expenditure	905	846	93.4
Medicaid NH expenditure	126	100	79.7
Total home care expenditure	334	367	110.1
Medicaid home care expenditure	32	63	201.1
Welfare transfers	12.0	12.3	102.8
Total tax revenue	22,571	22,525	99.8
Total Medicaid expenditures	158	164	104.0
Unproductive government spending	15,751	15,698	99.7

The fiscal implications of the Medicaid expansion are as follows. The expansion increases Medicaid spending on home care by roughly double; however, this is in conjunction with a 20.3% reduction in Medicaid financed nursing home expenditures. The net result is an increase in total Medicaid long-term care outlays of 4%. The model suggests that for every \$1,000 increase in home care expenditures, Medicaid's total long-term care costs increase by \$196. This is a larger cost reduction than the one found in Guo et al. (2015) (\$649 net increase in Medicaid spending per\$1,000 increase in home care expenditures). The larger reduction in this counterfactual is primarily driven by the fact that I am solely addressing

the elderly population and the expansion targets the demographic group with the highest rate of Medicaid financed nursing home utilization.

The expansion also impacts the government's budget through the general welfare program and tax revenues. An increase in the share of the elderly population residing in the community increases their reliance on other, non-Medicaid, welfare programs. As a result, expenditures on the government provided consumption floor, $\underline{c}$, increases by 2.8%. The reform's effect on aggregate tax revenue is small. The reform results in a decrease in the share of the working-age population working full-time, it is more pronounced among low-productivity workers. This results in a slightly larger reduction in the aggregate labor supply measured in efficiency units. For a detailed cross-section of the reform's impact on labor supply, see table 11.

Table 11: Counterfactual: Impact on Labor Supply

Kid's Labor	Health Status							
Productivity	h_1	h_2	h_3	h_4	h_5	h_6	h_7	Average
z_1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
z_2	1.07	0.66	0.71	0.84	0.93	0.92	1.01	1.02
z_3	1.00	0.85	0.87	0.96	0.90	0.96	0.99	0.98
z_4	0.99	0.89	0.90	0.94	0.93	0.98	1.00	0.98
z_5	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Average	1.03	0.79	0.82	0.91	0.92	0.95	1.00	

This table displays the fraction of workers within each productivity-health status bin that choose to work full time in the counterfactual economy *relative* to the benchmark economy levels.

The increased share of individuals receiving formal home care via Medicaid drives up the private-pay rate for home care. Through the same mechanism, the decreased share of nursing home residents receiving Medicaid lowers the private-pay medical costs associated with entering a nursing facility. This is offset however by a rise in consumption among private-pay nursing home residents. This makes the cost savings resulting from a switch from nursing home care to home based care smaller than a partial equilibrium analysis

would suggest. The net result is a 2.1% reduction in total long-term care expenditures.

The reform affects individuals' care utilization decisions. Increasing access to home and community-based care reduces the nursing home population by 0.3 percentage points. The decline in nursing home utilization is concentrated among the Medicaid sub-population, and specifically those with newly acquired home care benefits (corresponding to health status h_5). Table 12 shows the change in nursing home utilization across the productivity-health sub-populations. As institutional care is considerably more costly for private-pay residents with heath conditions requiring less than 39 hours of care per week, the reform's impact on nursing home utilization is concentrated among those with more severe health conditions. Approximately 38% of aged individuals that utilized nursing home care in the benchmark economy, but were not eligible for Medicaid's home care benefits, switched out of nursing home care and into home care. This amounts to a 27% reduction in Medicaid's nursing home beneficiaries. Those with more significant care requirements increase their nursing home utilization as the cost of receiving care in the home is costly post-reform and the medical cost of institutionalized care has fallen.

Those elderly individuals that transfer from nursing home care to home based care following the Medicaid expansion are the largest source of cost reduction associated with the reform. For this reason it is useful to consider what household characteristics are associated with the highest propensity to reduce nursing home utilization and substitute into home care. I find that adults with marginally higher income levels are most likely to switch care settings following the reform. These individuals gain access to Medicaid benefits through their ability to spend-down their income to become eligible. This is an important insight. A state-run Medicaid program looking to expand home based care through a reduction in the functional eligibility requirements will see smaller increases in aggregate Medicaid expenditures if their program also allows individuals the option to spend-down their income. Absent this eligibility channel, the population most prone to substitute away from Medicaid

financed nursing home care and into Medicaid financed home care will remain ineligible for home care benefits.

Table 12: Counterfactual: Impact on Nursing Home Utilization

Kid's Labor Productivity	Health Status h_5	h_6	h_7	Average
z_1	0.99	1.00	1.00	0.98
z_2	1.00	1.02	1.00	1.00
z_3	0.36	1.00	1.00	0.59
z_4	0.34	0.96	1.01	0.56
z_5	0.37	0.94	1.01	0.59
Average	0.62	1.01	1.00	

This table displays the share of each productivity-health bin utilizing nursing home care in the counterfactual economy, relative to the benchmark economy.

The fall in aggregate nursing home utilization results in an increase in total home care hours and total informal care hours; however, the share of home care hours coming from informal sources falls by 2.0 percentage points. Table 13 shows how the policy reform impacted informal care provision in the productivity-health cross-section relative to the benchmark economy. When health care needs are modest, kid's provide more informal care after the Medicaid expansion because of the increase in the private-pay home care costs. The benefit of an additional hour of home care is higher in the counterfactual economy. Retirees that now have the option of Medicaid home care benefits (h_5) receive substantially less informal care per-capita post-reform (table 14). The effect is slightly largest among middle and low-middle income households.

Table 13: Counterfactual: Impact on Total Informal Care Hours

Kid's Labor	Health Status						
Productivity	h_2	h_3	h_4	h_5	h_6	h_7	Average
z_1	1.13	1.08	1.12	1.08	1.11	1.12	1.11
z_2	1.39	1.28	1.25	1.10	1.16	0.87	1.36
z_3	1.32	1.20	1.09	1.13	1.10	1.04	1.30
z_4	1.14	1.08	1.06	1.21	1.22	0.90	1.12
z_5	1.06	1.04	1.02	1.21	1.12	0.77	1.03
Average	1.30	1.20	1.15	1.09	1.16	0.91	

This table displays the total amount of informal care provided by children within each productivity-health status bin in the counterfactual economy, relative to the amount provided in the benchmark economy.

Providing informal care is burdensome for caregivers as it reduces the time they can dedicate to leisure and/or wage-earning labor hours. The expansion of Medicaid's home care benefits increased the aggregate amount of informal care provided in the economy; however, this effect varies depending on household demographics (see table 14). Per-capita informal care provision falls among those households gaining access to Medicaid financed home care post reform (h_5). However, as the cost of private-pay home care increased following the reform, most households show an increased amount of informal care per community resident. Thus the welfare gain associated with a reduction in the burden of providing informal care is concentrated among certain demographic households. Specifically, informal care provision rises the most among households with low to middle-income children. Finally, per-capita informal care provision rises the most among households with healthier parents in need of modest care. As care needs rise, preference for informal care falls and children are less prone to provide care.

Table 14: Counterfactual: Impact on Per-Capita Informal Care Hours

Kid's Labor	Health Status						
Productivity	h_2	h_3	h_4	h_5	h_6	h_7	Average
z_1	1.13	1.08	1.12	0.71	1.11	1.05	1.10
z_2	1.38	1.28	1.25	0.78	1.13	0.92	1.29
z_3	1.32	1.20	1.09	0.79	1.14	1.03	1.24
z_4	1.14	1.09	1.07	0.71	1.22	0.95	1.11
z_5	1.06	1.04	1.02	0.61	1.12	0.90	1.03
Average	1.27	1.18	1.13	0.75	1.15	0.96	

This table displays the per-capita amount of informal care provided by children within each productivity-health status bin in the counterfactual economy, relative to the amount provided in the benchmark economy.

5.1 Welfare Analysis

In this section I document the welfare effects of the counterfactual experiment discussed in the previous section whereby the functional eligibility requirement pertaining to home care benefits was reduced to the same level as institutional care. I measure welfare through consumption equivalent variation (CEV). I ask how much an individual would require, in terms of consumption, across every possible future state of the world in the benchmark economy to be equally well off as in the counterfactual economy. I compute the CEV for newly born adult children and newly retired aged parents across productivity levels and parental wealth.

There are three channels through which households' welfare are affected by the reform. The first is the direct effect of offering elderly parents the option of receiving Medicaid financing in the home (should they qualify). Medicaid financed home care is strictly preferred to Medicaid financed nursing home care when the elderly individual's income exceeds the Maintenance Allowance Amount (MNA) as consumption is higher in the community relative to the nursing home. For those households with income's below the consumption level provided by Medicaid financed nursing homes it is possible they would still choose to remain in the community with lower income if their adult child's informal car provision is sufficient

to outweigh the low consumption levels.

The second channel is through the change in private-pay home care costs. The rise in private-pay home care costs lowers consumption among retirees, holding informal care provision constant. However, the change in private-pay prices induces adult children to increase their informal care provision which increases retirees welfare. Additionally, Medicaid financed home care retirees receive less informal care. This is because informal care is provided via the child's altruism. Informal care directly improves parents' welfare but also indirectly through consumption for those paying out-of-pocket for care. From the new-born adult child's perspective welfare is affected through consumption via hours worked, leisure, and the welfare of their parent. The reform's benefit to the median new retiree is equivalent to 0.9% of retirement consumption in the benchmark economy. The benefit to the median new-born adult child is equivalent to 0.3% of lifetime consumption.

Table 15: Welfare: New Retirees (CEV)

Wealth	Labor Productivity				
Percentile	z_1	z_2	z_3	z_4	z_5
10^{th}	0.5	0.8	0.2	1.7	0.7
25^{th}	0.7	1.6	0.4	1.4	0.6
50^{th}	0.9	1.7	0.9	1.9	1.1
75^{th}	1.3	0.6	-0.6	1.5	0.8
90^{th}	1.4	0.6	-0.3	2.6	0.9

This table displays the consumption equivalent variation (CEV) for new retirees across productivity and wealth demographics. A positive CEV denotes the individual benefits from the Medicaid reform.

Table 16: Welfare: New-born Children (CEV)

Parental Wealth Percentile	Labor Productivity				
	z_1	z_2	z_3	z_4	z_5
10^{th}	-0.3	0.2	0.1	-0.4	-0.4
25^{th}	-0.3	0.0	0.4	-0.4	-0.5
50^{th}	0.0	0.4	0.3	0.0	-0.2
75^{th}	0.2	0.4	0.5	0.2	-0.2
90^{th}	0.8	1.4	1.8	0.7	0.0

This table displays the consumption equivalent variation (CEV) for new retirees across productivity and wealth demographics. A positive CEV denotes the individual benefits from the Medicaid reform.

6 Conclusion

In the face on an ageing population, the United States is expected to increase its spending on long-term care services for the next several decades. Currently the U.S. spends 2.0% of GDP on long-term care and Medicaid pays for 52% of all expenditures.[27] Since 1999, there has been a growing effort by the federal government to promote home and community-based care through the Medicaid program. Formal home care is often financially less costly and preferred over institutionalized care at the individual level. However, states have been reluctant to extend benefits broadly to the aged population citing concerns over the program's cost. In this paper, I quantify the fiscal and welfare implications of the functional eligibility rules that govern Medicaid's long-term care programs for institutional and home care. I develop a general equilibrium overlapping generations model in which aged individuals face long-term health risk and make care decisions jointly with their adult child. I calibrate the model to the U.S. economy and a common set of state Medicaid eligibility rules. In the model, aged individuals can receive care in a nursing home, via a formal home health aid, and/or informally through their adult child. To my knowledge this is the first paper to address the variability in care needs beyond a binary health status in a heterogenous-agent

[27]Excluding Medicare, which covers some home health and nursing home stays that last less than 100 days and immediately follow a qualifying acute care hospitalization.

structural model while simultaneously distinguishing between the three aforementioned care settings. This approach allows me to incorporate Medicaid's functional eligibility rules into the model and discuss their implications on care utilization, Medicaid spending, and the burden of informal care provision.

I find that the costs associated with an expansion of Medicaid's home and community-based care programs, through a reduction in the functional eligibility requirements, are partially offset by a reduction in nursing home expenditures. In the model, for every additional $1,000 spent on home and community-based care for the elderly population, Medicaid's total expenditures on long-term care increase by $192. This cost reduction, driven by lower Medicaid financed nursing home utilization, is 2.3 times larger than the point estimate found in Guo et al. (2015). This is because I focus exclusively on the aged population and do not address long-term care services provided by Medicaid to the non-aged disabled population. Furthermore, the counterfactual exercise conducted in this paper corresponds to a targeted expansion among the heaviest users of Medicaid financed nursing homes. In the 1994, 1999, and 2004 waves of the National Long-Term Care survey 76% of nursing home residents fell into the fifth health state corresponding to requiring assistance with 3 or more activities of daily living.

Critically, I find that the individuals most likely to change their choice of care setting in response to a Medicaid expansion are higher income. These individuals gain access to Medicaid's long-term care programs through the optional spend-down rule. Absent this eligibility pathway, the cost reductions associated with home care benefit expansions would be reduced. Due to the cost-sharing requirement implicit in the Medicaid program the reform raises the per-capita Medicaid expenditures on its nursing home residents by 9.7%. This is driven by the fact that only low-income elderly remain in the Medicaid financed nursing homes. As higher income elderly switch into Medicaid financed home care, their cost sharing responsibilities fall as they are permitted to retain income up to the Medicaid

Maintenance Needs Allowance.

The fiscal implications of expanding Medicaid's coverage for home and community-based care extends beyond the direct costs to the Medicaid program. Lowering the functional eligibility threshold results in a smaller segment of the population opting for full-time work. This is strongest among low-productivity children with parents that have low levels of care needs. The impact on aggregate tax revenue is modest. With an increased share of the aged population residing in the community, rather than in institutions, there is an increased burden on other social welfare programs that serve the indigent population. I find that expenditures on the general consumption floor provided by the government increase by 2.8% following the reform. The fiscal interactions between public welfare programs is an important area of research I leave to future work.

In the model, Medicaid's expansion of home and community-based care benefits has an uneven effect on informal caregivers. While aggregate informal care hours rise after the reform, per capita care among households directly affected by the reform fall while per-capita informal care rises across all other demographic households. From a behind the veil perspective the median new retiree benefits from the expansion, equivalent to 0.9% of retirement consumption in the benchmark economy. Similarly, the median new born child benefits 0.3% of lifetime consumption following the reform.

References

Arno, P. S., C. Levine, and M. M. Memmott (1999): "The economic value of informal caregiving," *Health Affairs*, 18, 182–188.

Attanasio, O., S. Kitao, and G. L. Violante (2010): "Financing Medicare: A general equilibrium analysis," in *Demography and the Economy*, University of Chicago Press, 333–366.

Barczyk, D. and M. Kredler (2017): "Evaluating long-term-care policy options, taking the family seriously," *The Review of Economic Studies*.

Barro, J. and S. Barnes (2016): "Federal subsidization and state Medicaid provision," *Review of Economic Dynamics*, 21, 29–45.

Bolin, K., B. Lindgren, and P. Lundborg (2008): "Informal and formal care among single-living elderly in Europe," *Health economics*, 17, 393–409.

Bonsang, E. (2009): "Does informal care from children to their elderly parents substitute for formal care in Europe?" *Journal of health economics*, 28, 143–154.

Braun, R. A., K. A. Kopecky, and T. Koreshkova (2016): "Old, sick, alone and poor: A welfare analysis of old-age social insurance programs," *The Review of Economic Studies*, rdw016.

Brown, J. R. and A. Finkelstein (2004): "Supply or demand: why is the market for long-term care insurance so small?" Tech. rep., National Bureau of Economic Research.

——— (2008): "The interaction of public and private insurance: Medicaid and the long-term care insurance market," *The American Economic Review*, 98, 1083–1102.

Burwell, B., S. Eiken, P. Saucier, and K. Sredl (2016): "Medicaid Expenditures for Long-Term Services and Supports (LTSS) in FY 2014," Tech. rep., Truven Health Analytics.

Byrne, D., M. S. Goeree, B. Hiedemann, and S. Stern (2009): "Formal home health care, informal care, and family decision making," *International Economic Review*, 50, 1205–1242.

Casanova, P., M. Cheeks, S. Dorn, G. Eckart, T. Lutterman, and R. Peters (2016): "The use of 1915(I) Medicaid Plan Option for individuals with Mental Health and Substance Use Disorders," Tech. rep., U.S. Department of Health and Human Services.

Charles, K. K. and P. Sevak (2005): "Can family caregiving substitute for nursing home care?" *Journal of health economics*, 24, 1174–1190.

Cornachione, E., M. Musumeci, and M. O. Watts (2015): "Medicaid Financial Eligibility for Seniors and People with Disabilities in 2015," Tech. rep., The Henry J. Kaiser Family Foundation.

De Nardi, M., E. French, and J. B. Jones (2010): "Why do the elderly save? The role of medical expenses," *Journal of Political Economy*, 118, 39–75.

——— (2016): "Medicaid insurance in old age," *The American Economic Review*, 106, 3480–3520.

Ettner, S. L. (1994): "The Effect of the Medicaid Home Care Benefit On Long-Term Care Choices of the Elderly," *Economic Inquiry*, 32, 103–127.

——— (1995): "The impact of parent care on female labor supply decisions," *Demography*, 32, 63–80.

Friedberg, L., W. Hou, W. Sun, A. Webb, and Z. Li (2015): "New evidence on the risk of requiring long-term care," .

Genworth (2015): "Genworth 2015 Cost of Care Survey," Tech. rep., Genworth Financial.

Goda, G. S., E. Golberstein, and D. C. Grabowski (2011): "Income and the utilization of long-term care services: Evidence from the Social Security benefit notch," *Journal of health economics*, 30, 719–729.

Gordon, G. and S. Qiu (2017): "A Divide and Conquer Algorithm for Exploiting Policy Function Monotonicity," *Quantitative Economics*, forthcoming.

Gouveia, M. and R. P. Strauss (1994): "Effective federal individual income tax functions: An exploratory empirical analysis," *National Tax Journal*, 317–339.

Grabowski, D. C. and J. Gruber (2007): "Moral hazard in nursing home use," *Journal of Health Economics*, 26, 560–577.

Guo, J., R. T. Konetzka, and W. G. Manning (2015): "The Causal Effects of Home Care Use on Institutional Long-Term Care Utilization and Expenditures," *Health economics*, 24, 4–17.

Hansen, G. D., M. Hsu, and J. Lee (2014): "Health insurance reform: The impact of a medicare buy-in," *Journal of Economic Dynamics and Control*, 45, 315–329.

Harrington, C., T. Ng, S. H. Kaye, and R. Newcomer (2009): "Home and community-based services: Public policies to improve access, costs and quality," *UCSF, PAS, January*.

Harrington, C., J. H. Swan, and H. Carrillo (2006): "Nurse staffing levels and Medicaid reimbursement rates in nursing facilities," *Health services research*, 42, 1105–1129.

Harris-Kojetin L, S. M. and V. R. Park-Lee E (2013): "Long-term care services in the United States: 2013 overview," *National Center for Health Statistics*, 37.

Hendrickson, L. and G. Kyzr-Sheeley (2008): "Determining Medicaid nursing home eligibility: A survey of state level of care assessment," *Prepared by Rutgers Center for State Health Policy and Concentric Solutions Corporation under Grant*, 92015.

Hunt, G. G. and S. C. Reinhard (2015): "Caregiving in the U.S. 2015," Tech. rep., National Alliance for Caregiving and AARP Public Policy Institute.

Janicki, H. P. (2014): "The role of asset testing in public health insurance reform," *Journal of Economic Dynamics and Control*, 44, 169–195.

Kaye, H. S., M. P. LaPlante, and C. Harrington (2009): "Do noninstitutional long-term care services reduce Medicaid spending?" *Health Affairs*, 28, 262–272.

Kitao, S. (2014): "A life-cycle model of unemployment and disability insurance," *Journal of Monetary Economics*, 68, 1–18.

Kopecky, K. A. and T. Koreshkova (2014): "The impact of medical and nursing home expenses on savings," *American Economic Journal: Macroeconomics*, 6, 29–72.

Lilly, M. B., A. Laporte, and P. C. Coyte (2007): "Labor market work and home care's unpaid caregivers: a systematic review of labor force participation rates, predictors of labor market withdrawal, and hours of work," *Milbank Quarterly*, 85, 641–690.

Lin, H. (2015): "Quality choice and market structure: A dynamic analysis of nursing home oligopolies," *International Economic Review*, 56, 1261–1290.

Løken, K. V., S. J. Lundberg, and J. Riise (2014): "Lifting the burden: State care of the elderly and labor supply of adult children," .

MACPAC (2016a): "MACStats: Medicaid and CHIP Data Book," Tech. rep., Mediciad and CHIP Payment and Access Commission.

——— (2016b): "Report to Congress on Medicaid and CHIP," Tech. rep., Mediciad and CHIP Payment and Access Commission.

Mommaerts, C. (2016): "Are Family Care and Nursing Homes Substitutes? Evidence from Medicaid Spend-Down Provisions," *Working Paper*.

Muramatsu, N., H. Yin, R. T. Campbell, R. L. Hoyem, M. A. Jacob, and C. O. Ross (2007): "Risk of nursing home admission among older americans: does states' spending on home-and community-based services matter?" *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, 62, S169–S178.

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

Pezzin, L. E., P. Kemper, and J. Reschovsky (1996): "Does publicly provided home care substitute for family care? Experimental evidence with endogenous living arrangements," *Journal of Human Resources*, 650–676.

Reinhard, S. C., L. F. Feinberg, and A. Houser (2015): "Valuing the Invaluable: 2015 Update," Tech. rep., AARP Public Policy Institute.

Robinson, J. (2002): "A long-term care status transition model," *Unpublished paper*.

Stewart, K. A., D. C. Grabowski, and D. N. Lakdawalla (2009): "Annual expenditures for nursing home care: Private and public payer price growth, 1977–2004," *Medical care*, 47, 295.

Van Houtven, C. H. and E. C. Norton (2004): "Informal care and health care use of older adults," *Journal of health economics*, 23, 1159–1180.

Wolff, J. L., J. D. Kasper, and A. D. Shore (2008): "Long-term care preferences among older adults: a moving target?" *Journal of aging & social policy*, 20, 182–200.

Appendices

A National Long-Term Care Survey: Summary

In this appendix I include summary statistics for the 1994, 1999, and 2004 waves of the National Long-Term Care Survey (NLTCS) for the community, paid-care, and institutionalized populations.

Table 17: Summary Statistics (*institutional residents: 1994, 1999, and 2004*)

	1994		1999		2004	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Black	0.08	0.26	0.07	0.26	0.10	0.30
Female	0.74	0.44	0.75	0.43	0.74	0.44
Age	83.17	7.76	84.14	7.72	83.68	7.59
Number of ADLs	4.78	1.24	4.37	1.53	4.93	0.83
Cognitively Impaired (1=yes)	0.30	0.46	0.09	0.28	0.11	0.31
No Cog. Assessment	0.49	0.50	0.74	0.44	0.62	0.49
Married	0.19	0.39	0.16	0.37	0.18	0.39
Number of Children	1.29	1.82	1.73	1.72	2.06	1.91
< High School	0.36	0.48	0.47	0.50	0.42	0.49
College	0.41	0.49	0.23	0.42	0.28	0.45
Annual Income (thou. 2004$)	34.41	33.66	39.94	44.90	37.85	40.11
Top Income Bracket	0.19	0.40	0.09	0.29	0.11	0.31
Own Home	0.08	0.28	0.08	0.27	0.19	0.39
Medicaid Status	0.56	0.50	0.50	0.50	0.53	0.50
Payer: Out-of-pocket	0.53	0.50	0.47	0.50	0.39	0.49
Payer: Family	0.09	0.28	0.08	0.27	0.07	0.25
Payer: Insurance	0.04	0.20	0.08	0.27	0.05	0.22
Payer: Medicaid	0.48	0.50	0.48	0.50	0.50	0.50
Payer: Other	0.22	0.41	0.32	0.47	0.21	0.41
Observations	1,330		1,036		970	

Table 18: Summary Statistics (*community residents: 1994, 1999, and 2004*)

	1994		1999		2004	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Home Care Use	0.50	0.50	0.39	0.49	0.41	0.49
Paid Care Use	0.19	0.39	0.14	0.35	0.12	0.33
Unpaid Care Use	0.44	0.50	0.33	0.47	0.35	0.48
Hours of Home Care	14.44	35.01	11.37	30.77	14.01	34.36
Hours of Paid Care	3.08	16.84	2.74	16.56	3.28	16.89
Hours of Unpaid Care	11.35	29.24	8.63	24.95	10.73	29.29
Black	0.11	0.31	0.05	0.22	0.08	0.28
Female	0.64	0.48	0.63	0.48	0.62	0.48
Rural Area	0.23	0.42	0.21	0.41	0.21	0.41
Age	76.40	7.41	77.43	7.39	77.42	8.07
Number of ADLs	1.26	1.84	1.46	1.93	1.48	1.94
Number of IADLs	1.59	2.12	1.46	2.10	1.47	2.12
Cognitively Impaired (1=yes)	0.04	0.20	0.01	0.11	0.03	0.17
No Cog. Assessment	0.21	0.41	0.46	0.50	0.13	0.34
Married	0.52	0.50	0.53	0.50	0.57	0.49
Number of Children	2.55	2.23	2.56	2.08	2.70	2.14
< High School	0.47	0.50	0.42	0.49	0.35	0.48
College	0.26	0.44	0.30	0.46	0.36	0.48
Annual Income (thou. 2004$)	25.69	19.93	28.80	22.68	29.23	21.68
Top Income Bracket	0.02	0.15	0.02	0.14	0.03	0.17
Own Home	0.76	0.43	0.72	0.45	0.71	0.45
Medicaid Status	0.14	0.35	0.17	0.37	0.19	0.39
Payer: Out-of-pocket	0.11	0.31	0.07	0.26	0.06	0.24
Payer: Family	0.01	0.09	0.01	0.08	0.01	0.11
Payer: Insurance	0.01	0.10	0.01	0.12	0.01	0.09
Payer: Medicaid	0.02	0.13	0.02	0.15	0.02	0.14
Payer: Other	0.02	0.15	0.05	0.21	0.03	0.17
Observations	5,089		5,147		5,201	

Table 19: Summary Statistics (*paid care residents: 1994, 1999, and 2004*)

	1994		1999		2004	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Home Care Use	1.00	0.00	1.00	0.00	1.00	0.00
Paid Care Use	1.00	0.00	1.00	0.00	1.00	0.00
Unpaid Care Use	0.66	0.47	0.55	0.50	0.48	0.50
Hours of Home Care	35.83	55.02	35.49	53.21	40.32	52.99
Hours of Paid Care	16.61	36.11	19.44	40.24	26.63	41.18
Hours of Unpaid Care	19.22	38.91	16.05	33.84	13.69	31.07
Black	0.12	0.32	0.06	0.24	0.08	0.26
Female	0.75	0.43	0.72	0.45	0.75	0.43
Rural Area	0.21	0.41	0.18	0.39	0.15	0.36
Age	79.72	7.80	81.16	7.78	82.47	7.90
Number of ADLs	2.84	2.13	3.24	2.13	3.50	1.91
Number of IADLs	3.45	2.22	3.48	2.41	3.74	2.23
Cognitively Impaired (1=yes)	0.07	0.25	0.02	0.15	0.07	0.25
No Cog. Assessment	0.29	0.45	0.54	0.50	0.27	0.45
Married	0.38	0.49	0.36	0.48	0.43	0.50
Number of Children	2.09	2.08	2.45	2.33	2.14	1.95
< High School	0.46	0.50	0.45	0.50	0.37	0.48
College	0.29	0.45	0.30	0.46	0.39	0.49
Annual Income (thou. 2004$)	22.32	19.15	25.06	22.84	23.32	19.92
Top Income Bracket	0.02	0.15	0.02	0.13	0.02	0.16
Own Home	0.64	0.48	0.54	0.50	0.44	0.50
Medicaid Status	0.24	0.43	0.31	0.46	0.32	0.47
Payer: Out-of-pocket	0.60	0.49	0.53	0.50	0.48	0.50
Payer: Family	0.04	0.20	0.05	0.22	0.09	0.29
Payer: Insurance	0.05	0.22	0.10	0.29	0.07	0.25
Payer: Medicaid	0.10	0.30	0.16	0.37	0.16	0.36
Payer: Other	0.13	0.34	0.34	0.47	0.23	0.42
Observations	802-1,063		676-836		601-769	

B Definition of the Competitive Equilibrium

The competitive equilibrium of the model described in section 4 consists of a set of value function, $\{V^p(x), V^k(x), V^s(\hat{x})\}$, policy functions, $\{c_p(x),\ c_k(x),\ c_s(\hat{x}),\ a'_p(x),\ a'_k(x),\ a'_s(\hat{x}),\ n_k(x),\ n_s(\hat{x}),\ IC(x),\ inst(x)\}$, prices, $\{r,\ w_g,\ w_{FC},\ w_{inst},\ p_f,\ p_{inst}\}$, government policies, $\{\tau^c,\ \tau(y^{tax}),\ T^W,\ T^M,\ S(z_r),\ \bar{y},\ \bar{a},\ \bar{y}^{SD},\ h^I,\ h^H,\ \underline{y}_{inst},\ \underline{y}^{MNA}\}$, and invariant distributions, $\{\mu,\ \hat{\mu}\}$. Where $x \equiv \{j_i,\ a_i,\ z,\ z_r,\ a_{-i},\ h\}_{i\in\{k,p\}}$ and $\hat{x} \equiv \{j_k,\ a_k,\ z,\ b,\ j_d\}$.

1. Given prices and government policies the individuals' (parent and kid) policy functions solve their dynamic programming problem.

2. Given prices, production firms choose their demand for labor to maximize profits resulting in:

$$w_g = A_g \qquad w_f = \bar{p}_f A_f \qquad w_{inst} = \bar{p}_{inst} A_{inst}$$

   where $\bar{p}_f$ and $\bar{p}_{inst}$ denote the average price per unit received by the home health and nursing home firms.

3. The private-pay home health and nursing home prices, p^p_f and p^p_{inst}, adjust such that the home health and nursing home firms operate at zero profits.

4. The labor, goods, formal home care, and institutionalized care markets clear:

$$\int_X \epsilon(j,z) n_k(x) d\mu + \int_{\hat{X}} \epsilon(j,z) n_s(\hat{x}) d\hat{\mu} = N_g + N_f + N_{inst} = N$$

$$C + \bar{p}_f FC + \bar{p}_{inst} NH + K' + G = A_g N_g + \bar{p}_f A_f N_f + \bar{p}_{inst} A_{inst} N_{inst} + (1+r)K$$

   where

$$C = \int_X (c_k(x) + c_p(x))d\mu + \int_{\hat{X}} c_s(\hat{x})d\hat{\mu}$$

$$FC = \int_X (LOC(h, inst = 0) - IC(x))d\mu = A_f N_f$$

$$NH = \int_X LOC(h, inst = 1)inst(x)d\mu = A_{inst} N_{inst}$$

$$K' = \int_X (a'_p(x) + a'_k(x))d\mu + \int_{\hat{X}} a'_s(\hat{x})d\hat{\mu}$$

5. The distributions of individuals across states, $\{\mu, \hat{\mu}\}$, are consistent with the individuals' behavior:

$$\mu_{j+1}(X_0) = \int_{X_0} \Big\{ \int_X \Omega_j(x, x')d\mu_j \Big\} dx' \qquad \forall X_0 \in X$$

where $\Omega_j(x, x')$ is the probability that an individual at age j, and state x moves to state x'.

6. Government spending, G, adjusts such that the government period budget is satisfied in every period.

$$G + SS + MT = CT + IT$$

where G is unproductive government spending, SS is social security transfers, MT are means tested transfers, CT are consumption tax receipts, and IT are income tax receipts.

$$SS = \int_X S(x)d\mu$$

$$MT = \int_X (T^M(x) + T^W(x))d\mu + \int_{\hat{X}} T^W(\hat{x})d\hat{\mu}$$

$$CT = \int_X \tau^c(c_k(x) + c_p(x))d\mu + \int_{\hat{X}} \tau^c c_s(\hat{x})d\hat{\mu}$$

$$IT = \int_X \tau(y^{tax}(x))d\mu + \int_{\hat{X}} \tau(y^{tax}(\hat{x}))d\hat{\mu}$$