Welfare-enhancing public and private insurance arrangements for long-term care risk*†

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Abstract

Long-term care is costly. About 45 percent of 65-year-old Americans will require formal long-term care assistance during their lifetime and one in ten will incur out-of-pocket expenses of $200,000 or more. Surprisingly, only 10% of retirees have private long-term care insurance. We use a quantitative structural model to show that the obstacle to reforms that increase coverage is disagreement among low-, middle-, and high-income Americans about whether to increase the scale of private or public insurance. Then we present a reform that increases welfare across the income distribution because it increases private insurance takeup and reduces public long-term care expenditures while maintaining the current safety net provided by Medicaid.

Keywords: long-term care insurance; Medicaid; means-tested transfers; adverse selection; insurance rejections.

JEL Classification numbers: D82, D91, E62, G22, H30, I13.

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1 Introduction

The single largest financial risk faced by elderly Americans is the possibility of a costly long-term care (LTC) event. About one in three Americans will experience a nursing home stay exceeding 100 days during their lifetime, yet public LTC benefits are largely limited to the impoverished, and roughly one in twelve individuals will incur out-of-pocket expenses of $200,000 or more. Despite this risk, only about 10% of retirees have private long-term care insurance (LTCI). Instead, many middle-class and affluent Americans hold wealth until late in life and rely on personal savings to finance costly LTC needs.

These observations suggest that there should be a way to reform US LTC arrangements to increase insurance coverage, and we propose a reform that works. To evaluate reforms, we use a model to take explicit positions on the market failures responsible for the small size of the private LTCI market, as well as on the qualification rules and public benefit levels provided by Medicaid. The model captures both the challenges to, and opportunities for, reform. The central challenge is disagreement among individuals about how to increase total insurance coverage. Reducing the scale of public LTCI expands the private market and raises the welfare of affluent individuals, but generates large welfare losses for the poor and middle class. Expanding the scale of public LTCI has the opposite effects on private insurance and welfare.

Despite this disagreement, we show that it is possible to build a consensus around a reform to Medicaid eligibility rules. Under current policy, Medicaid benefits are means-tested and cover only residual qualifying LTC costs after private insurance has paid out. In other words, Medicaid acts as a secondary payer. We show that when Medicaid instead serves as the primary payer of LTC benefits, welfare increases across the income distribution. The poor are content because they hold little wealth and continue to qualify for means-tested Medicaid. Middle-class individuals benefit because they can now combine private and public insurance in ways that increase their total coverage against LTC risk and improve intertemporal consumption smoothing. Finally, affluent individuals benefit from a lower tax burden because aggregate Medicaid expenditures decline. The reduction in Medicaid outlays occurs because middle-income individuals save more for retirement reducing the likelihood that they will qualify for Medicaid. Their overall insurance coverage improves but their reliance on Medicaid falls. Outlays rise somewhat for affluent households, whose savings decline, but aggregate expenditures fall on net, leading to lower taxes.

We reach these conclusions using a general equilibrium optimal contracting model of US private and public LTC arrangements. One justification for public provision of LTCI is that informational restrictions and adverse selection hamper the private market. Our model incorporates these supply-side frictions and captures the three ways that US private insurers confront them. Namely, they allocate significant resources to screening applicants, reject those deemed high risk, and use risk-based pricing to design contracts for individuals who pass underwriting. Likewise, the insurer in our model sorts individuals into risk groups based on observable information and decides which risk groups to insure and which to deny coverage. He then optimally chooses the menu of contracts to offer each insurable risk group. Modeling the insurer's problem allows us to analyze how pricing, private insurer participation, private insurance coverage ratios, and insurer profits respond to reforms of

public LTC insurance.

Our optimal contracting model builds on the work of Hendren (2013), Chade and Schlee (2016), and Braun et al. (2019). Hendren (2013) and Chade and Schlee (2016) show that introducing administrative costs into the adverse selection framework of Stiglitz (1977) can generate coverage denials of high-risk individuals, as well as incomplete coverage and high premiums for those who pass underwriting. Braun et al. (2019) show that a model incorporating Medicaid, administrative costs, and asymmetric information can account for the low take-up of private LTCI, along with many other features of the US private LTCI market.

Previous research has found that individuals value means-tested Medicaid benefits for the elderly and has analyzed reforms that change the scale of these benefits (De Nardi et al. (2016), Kopecky and Koreshkova (2014), Braun et al. (2017) and Conesa et al. (2018)).[1] The largest component of Medicaid expenditures for the elderly is LTC, yet this literature abstracts from the private LTCI market. Thus, it is an open question whether public LTCI continues to be valued when individuals have the outside option of purchasing private LTCI. Our structural model suggests that public insurance is still valuable: ex ante welfare is higher in our baseline economy with means-tested Medicaid benefits than in the economy where the scale of Medicaid has been substantially reduced.

Brown and Finkelstein (2008) and Braun et al. (2019) study the interaction of Medicaid and private insurance in settings where Medicaid is means-tested and operates as a secondary payer. Both show that, under the secondary-payer provision, private LTCI provides little additional protection for individuals who have a high likelihood of qualifying for Medicaid because it reduces Medicaid benefits dollar-for-dollar. They find that Medicaid substantially crowds out demand for private LTCI and show that many low- and middle-class individuals prefer to run down their retirement wealth to qualify for Medicaid-financed LTC rather than purchase costly private LTCI policies. However, these studies do not consider the separate effects of Medicaid's means-test and secondary-payer provision, and Brown and Finkelstein (2008) do not model the supply side of the private LTCI market or retirement savings decisions.

We assess the individual role of the secondary payer provision in a model where individuals choose retirement savings and insurers adjust pricing and coverage in response to changes in public insurance arrangements. Our results indicate that the secondary payer rule has particularly pronounced crowding-out effects on middle-class saving incentives and reduces private LTCI demand of low-, middle-, and even higher-income individuals. When Medicaid instead acts as the primary payer, many middle-class individuals choose to save more for retirement and purchase private insurance, allowing them to enjoy higher consumption following an LTC event and to better self-insure against other idiosyncratic risks.

Other research analyzes the effects of historical policy reforms on the private LTCI market. Aizawa and Ko (2023) study how changes in the regulatory environment for private LTCI affected welfare and market performance. They find that shifting aggregate risk from policyholders to insurers modestly increased welfare but reduced insurer profits and increased market concentration. A second strand of the literature evalutes the Long Term Care Insurance Partnership (LCTIP) program, which relaxes Medicaid asset tests for individuals

[1] A related literature studies the effects of Medicaid benefits on working-age individuals and finds that they distort labor supply (Pashchenko and Porapakkarm, 2017; Capatina and Keane, 2025).

who purchase conforming private LTCI policies. The goal of the program is to increase private LTCI coverage and reduce reliance on Medicaid. Early studies, including Lin and Prince (2013), Goda (2011), and Bergquist et al. (2018), find relatively small effects of the program on LTCI take-up. More recent work using more years of data finds larger impacts. In particular, Costa-Font and Raut (2025) estimate that the LTCIP increases LTCI take-up by 14.7% and reduces Medicaid participation by 13.3%. More interestingly, they document heterogenous effects of the program across the wealth distribution: while LTCI take-up increases monotonically with wealth, Medicaid participation exhibits a hump-shaped response, with the largest declines in Medicaid takeup among middle-wealth individuals.

Our structural model of public, private, and self-insurance against long-term care risk allows us to analyze reforms that have not yet been implemented. We find that an important reason why ex ante welfare-improving reforms have failed to gain traction is disagreement across individuals over the appropriate scale of public insurance once income and health status are realized. The model also enables us to identify and vary the specific features of existing public policy arrangements that most strongly depress saving and demand for private LTCI. This opens the door to identifying novel policy reforms.

Finally, a large literature following the insight of Hubbard et al. (1994) emphasizes that asset tests in public insurance programs distort savings incentives. Recent contributions, including Wellschmied (2021) and Joyce and Singh (2025), document that asset-tested social insurance reduces precautionary savings among low-income individuals. Maynard and Qiu (2009) show that increases in Medicaid generosity during the late 1980s and early 1990s reduced the wealth of working-age households, with a U-shaped response across the wealth distribution. We show that increasing Medicaid generosity in our general equilibrium framework generates a similar quantitative pattern, with the largest declines in savings occurring in the middle of the wealth distribution. As in Hubbard et al. (1994), greater Medicaid generosity has a smaller effect on the saving behavior of wealthy individuals, who are unlikely to qualify for benefits, but it also has a smaller effect on poorer individuals, who are already relatively well insured by Medicaid in the baseline.

The remainder of the paper is organized as follows. Section 2 provides an overview of how LTC is provided and insured in the US. Section 3.1 presents a graphical analysis of the information frictions that provide a rationale for public insurance and illustrates how administrative costs and Medicaid's means-testing and secondary payer provisions affect pricing, coverage, and takeup of private LTCI. In Section 3.2, we illustrate how Medicaid impacts savings when agents have access to private insurance. Section 3.3 describes our quantitative general equilibrium model, and Section 4 provides an overview of how we parameterize the model. Our main results are reported in Section 5. Section 6 concludes.

2 Long-term care risk and coverage in the US

To motivate our analysis, we first describe the likelihood and cost of LTC events in the US, along with the structure of existing private and public insurance arrangements. An LTC event refers to a sustained period during which an individual requires assistance with activities of daily living (ADLs)—such as bathing, dressing, or eating—because of physical or cognitive impairments. The severity of need is commonly measured by the number of ADLs

an individual cannot perform without help. For instance, under the Health Insurance Portability and Accountability Act (HIPAA), an LTC event is defined as requiring assistance with at least two ADLs or substantial supervision due to cognitive impairment (Accountability Act, 1996). In our analysis, we define an LTC event as a spell during which assistance with ADLs is needed for more than 100 days but the individual is not terminally ill. By defining an LTC event in this way, we exclude short-term and end-of-life care that is largely covered by Medicare.[2]

The risk of an LTC event increases with age and is higher for women as compared to men. According to the estimates of Favreault and Dey (2022), as of age 65, the probability of meeting the HIPAA definition of need for care before death is 64 percent for women and 49 percent for men. Conditional on needing LTC, the average duration of care is only slightly higher for women (5.6 years versus 5.1 years). Variation in the risk of needing LTC is smaller by income and health status than by gender. The risk declines from about 63 percent for sixty-five-year-olds in the lowest income quintile to 54 percent for those in the highest, and by about 60 percent for sixty-five-year-olds with poor self-reported health to about 55 percent for those who report their health as good, very good, or excellent. On the one hand, higher-income and better health individuals are healthier, which reduces their risk of needing LTC, but on the other hand, they live longer, increasing their risk.

Most individuals who experience an LTC event rely on informal care from relatives or friends. Still, the risk of needing formal LTC before death remains substantial. Using the 2018 HRS, Gruber and McGarry (2023) show that 69 percent of current care recipients rely exclusively on informal care, most often provided by adult children (46 percent) or spouses (32 percent). Yet not all elderly individuals have family members or friends to rely on. Moreover, since informal caregiving can impose significant burdens on family members as care requirements intensify, the likelihood of using formal LTC rises with the severity of need. Among individuals aged 65 and older who are currently receiving care, the probability of formal care use is approximately 22 percent for those needing help with two ADLs and increases to about 50 percent for those needing help with three or more ADLs (Gruber and McGarry, 2023). Consistent with this pattern, Favreault and Dey (2022) estimate that 45 percent of sixty-five-year-olds will require formal LTC at some point before death. While about half will use formal care for less than one year, 37 percent will require two to four years of care and 10 percent more than five years.

Formal LTC services are costly. According to Genworth Financial (2024), the median annual cost in 2024 was $77,800 for in-home care provided by a home health aide and $111,325 for a semi-private room in a skilled nursing facility. Moreover, most LTC costs are not covered by Medicare. Instead, the main public insurer of LTC risk is Medicaid. It provides a basic level of support services in licensed LTC facilities and more recently at home. Eligibility, however, is tightly means-tested. In most states, individuals must hold less than $3,000 in countable assets and meet strict income criteria. Although the primary residence is often excluded from the asset test, Medicaid may place a lien on the home and recover expenditures from the estate after death. Medicaid is also a secondary payer of long-term

[2]Medicare provides near-universal medical coverage for adults aged 65 and older, including hospice care and short-term post-acute nursing care (fully covered for 20 days and partially covered for the next 80), but does not insure against the risk of needing prolonged long-term care.

care services. Coverage only comes into effect after all other payment sources (including private insurance) have been exhausted.

Given the lack of extensive public insurance, one might expect a large private market for LTCI. In practice, however, the market is small and shrinking: only about 10 percent of current retirees hold an LTCI policy, and overall market size has declined steadily since 2002 (U.S. Department of Treasury, 2020). The remaining market is highly concentrated, with a small number of insurers dominating new sales. In 2023, the three largest carriers accounted for 84 percent of newly issued policies (Thau et al., 2024).

Contracts offered in this concentrated market are characterized by strict underwriting, limited coverage, and high prices. Insurers screen applicants and reject those deemed too risky to insure to mitigate adverse selection, resulting in high denial rates. In 2022, 20 percent of applicants ages 50–59, 30 percent of applicants ages 60–64, and 38.2 percent of applicants ages 65–69 were denied coverage (American Association for Long-Term Care Insurance, 2024). Conditional on obtaining insurance, indemnities typically cover only 34–66 percent of expected losses and loads—markups over actuarially fair insurance—ranged from 0.18 excluding lapses to 0.51 including lapses in 2000, and from 0.32 to 0.50 in 2010 (Brown and Finkelstein, 2007, 2011). These loads are higher than those observed for other life insurance products. For example, Mitchell et al. (1999) estimate loads on life annuities of 0.15 to 0.25. One contributing factor is that underwriting and claims processing are considerably more complex for LTCI than for life insurance or annuity products.[3]

Taken together, low take-up of private LTCI, along with Medicaid's strict means tests and secondary-payer provisions, imply that many Americans rely on their own savings to finance formal LTC services. Indeed, Kopecky and Koreshkova (2014) find that LTC expenses are a primary driver of wealth accumulation during retirement. This finding suggests scope for reforms that increase total insurance coverage. Yet, under the current system, there is also substantial heterogeneity in exposure to LTC risk. Less affluent individuals—who are most likely to satisfy Medicaid's means tests—are relatively well insured through the public system, while highly affluent individuals can easily self-insure through private savings. In contrast, middle-class Americans, who are too affluent to readily qualify for Medicaid yet insufficiently wealthy to self-insure, face significant LTC risk. This heterogeneity in risk exposure makes it difficult to find LTC policy reforms that generate broad-based welfare gains.

3 The Model

Our quantitative general equilibrium model has multiple periods, incorporates multiple sources of uncertainty, and features heterogeneous individuals with private information about their LTC risk.[4] When young, individuals self-insure against LTC risk and other retirement risks through saving. Upon retirement, they may purchase private LTCI from a monopolistic issuer. The insurer uses observable indicators of LTC risk to assign individuals to risk

[3]See Eaton (2016), who finds that while broker commissions are similar across LTCI and other life insurance lines, underwriting and claims processing are more expensive for LTC policies.

[4]We use "LTC risk" and "NH risk" interchangeably throughout Section 3. The quantitative model, however, is calibrated specifically to NH risk.

groups, decides which risk groups to insure or deny coverage, and designs optimal contracts for those deemed insurable. Public LTCI is also available, but it is means-tested and acts as a secondary payer.

The quantitative model reproduces key empirical features of the U.S. private LTCI market, including participation and coverage patterns across health status and permanent earnings quintiles. Before presenting the quantitative model, we develop intuition for the underlying economic mechanisms using a static contract design problem in which a monopolistic LTCI issuer faces a single risk group. This one-period model is then used to illustrate how Medicaid's crowd-out effects on private insurance can be mitigated by making it a primary payer. Finally, we introduce a simple two-period model to show how switching Medicaid from a secondary to a primary payer affects saving behavior and aggregate Medicaid outlays.

3.1 The one-period model

Consider a continuum of individuals each with resources $w+a$ and private type $i \in \{L, H\}$.[5] The fraction of individuals with private type L is ψ and the fraction with private type H is $1-\psi$. The risk of entering a nursing home (NH), θ^i, is lower for type-L individuals than type-H individuals, i.e., $0 < \theta^L < \theta^H < 1$. The simple model has two instances of time. At the beginning of the period, individuals decide whether to purchase an LTCI contract. Then the NH event is realized and $\eta \equiv \psi\theta^L + (1-\psi)\theta^H$ individuals incur NH expenses m.[6] If eligible, NH entrants may receive public LTCI benefits. The benefit level for type i is given by T^i. LTCI contracts specify a premium and an indemnity and are type specific. The premium for type i is π^i and the net indemnity is $\iota^i - \pi^i$.

The individuals' problem. Individuals are risk-averse and maximize utility subject to participation and incentive compatibility constraints. An individual of type i solves

$$\max_{c^i_{NH}, c^i, \pi^i, \iota^i} \theta^i u(c^i_{NH}) + (1-\theta^i)u(c^i), \tag{1}$$

subject to

$$c^i = w + a - \pi^i, \tag{2}$$

$$c^i_{NH} = w + a - m + \iota^i - \pi^i + T^i, \tag{3}$$

$$\tag{4}$$

where $u(c) = c^{1-\sigma}/(1-\sigma)$ with $\sigma > 0$ and T^i are public NH benefits.

The insurer's problem. The insurer cannot directly observe an individual's risk exposure type i and faces claims processing costs ($\lambda - 1 \geq 0$) that are proportional to indemnities. He chooses a menu of contracts to offer that maximizes his expected profits subject to the

[5] We give individuals two endowments here to facilitate comparison with our quantitative model which has multiple periods and saving. In that model, w is the endowment and a is beginning-of-period asset holdings.

[6] A NH (or equivalently LTC event) in the model is an expense shock. These expenses represent the care component of NH costs.

participation and incentive compatibility constraints of each private type by solving

$$\max_{\{\pi^i,\iota^i\}_{i\in\{L,H\}}} \psi[\pi^L - \lambda\theta^L\iota^L] + (1-\psi)[\pi^H - \lambda\theta^H\iota^H], \tag{5}$$

subject to

$$(PC_i) \quad U(\theta^i\pi^i, \iota^i) - U(\theta^i, 0, 0) \geq 0, \quad i \in \{L, H\}, \tag{6}$$

$$(IC_i) \quad U(\theta^i, \pi^i, \iota^i) - U(\theta^i, \pi^j, \iota^j) \geq 0, \quad i, j \in \{L, H\}, \tag{7}$$

where $U(\theta^i, \pi^i, \iota^i) = \theta^i u(c^i_{NH}) + (1-\theta^i)u(c^i)$. Equation (6) states that each type $i \in \{L, H\}$ must be at least as well off with the contract designed for them as they would be if they did not purchase any private insurance. Equation (7) states that individuals must weakly prefer their own contract to the contract designed for the other private type.

It will be helpful in the graphical analysis that follows to refer to the optimality conditions for the insurer's problem

$$MRS(\theta^L, \pi^L, \iota^L) = \lambda\eta, \tag{8}$$

$$MRS(\theta^H, \pi^H, \iota^H) = \lambda\theta^H, \tag{9}$$

$$U(\theta^L\pi^L, \iota^L) - U(\theta^L, 0, 0) = 0, \tag{10}$$

$$U(\theta^H, \pi^H, \iota^H) - U(\theta^H, \pi^L, \iota^L) = 0, \tag{11}$$

where the marginal rate of substitution (MRS) of type i,

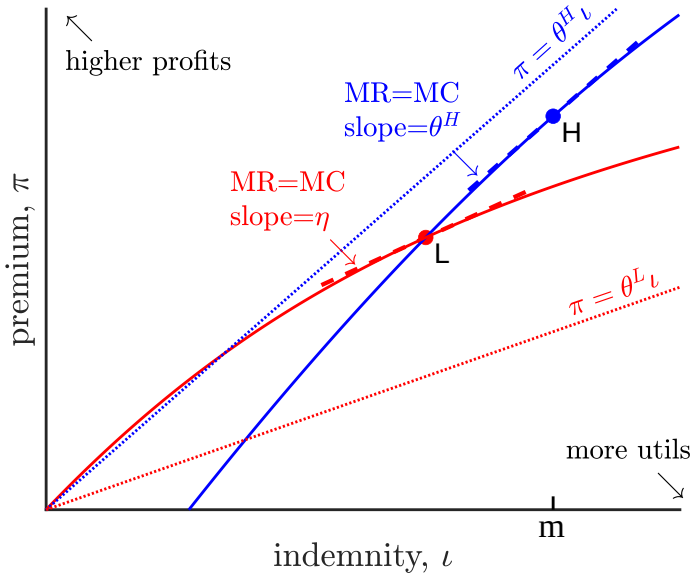
$$MRS(\theta^i, \pi^i, \iota^i) = -\frac{dU(\theta^i, \pi^i, \iota^i)/d\iota^i}{dU(\theta^i, \pi^i, \iota^i)/d\pi^i},$$

is the amount by which the indemnity ι^i must increase given a marginal increase in the premium π^i so as to keep type i's utility constant. Observe that at the optimal menu of contracts, the participation constraint binds for type L and the incentive compatibility constraint binds for type H.

Optimal contracts with no claims processing costs or public insurance. When claims processing (CP) costs are zero ($\lambda = 1$) and public insurance is absent ($T^L = T^H = 0$), our model is equivalent to the specification considered by Stiglitz (1977). Figure 1 illustrates the optimal contracts in this case. The solid curved lines are (indirect) indifference curves of types L and H with utility increasing to the southeast.[7] The slopes of the dashed lines are the marginal costs of insuring each given type. The contracts at points L and H satisfy the optimality equations (8)–(11). At point L, the MRS (marginal revenue) equals marginal cost for type L—equation (8). At point H, the same condition holds for type H—equation (9). Type L's participation constraint binds because his indifference curve passes through the origin indicating that he is indifferent between no insurance and contract L, in other words, equation (10) is satisfied. Equation (11) is satisfied too. The participation constraint of type H is binding because his indifference curve passes through point L indicating that

[7]The indifference curves are implicit functions of consumption. Our objective is to illustrate how admin-

Figure 1: Optimal contracts with no administrative costs and no public insurance



Note: Point H is the optimal contract for type-H individuals and point L is the optimal contract for type-L individuals. The parametrization used to create the figure is $\sigma = 1.1$, $\psi = 0.8$, $\theta^L = 0.2$, $\theta^H = 0.5$, $w + a = 1.0$, $m = 0.8.$, $\lambda = 1$, and $\underline{c}_{NH} = 0$.

he is indifferent between the two contracts.

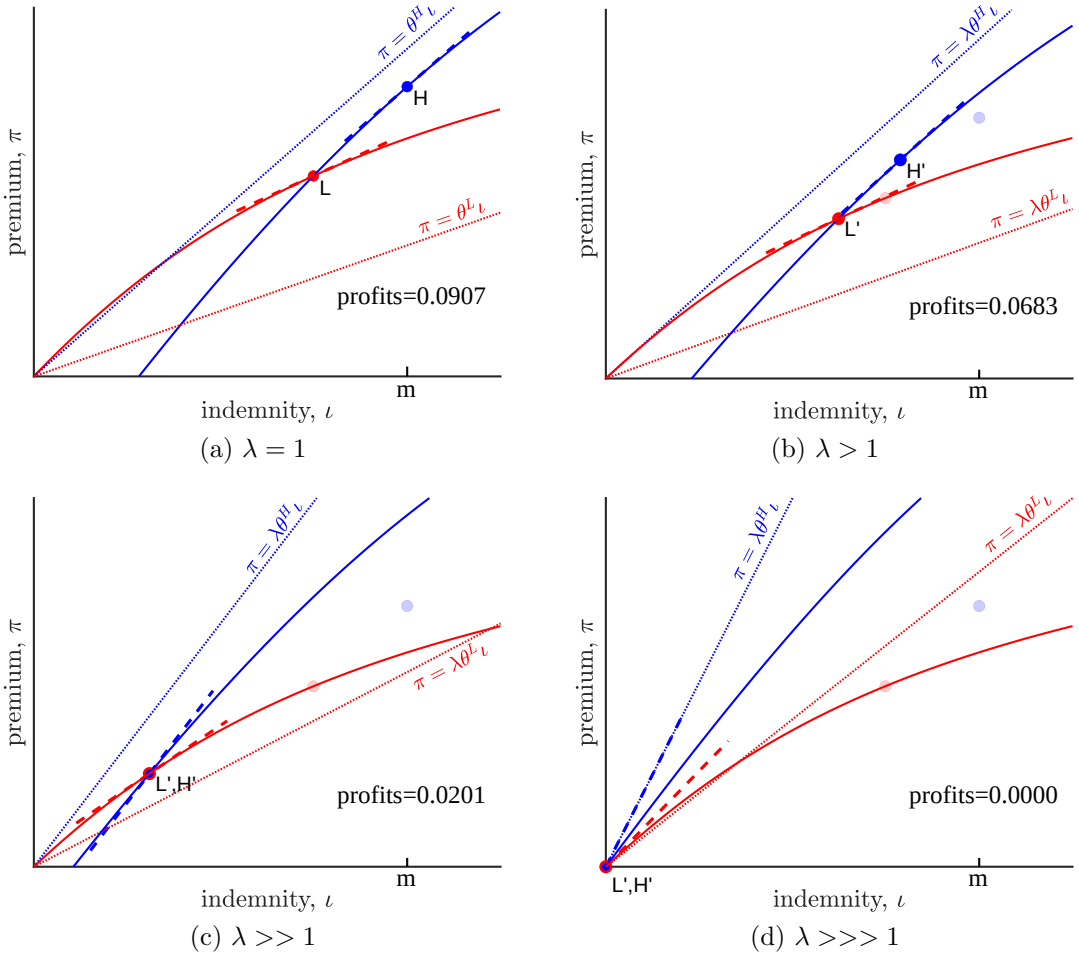
As Figure 1 shows, the optimal contracts are separating and feature full coverage of the loss m for high-risk (H) types and partial coverage for low-risk (L) types.[8] While high-risk types always receive full insurance, the optimal contract for low-risk types may involve no coverage at all. To understand why, notice that, when low-risk types obtain positive insurance, the optimal contracts always feature cross-subsidization from low-risk to high-risk types. The dotted straight lines in the figure are actuarially fair contract rays (along which expected indemnities equal premium revenue within the given type). The optimal contract for type H lies below its zero-profit ray, implying losses on high-risk contracts, whereas the optimal contract for type L lies above its zero-profit ray, generating offsetting profits. As long as profits are positive on net, the optimal menu will feature a positive amount of coverage for both types. However, cross-subsidization becomes more costly when high-risk individuals become relatively more expensive to insure—either because their risk of nursing home entry increases or because their share of the risk pool rises. Once cross-subsidization is no longer profitable, the optimal menu excludes low-risk types—consisting of a full-coverage contract for type H and a $(0, 0)$ contract for type L.[9]

istrative costs and public insurance influence the pricing and coverage of private insurance contracts. It is easier to do this in the contract space than in the consumption space.

[8]The optimal contracts are always separating. Consider a pooling contract at point L. MRS is steeper than marginal cost for type H at this point, so contracts to the right along type H's indifference curve remain incentive compatible while reducing insurer losses.

[9]Optimal contracts with incomplete coverage for low-risk types and cross-subsidization arise because of asymmetric information. Under full information, both types receive a full coverage contract, but the insurer extracts all the surplus. The optimal contracts lie at the intersection of each type's binding participation constraint and a vertical line passing through point **m**. Type L's utility is unchanged as in both cases he is on his participation constraint, while type H's utility falls due to higher premiums.

Figure 2: Optimal contracts with administrative costs



Note: Panel (a) shows the baseline case with no administrative costs ($\lambda = 1$). In panel (b), administrative costs are positive ($\lambda > 1$), and the optimal contract menu is separating. In panel (c), administrative costs are higher ($\lambda \gg 1$), and the optimal menu is a pooling contract with positive coverage. In panel (d), administrative costs are even higher ($\lambda \ggg 1$) and the optimal menu is a pooling $(0, 0)$ contract. Faded dots in panels (b)–(d) denote the optimal contracts in the absence of administrative costs. The parameterization used to create the figure is $\sigma = 1.1$, $\phi = 0.8$, $\theta^L = 0.2$, $\theta^H = 0.5$, $w + a = 1.0$, $m = 0.8$, $\lambda \in \{1, 1.15, 1.65, 2.5\}$, and $\underline{c}_{NH} = 0$.

Notice that the optimal contracts are inconsistent with two of the main features of the US private LTCI market described in Section 2. First, conditional on obtaining insurance, policies in the US private LTCI market only provide partial coverage. In contrast, in the model, high-risk types always receive full insurance. Second, in the US market, entire risk groups are deemed unprofitable and denied coverage. In contrast, in the model, at least one non-zero insurance contract is always offered to the risk group—the one designed for the high-risk types.

Optimal contracts with claims processing costs. Setting $\lambda > 1$ introduces proportional claims processing costs, which raise the marginal cost of providing insurance to both types, as shown in equations (8) and (9). Modeling these administrative costs substantially alters the optimal contracts, generating features that better resemble the US private LTCI

market. Coverage becomes incomplete even for high-risk types, and if λ is sufficiently high, profitable contracts no longer exist, leading the insurer to deny coverage to the entire risk group.[10]

Figure 2 illustrates how optimal contracts evolve as claims processing costs increase. As λ rises, higher marginal costs reduce coverage ratios, moving both high- and low-type contracts down the agents' indifference curves toward the origin. At the same time, cross-subsidization becomes progressively more costly as the slopes of the zero-profit rays (the dotted lines) increase, reducing profits on low-risk contracts and increasing losses on high-risk contracts. When claims processing costs are moderate, the insurer continues to use separating contracts and cross-subsidization to confront asymmetric information. As λ rises further, however, cross-subsidization becomes infeasible, and a pooling equilibrium emerges as illustrated in Panel 2c. At the optimal pooling contract, marginal cost exceeds the MRS for high-risk types, but incentive compatibility prevents the insurer from offering them a lower coverage contract.

For sufficiently large λ, coverage falls to zero as reported in Panel 2d. Since marginal cost exceeds MRS for both types at $(0, 0)$, no profitable insurance contracts exist and the entire risk group is denied coverage.[11] All else equal, denials are more likely when the fraction of high-risk types, $1 - \psi$, is large or when high-risk individuals face substantially higher NH entry risk than low-risk individuals ($\theta^H >> \theta^L$), as both increase the overall cost of insuring the risk group, reducing profitability. Denials are also more likely when endowments are high relative to expected losses, as this lowers individuals' marginal rates of substitution relative to marginal costs, indicating that the entire risk group prefers to self-insure. This last channel proves important for generating low private LTCI participation among higher-income individuals in our quantitative model.

Optimal contracts with public insurance. The availability of means-tested public insurance has a large impact on the private market. By reducing individuals' willingness to pay (WTP) for private coverage, public insurance lowers the profitability of private LTCI and can eliminate private coverage altogether if a risk group's endowment is sufficiently low. To illustrate these effects, assume public NH benefits are given by

$$T^i = \max\left\{0, \underline{c}_{NH} - \left[w + a - m + \iota^i - \pi^i\right]\right\}, \tag{12}$$

which makes them just enough to provide their recipient with the level of consumption $\underline{c}_{NH}$ in the NH state.

Equation (12) is a stylized representation of how Medicaid works in practice that effectively captures the program's two key features. First, benefits are means-tested, declining

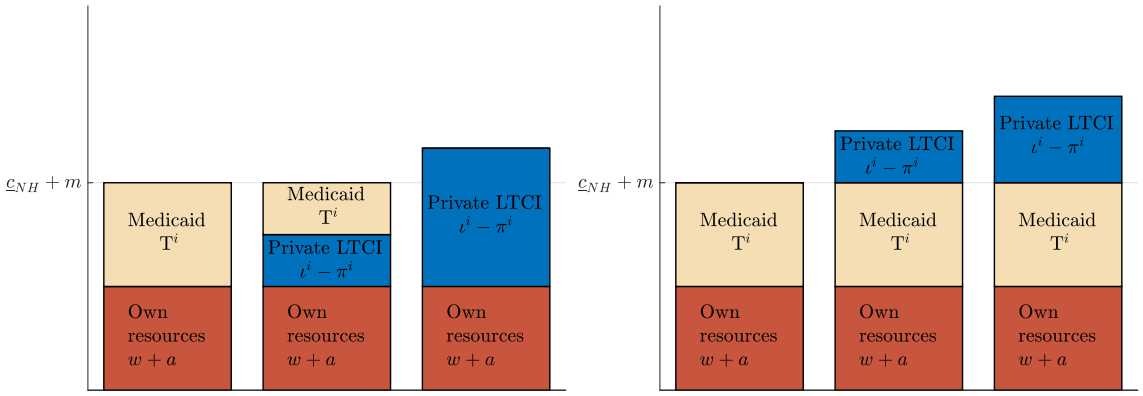
[10] Administrative costs also strengthen the case for public insurance, as emphasized in the public finance literature (Gruber, 2022). Suitably designed public insurance can extend coverage to groups denied private insurance and can supplement coverage for insured risk groups. Public provision may also avoid administrative costs faced by private insurers, such as underwriting expenses and commissions paid to insurance brokers.

[11] While there are no profitable menus with private information, notice that the slope of the zero-profit ray is flatter than the slope of the low-risk type's indifference curve at $(0, 0)$. The optimal menu with full information would feature positive insurance for low-risk types and no insurance for high-risk types at this value of λ.

with an individual's endowment. Second, Medicaid operates as a secondary payer, reducing benefits one-for-one with net private insurance payouts. Figure 3a illustrates this mechanism for an individual who experiences an NH event and qualifies for Medicaid in the absence of private insurance ($\underline{c}_{NH} + m > w + a$). The figure shows that purchasing private LTCI does not increase total resources in the NH state unless the individual forgoes Medicaid entirely, since any private payout reduces public benefits dollar-for-dollar.

Because Medicaid benefits are means-tested, their effects on private insurance coverage and pricing depend on individuals' income and wealth. For very wealthy individuals, Medicaid will have no direct impact. For individuals with more moderate income and wealth, however, it alters private LTCI contracts in ways that depend on the amount of resources they have at the time of NH entry. Figure 4 illustrates Medicaid's effects by comparing optimal contracts in the absence of public NH insurance (panel 4a) with those that arise when it is available (panels 4b and 4c).[12] In both Medicaid cases, individuals would qualify for public benefits in the absence of private LTCI ($\underline{c}_{NH} > w + a - m$), but the size of their endowment relative to the Medicaid consumption floor differs across panels: in panel 4b endowments are low relative to $\underline{c}_{NH}$, while in panel 4c they are relatively high.

Figure 3: Total resources in the LTC state under different insurance arrangements when Medicaid is a secondary payer versus a primary payer



(a) Medicaid secondary payer (b) Medicaid primary payer

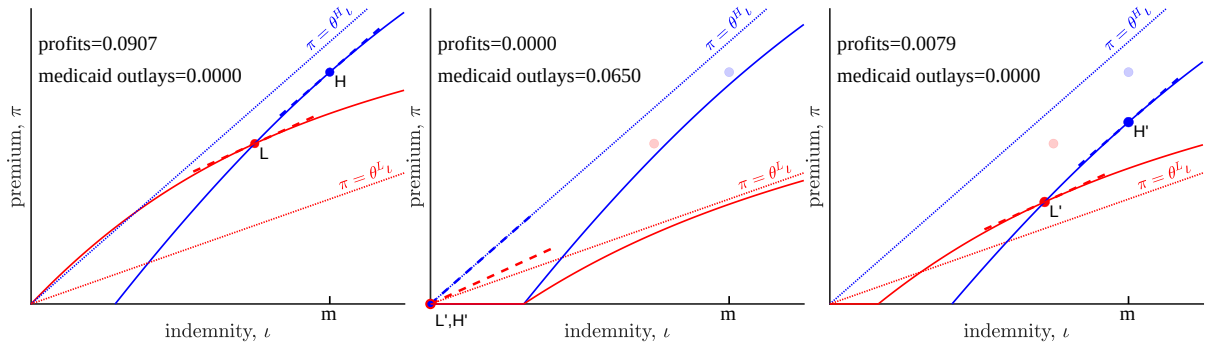
Note: The figure shows total resources for an individual who would qualify for Medicaid in the absence of private insurance (i.e., $\underline{c}_{NH} + m > w + a$). Panel (a) considers the case in which Medicaid is a secondary payer. Panel (b) considers the case in which Medicaid is a primary payer. In each panel, the left bar corresponds to no private insurance, and the middle and right bars illustrate how total resources change as private long-term care insurance coverage increases.

The secondary-payer provision is central to the changes in optimal contracts shown in Figure 4. By improving individuals' outside option, it tightens their participation constraints, leading to the kinks and downward shifts in the indifference curves in panels 4b and 4c.[13] Individuals are unwilling to purchase contracts to the left of the kinks because they offer less coverage than they can get for free from Medicaid. To the right of the kinks, private insurance provides more coverage of the loss than Medicaid, but because individuals can get free Medicaid benefits if they don't purchase private LTCI, WTP for that coverage declines. When the consumption floor is high relative to endowments, as in panel 4b, no menu of

[12] Claims processing costs are absent in all Medicaid scenarios.

[13] Recall that indifference curves are defined over contracts, not consumption.

Figure 4: Optimal contracts when public insurance is means-tested and a secondary payer



(a) $\underline{c}_{NH} = 0$ (b) $w + a$ low relative to $\underline{c}_{NH}$ (c) $w + a$ high relative to $\underline{c}_{NH}$

Note: Panel (a) shows the baseline case with no public insurance ($\underline{c}_{NH} = 0$). In panel (b), $w + a$ is low relative to $\underline{c}_{NH}$, and the optimal contract menu is a pooling $(0, 0)$ contract. In panel (c), $w + a$ is high relative to $\underline{c}_{NH}$, and the optimal contract menu is separating with positive coverage for both types. Faded dots in panels (b) and (c) denote the optimal contracts in the absence of public insurance. The parameterization used to create the figure is $\sigma = 1.1$, $\phi = 0.8$, $\theta^L = 0.2$, $\theta^H = 0.5$, $w+a = 1.0$, $m = 0.8$, $\lambda = 1$, $\underline{c}_{NH} \in \{0, 0.45, 0.33\}$.

contracts that are both attractive to individuals and profitable to the insurer exists. When endowments are higher, as in panel 4c, private insurance remains viable and, as in the baseline, high-risk types receive full coverage, but insurers must offer more generous terms to induce participation. Consequently, premiums and profits are substantially lower than in the absence of Medicaid. Modeling these crowding out effects of Medicaid plays a central role in our quantitative model's ability to reproduce low takeup rates of private LTCI among lower-income Americans.

Optimal contracts when public insurance is a primary payer. Figure 4 shows that when Medicaid is a secondary payer, it reduces WTP for private insurance and crowds out the private market by both shrinking the set of risk groups that are profitable to insure and reducing profits within insurable groups. If Medicaid remains means-tested but instead becomes a primary payer, these crowd-out effects are attenuated, leading to both a larger set of profitable risk groups and higher profits among those previously insurable.

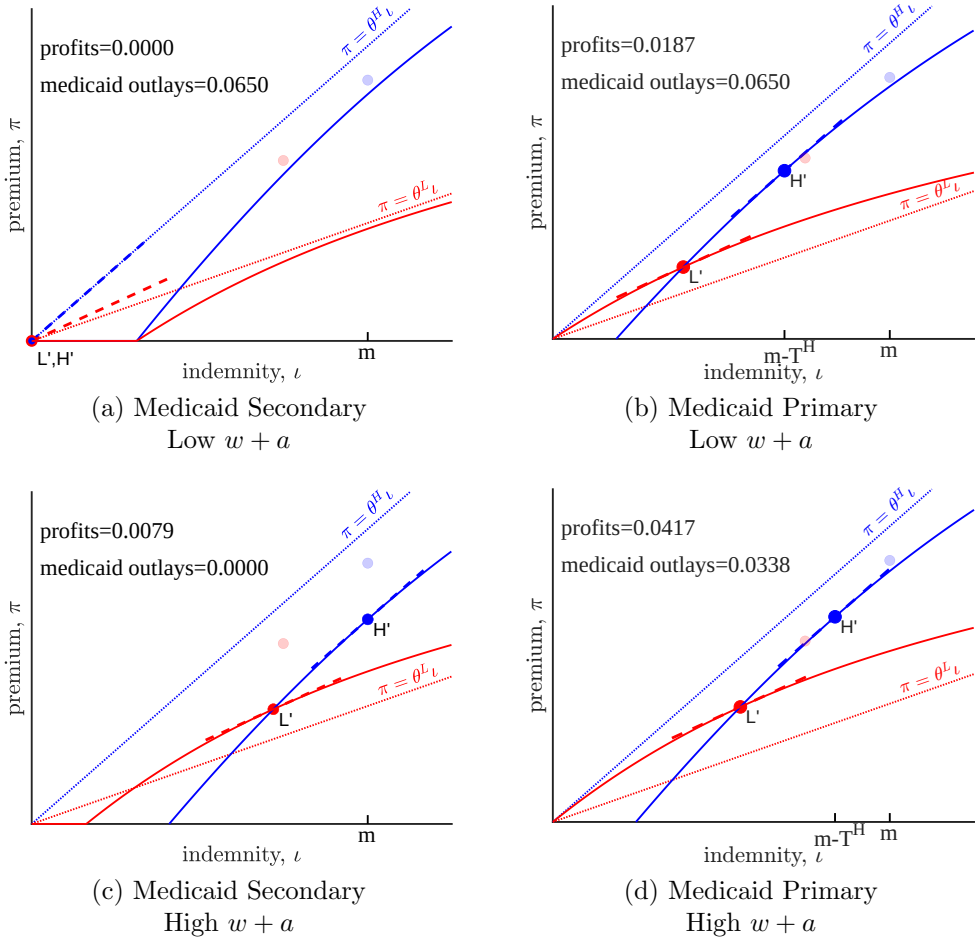
To illustrate this case, suppose public nursing home benefits are instead given by

$$T = \max\Big\{0, \underline{c}_{NH} - \big[w + a - m\big]\Big\}. \tag{13}$$

Public insurance remains means-tested, since individuals with sufficiently high endowments do not receive benefits, but individuals who may qualify for Medicaid now have a stronger incentive to purchase private insurance. As shown in Figure 3b, private insurance becomes a top-up to public coverage: individuals receive public benefits of T and can insure part or all of the residual loss $m - T$. As a result, while marginal WTP for additional private insurance is lower—because the effective loss is smaller—participation constraints are relaxed. Thus, whereas secondary-payer Medicaid tightens participation constraints, primary-payer Medicaid instead reduces marginal rates of substitution.

Figure 5 compares optimal contracts when Medicaid acts as a secondary payer versus a primary payer for the same two risk groups considered in Figure 4. Consider first the risk

Figure 5: Optimal contracts when public insurance is means-tested and a primary payer



(a) Medicaid Secondary
Low $w + a$

(b) Medicaid Primary
Low $w + a$

(c) Medicaid Secondary
High $w + a$

(d) Medicaid Primary
High $w + a$

Note: Panels (a) and (c) reproduce panels (b) and (c) of Figure 4 for ease of comparison. In panels (a) and (b), $w + a$ is low relative to $\underline{c}_{NH}$. Panel (a) shows the optimal contract menu when Medicaid is a secondary payer, while panel (b) shows the corresponding menu under the same parameterization when Medicaid is a primary payer. In panels (c) and (d), $w + a$ is high relative to $\underline{c}_{NH}$. Panel (c) shows the optimal contract menu when Medicaid is a secondary payer, and panel (d) shows the corresponding menu when Medicaid is a primary payer. Faded dots in panels (a)–(d) denote the optimal contracts in the absence of public insurance. The parameterization used to create the figure is $\sigma = 1.1$, $\phi = 0.8$, $\theta^L = 0.2$, $\theta^H = 0.5$, $w+a = 1.0$, $m = 0.8$, $\lambda = 1$, with $\underline{c}_{NH} = 0.45$ in the upper panels and $\underline{c}_{NH} = 0.33$ in the lower panels.

group with low endowments, $w+a$, relative to $\underline{c}_{NH}$. Under the baseline Medicaid secondary-payer arrangement, this group is uninsurable and the private insurer earns zero profits. When Medicaid instead acts as the primary payer, participation constraints are relaxed and both high-risk and low-risk types choose to purchase private coverage. Medicaid outlays to the risk group remain unchanged relative to the baseline, but total insurance coverage against the loss increases because individuals now supplement public insurance with private LTCI.

In contrast, for the risk group with high endowments, private insurance contracts are smaller when Medicaid acts as the primary payer, as shown in panels 5c–5d. When Medicaid acts as a secondary payer, this group receives no public insurance benefits because net private indemnities count toward the Medicaid means test. When Medicaid serves instead as the primary payer, net private indemnities are excluded from the means test, and individuals in this group now qualify for Medicaid benefits. As a result, Medicaid outlays for the group

increase from zero to 0.0338. With Medicaid covering a share of the loss, the marginal value of additional private insurance (MRS) declines for both types, leading to lower coverage levels and premiums. Despite the smaller contract size, insurer profits are higher than under the Medicaid secondary-payer arrangement. This is due to the relaxation of the participation constraint: individuals no longer need to pay for coverage they could otherwise obtain for free through Medicaid in order to purchase additional protection. In this setting, private insurance becomes more valuable at the margin because the net private indemnities are excluded from the Medicaid means test. In both the high- and the low-endowment risk group, high-risk individuals receive full coverage of the loss with Medicaid covering T^H and private insurance covering $m - T^H$.

We conclude the analysis of the one-period model by summarizing its main properties. First, when Medicaid and claims processing costs are absent, high-risk types always receive complete coverage. Type L may be excluded, but LTCI takeup in a given risk group is always positive. Second, claims processing costs increase the marginal cost of private insurance, leading to lower takeup rates, coverage ratios, and profits. In the presence of these costs, risk groups with high endowments relative to the loss, or with a high share of high-risk individuals, are more likely to be excluded, and aggregate LTCI participation can decline. Third, means-tested public insurance crowds out private coverage and can generate no-trade outcomes for risk groups with sufficiently low endowments, further reducing aggregate LTCI participation. Fourth, crowding out is particularly strong when Medicaid acts as a secondary payer. When Medicaid is instead a primary payer, private LTCI participation increases. Medicaid recipiency rates also increase, leading to higher aggregate Medicaid expenditures. This last result, however, contrasts with the findings from our quantitative model, which incorporates multiple periods and a retirement saving decision. As we show next, allowing agents to choose savings before purchasing private LTCI can cause total Medicaid spending to decline.

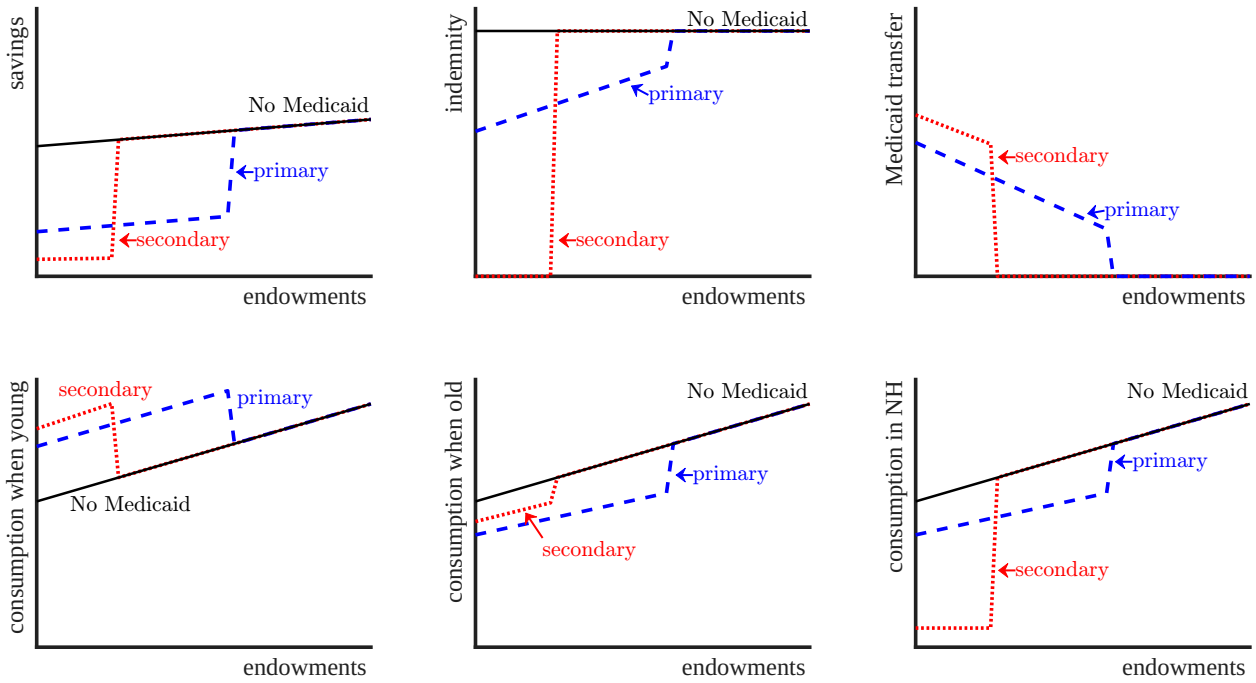
3.2 The two-period model

To illustrate how Medicaid's payer status affects retirement saving and aggregate Medicaid spending, we introduce a simple two-period model that adds an intertemporal saving decision prior to private LTCI purchase and the realization of long-term care risk.[14] The purpose of this framework is to demonstrate how Medicaid's secondary- versus primary-payer status distorts saving incentives and impacts Medicaid outlays, abstracting from supply-side considerations, private information, and administrative costs.

The model extends Hubbard et al. (1995), who show that asset tests in public insurance generate nonconvex budget sets that depress saving incentives among low-income individuals, but abstract from private insurance. Individuals receive an endowment in each period and face a positive probability of incurring NH expenses in period 2. Medicaid provides free insurance that guarantees a minimum level of consumption in the NH state but is means-tested. Individuals choose consumption and saving in period 1 and, at the beginning of period 2, decide how much private insurance to purchase. For simplicity, private insurance is

[14]The full model and its analysis are presented in Appendix Section 7.2.

Figure 6: Optimal savings, insurance, and consumption as endowments increase in the 2-period model



Note: Starting with the top-left panel and moving clockwise, the figure reports optimal savings, private insurance indemnities, Medicaid transfers, consumption when young, consumption when old and not in a NH, and consumption when in a NH as functions of endowments under three versions of the two-period model: no Medicaid (solid lines), Medicaid as a secondary payer (dotted lines), and Medicaid as a primary payer (dashed lines). In each panel, period-1 and period-2 endowments increase proportionally along the x-axis. See Appendix Section 7.2 for details on the model and parameterization.

actuarially fair and consists of an indemnity in the NH state and a premium in the non-NH state.[15] The discount factor and gross return on savings are normalized to one.

Figure 6 summarizes optimal saving, private insurance indemnities, Medicaid transfers, and consumption as a function of endowments under three scenarios: no Medicaid, Medicaid as a secondary payer, and Medicaid as a primary payer.[16] Absent Medicaid, all individuals fully insure against NH risk through private insurance, and consumption is perfectly smoothed over time and across NH states.

When Medicaid operates as a secondary payer, individuals with low endowments choose to consume most of their income when young and rely on Medicaid if they experience an NH event. As in our one-period model, private insurance is unattractive for these individuals because Medicaid provides a relatively generous consumption floor. Saving is also discouraged because assets only increase consumption in the non-NH state. Although this strategy results in incomplete insurance and limited intertemporal smoothing, the availability of free Medicaid benefits makes it optimal. Individuals with higher endowments instead forgo Medicaid, purchase private insurance, and perfectly smooth consumption over time and across NH states.

When Medicaid acts as a primary payer, saving incentives change. Low-endowment indi-

[15]This setup is equivalent to assuming that the premium is paid in both old-age states and that the indemnity is net of the premium.

[16]Both the period-1 and period-2 endowment increase proportionally along the x-axes.

viduals now purchase top-up private insurance to increase NH-state consumption above the Medicaid floor, equalizing consumption across NH states. Because assets can now increase consumption in both old-age states, the marginal benefit of saving rises, and these individuals carry more wealth into period 2. Savings are still lower than in the no-Medicaid benchmark because free Medicaid benefits reduce the size of the loss in the NH state, but Medicaid's distortionary effect on the savings of low-endowment individuals is reduced. Individuals with intermediate endowments who previously didn't qualify for Medicaid respond differently: by saving less and purchasing less private insurance, they become eligible for Medicaid transfers, trading off lower insurance expenditures against reduced consumption smoothing. Saving and insurance choices of the highest-endowment individuals do not change as they continue to prefer to perfectly smooth their consumption over both time and NH states.

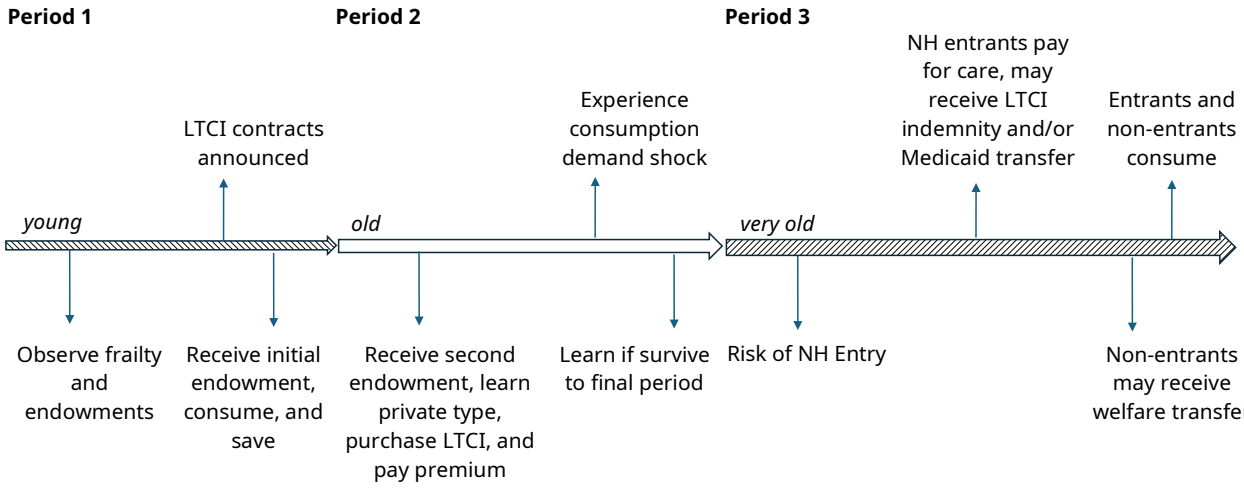
The two-period model highlights that aggregate Medicaid spending can fall when Medicaid becomes a primary payer, depending on the endowment distribution. Transfers to the lowest-endowment individuals decline, while transfers to middle-endowment individuals increase. Yet, Medicaid take-up is always higher when Medicaid is primary, as in the one-period model. In the quantitative model, individuals face uncertainty about their NH risk exposure and consumption needs during retirement, making asset holdings at the time of NH entry uncertain. With this uncertainty, higher savings under Medicaid primary reduce some individuals' likelihood of qualifying for Medicaid benefits, and aggregate Medicaid take-up rates can also decline.

3.3 The quantitative model

Our quantitative model integrates and extends the one- and two-period models in the following ways. Most Americans pay for long-term care expenses using their personal savings. We adopt a multi-period framework with incomplete information about LTC risk and other risks faced during retirement, and allow individuals to self-insure by saving. At birth, individuals observe their frailty, which is a public indicator of their health, and their labor productivity, and make a savings decision. Individuals are forward-looking and understand that they will have the opportunity to purchase private LTCI in the future. They also recognize that, when making their purchase decision, they will have an informational advantage over the insurer regarding their health status but may be denied coverage. In other words, they recognize that, based on their observable characteristics, there may be no contract that both they are willing to purchase and that is profitable for the insurer to offer. Individuals understand that private insurance is expensive and that Medicaid provides free benefits, but those benefits are means-tested and subject to a secondary-payer provision. Finally, individuals face mortality and consumption expenditure risk during retirement which means that they are uncertain about their asset levels in the final stage of life when the LTC event is realized.

In the US, the average age of private LTCI purchase is 60, while the average age of NH entry is 83. During this period, individuals face a variety of risks, such as the risk of acute medical expenses or the risk of a spousal death event. Moreover, the timing of an NH event is uncertain, and individuals who experience a NH event very late in life are likely to have consumed a larger fraction of their lifetime endowment beforehand. Consequently, at LTCI purchase age, individuals likely face uncertainty about their resources at the time of NH entry. In the quantitative model, we capture this uncertainty in a tractable way. We

Figure 7: Timeline of events in the baseline model



assume that individuals experience a consumption demand shock that occurs after LTCI purchase. Eligibility for Medicaid at NH entry depends on the realization of this shock: individuals become eligible only under sufficiently large shocks that deplete their resources. As a result, private LTCI that insures against states where the demand shock is small can be valuable. However, unlike the simple model without post-purchase uncertainty, individuals will not want a full coverage private LTCI contract since Medicaid provides them with partial protection against NH risk in expectation.

Our objective is to propose welfare-enhancing reforms to private and public insurance arrangements for long-term care risk. While our one-period model includes claims processing costs on the private insurer, it abstracts from additional costs of insurance provision including those incurred by the public insurer. It also abstracts from public insurance financing. In the quantitative model, we assume that Medicaid is funded through income taxation. Our quantitative model also recognizes the broader range of administrative costs faced by private insurers, as well as the fact that public LTCI also incurs administrative costs. The costs of producing private insurance in the quantitative model consist of a variable-cost component (claims processing cost) that is proportional to indemnities and a per-capita fixed-cost component that is proportional to the fraction of individuals who purchase private insurance. The variable-cost component captures commissions paid to insurance agents and brokers. The fixed-cost component captures both underwriting costs and costs of paying claims. Medicaid does not pay commissions. However, Medicaid incurs fixed costs of paying claims. In particular, Medicaid must assess applicants' benefit eligibility and transfer amounts. These costs are captured by assuming that the public insurer in the model also incurs per-capita fixed costs, which are proportional to the fraction of individuals receiving Medicaid benefits.

3.3.1 Individual's problem

Figure 7 shows the timing of events in the model. At birth, an individual draws his frailty status f and lifetime endowment of the consumption good $\mathbf{w} = [w_y, w_o]'$ which are jointly

distributed with density $h(f, \mathbf{w})$. Frailty status and endowments are noisy public indicators of NH risk. He also observes his survival probability from period 2 to period 3, $s_{f,\mathbf{w}}$, which varies with f and $\mathbf{w}$, and the menus of LTCI contracts that will be available in period 2. A working-aged individual then decides how to divide his earnings, w_y, between consumption c_y and savings a. Individuals are forward-looking, and their savings decisions are influenced by Medicaid and pricing and coverage levels of private LTCI contracts. Medicaid benefits are means-tested and Medicaid is a secondary payer. These features create incentives for low-income individuals to save less to qualify for Medicaid and refrain from purchasing private LTCI. Private LTCI contracts are also not actuarially fair and offer incomplete coverage which also depresses willingness to pay by high-income individuals who have the option of saving more and self-insuring against NH risk.

In period 2, the individual receives a pension w_o and observes his true risk of entering a NH conditional on surviving to period 3: $\theta^i_{f,\mathbf{w}}$, $i \in \{g, b\}$ with $\theta^g_{f,\mathbf{w}} < \theta^b_{f,\mathbf{w}}$. With probability ψ the individual realizes a low (good). NH entry probability, $i = g$, and with probability $1 - \psi$ he realizes a high (bad) NH entry probability, $i = b$. The individual's true type $i \in \{g, b\}$ is private information.[17] We assume that NH entry probabilities also depend on f and $\mathbf{w}$. The individual then chooses a LTCI contract from the menu offered to him by the private insurer.[18] The insurer observes and conditions the menu of contracts offered to each individual on their frailty status, endowments, and assets. We assume that the insurer observes assets because, as we discussed above, LTC insurers are required by regulators in many states to ascertain that the LTCI product sold to an individual is suitable (affordable).[19] Each menu contains two incentive-compatible contracts: one for the good types and one for the bad types. A contract consists of a premium $\pi^i_{f,\mathbf{w}}(a)$ that the individual pays to the insurer and an indemnity $\iota^i_{f,\mathbf{w}}(a)$ that the insurer pays to the individual if the NH event occurs.

After purchasing LTCI, individuals experience a demand shock that induces them to consume a fraction κ of their young endowment where $\kappa \in [\underline{\kappa}, \overline{\kappa}] \subseteq [0, 1]$ with density $q(\kappa)$. The demand shock creates uncertainty about the size of wealth at the time of NH entry and is important if the model is to account for the observation that Medicaid only provides partial coverage of NH expenses for many individuals.

Period 2 ends with the death event. With probability $s_{f,w}$ individuals survive until period 3 and with probability $1 - s_{f,w}$ they consume their wealth and die.[20] We model mortality

[17] Individuals may have private information about their likelihood of needing NH care for several reasons, including superior information about their own health or financial resources and private information about the likelihood of receiving informal care from a relative.

[18] We assume the insurer does not offer insurance to working-age individuals in period 1 because LTCI takeup rates are low among younger individuals. For example, only 9% of LTCI buyers were less than 50 years old in 2015 according to LifePlans, Inc. "Who Buys Long-Term Care Insurance? Twenty-Five Years of Study of Buyers and Non-Buyers in 2015–2016" (2017).

[19] The reference in footnote 2 contains a model worksheet for reporting financial assets that is used to determine suitability. Lewis et al. (2003) reports that 31 States had adopted some form of suitability guidelines by 2002 and Chapter 5 of "Wall Street Instructors Long-term Care Partnerships online training course" https://www.wallstreetinstructors.com/ce/continuing_education/ltc8/id32.htm explains how suitability is assessed in the state of Florida.

[20] There is evidence that individuals anticipate their death. Poterba et al. (2011) have found that most retirees die with very little wealth and Hendricks (2001) finds that most individuals receive very small or no inheritances. Abstracting from bequest motives eliminates any desire for agents to use LTCI to insure survival risk.

risk because it is correlated with frailty and wealth and affects the likelihood of NH entry.

Finally, in period 3 the NH shock is realized and those who enter a NH pay the cost m and receive the private LTCI indemnity. NH entrants may also receive benefits from the public means-tested LTCI program (Medicaid). Medicaid is a secondary insurer in that it guarantees a consumption floor of $\underline{c}_{NH}$ to those who experience a NH shock and have low wealth and low levels of private insurance.

An individual of type $(f, \mathbf{w})$ solves the following maximization problem, where the dependence of choices and contracts on f and $\mathbf{w}$ is omitted to conserve notation,

$$U_1(f, \mathbf{w}) = \max_{a \geq 0, c_y, \mathbf{c}_o, \mathbf{c}_{NH}} u(c_y) + \beta U_2(a),$$

with

$$U_2(a) = \left[\psi u_2(a, \theta^g_{f,\mathbf{w}}, \pi^g, \iota^g) + (1-\psi) u_2(a, \theta^b_{f,\mathbf{w}}, \pi^b, \iota^b)\right],$$

and

$$u_2(a, \theta^i, \pi^i, \iota^i) = \int_{\underline{\kappa}}^{\overline{\kappa}} \Bigg\{ u(\kappa w_y) + \alpha \Big[s_{f,\mathbf{w}} \big(\theta^i u(c^{i,\kappa}_{NH}) + (1-\theta^i) u(c^{i,\kappa}_o) \big) + (1 - s_{f,\mathbf{w}}) u(c^{i,\kappa}_o) \Big] \Bigg\} q(\kappa) d\kappa,$$

subject to

$$\begin{aligned}
&c_y = w_y - T(w_y) - a, \\
&c^{i,\kappa}_o + \kappa w_y = y_o - T(y_o) + a - \pi^i(a), \\
&c^{i,\kappa}_{NH} + \kappa w_y = y_o - T(y_o) + a - m + \iota^i(a) - \pi^i(a) + TR(y_o, a, \pi^i(a), \iota^i(a), m, \kappa),
\end{aligned} \tag{14}$$

for $i \in \{g, b\}$. Income in old age is defined as

$$y_o \equiv w_o + ra + d_{\mathbf{w}} \Pi, \tag{15}$$

where Π denotes aggregate profits, $d_{\mathbf{w}}$ is an individual's dividend expressed as a share of aggregate profits, and r denotes the (net) real interest rate. The parameter β captures discounting between the time individuals start working and the start of retirement, while the parameter α captures discounting between the start of retirement and the moment of NH entry. Taxes are progressive, specifically,

$$T(y) = \tau \max(y - \tau_0, 0),$$

where τ is the tax rate and τ_0 units of income are tax exempt. The baseline Medicaid transfer is

$$TR(y_o, a, \pi, \iota, m, \kappa) = \max\left\{0, \underline{c}_{NH} - \left[y_o - T(y_o) + a - m + \iota - \pi - \kappa w_y\right]\right\}. \tag{16}$$

In the following analysis, we will also consider policy reforms where Medicaid benefits are means-tested but Medicaid is a primary payer. Under this assumption, Medicaid transfers are given by

$$TR^P(y_o, a, \pi, \iota, m, \kappa) = \max\left\{0, \underline{c}_{NH} - \left[y_o - T(y_o) + a - m - \kappa w_y\right]\right\},$$

and the individual's problem is found by replacing TR with TR^P in equation (14).

US retirees with low means receive income transfers from the Supplemental Security Income (SSI) program and other medical expense assistance from Medicaid. We capture these other programs in a simple way. We start by solving the individual's problem above which assumes that there is only a single consumption floor in the NH state. Then we check whether the individual prefers to save nothing, not purchase LTCI, and consume the consumption floors $\underline{c}_{NH}$ in the NH state and $\underline{c}_o$ in the non-NH state. If he does, we assign him the two consumption floors and set his savings and private LTCI coverage to zero.[21]

3.3.2 Insurer's problem

The insurer observes each individual's endowments $\mathbf{w}$, frailty status f, and assets a. He does not observe an individual's true NH entry probability, $\theta^i_{f,\mathbf{w}}$, but knows the distribution of NH risk in the population and the individual's survival risk $s_{f,\mathbf{w}}$. We assume that the insurer does not recognize that asset holdings depend on $\mathbf{w}$ and f through household optimization. We believe that this is realistic because most people purchase private LTCI relatively late in life. Note that the demand shock, κ, is realized after the LTCI is contracted.

The insurer chooses a menu of contracts $\left(\pi^i_{f,\mathbf{w}}(a), \iota^i_{f,\mathbf{w}}(a)\right)$, $i \in \{g, b\}$ for each group of observable types that maximizes expected revenues, taking into account that individuals face survival risk after insurance purchase. As in the simple model, the insurer incurs a variable cost of paying claims with constant of proportion $\lambda - 1 \geq 0$. In addition, he incurs a per-capita fixed cost of paying claims $\gamma \geq 0$. His maximization problem is

$$\begin{aligned}\Pi(h, \mathbf{w}, a) = \max_{(\pi^i_{f,\mathbf{w}}(a), \iota^i_{f,\mathbf{w}}(a))_{i\in\{g,b\}}} & \psi\Big\{\pi^g_{f,\mathbf{w}}(a) - s_{f,\mathbf{w}}\theta^g_{f,\mathbf{w}}\big[\lambda\iota^g_{f,\mathbf{w}}(a) + \gamma I(\iota^g_{f,\mathbf{w}}(a) > 0)\big]\Big\} \\ & + (1-\psi)\Big\{\pi^b_{f,\mathbf{w}}(a) - s_{f,\mathbf{w}}\theta^b_{f,\mathbf{w}}\big[\lambda\iota^b_{f,\mathbf{w}}(a) + \gamma I(\iota^b_{f,\mathbf{w}}(a) > 0)\big]\Big\}\end{aligned} \tag{17}$$

subject to the incentive compatibility and participation constraints

$$(IC_i) \quad u_2(a, \theta^i_{f,\mathbf{w}}, \pi^i_{f,\mathbf{w}}(a), \iota^i_{f,\mathbf{w}}(a)) \geq u_2(a, \theta^i_{f,\mathbf{w}}, \pi^j_{f,\mathbf{w}}(a), \iota^j_{f,\mathbf{w}}(a)), \quad \forall i, j \in \{g, b\}, i \neq j \tag{18}$$

$$(PC_i) \quad u_2(a, \theta^i_{f,\mathbf{w}}, \pi^i_{f,\mathbf{w}}(a), \iota^i_{f,\mathbf{w}}(a)) \geq u_2(a, \theta^i_{f,\mathbf{w}}, 0, 0), \quad \forall i \in \{g, b\}. \tag{19}$$

Let $\tilde{h}(f, \mathbf{w}, a)$ denote the measure of agents with frailty status f, endowment $\mathbf{w}$, and asset holdings a. Then total profits for the insurer are given by

$$\Pi = \sum_{\mathbf{w}} \sum_{f} \sum_{a} \Pi(f, \mathbf{w}, a)\tilde{h}(f, \mathbf{w}, a). \tag{20}$$

3.4 Government's problem

In period 1 the government taxes the income of workers and saves the proceeds, earning an interest rate of $1+r$. Then in period 2, it taxes old individuals' income and uses its resources

[21] Modeling SSI in this way helps us to generate the low levels of savings of individuals in the bottom wealth quintile without introducing additional nonconvexities into the insurer's maximization problem.

to finance the two means-tested welfare programs. Like the private insurer, the government incurs administrative costs of running both of these programs.[22] These costs are assumed to be per capita fixed costs and, hence, proportional to the fraction of individuals receiving transfers. Let γ_{gov} denote the cost per transfer recipient.

Given the two consumption floors guaranteed by the programs, $\{\underline{c}_{NH}, \underline{c}_o\}$, the income tax rate τ is set to satisfy the government budget constraint

$$REV = \sum_{\mathbf{w}} \sum_{f} \left[TR^{f,\mathbf{w}} + \gamma_{gov} fracTR^{f,\mathbf{w}} \right] h(f, \mathbf{w}), \tag{21}$$

where $TR^{f,\mathbf{w}} h(f, \mathbf{w})$ is aggregate government transfers to individuals of type $(f, \mathbf{w})$ via the two welfare programs and $fracTR^{f,\mathbf{w}}$ is the fraction of individuals of type $(f, \mathbf{w})$ receiving government transfers. Aggregate government revenue, REV, is given by

$$REV \equiv \sum_{\mathbf{w}} \sum_{f} (1+r) T(\omega_y) h(f, \mathbf{w}) + \sum_{\mathbf{w}} \sum_{f} \sum_{a} T(y_o) \tilde{h}(f, \mathbf{w}, a),$$

where the tax function $T(\cdot)$ is defined in equation (16) and income in old age y_o is defined in equation (15).

3.5 Equilibrium

We solve for a competitive equilibrium under the assumption that the real interest rate is exogenous. The US economy has strong international financial linkages and it is unlikely that changes in LTCI arrangements would have a large effect on US real interest rates. Medicaid is financed with an income tax that distorts savings incentives, and Medicaid incurs administrative costs that depend on private insurance market contracts. We thus solve a fixed point problem that ensures that the government budget constraint is satisfied, that insurance markets clear, and that total dividend income received by individuals equals total profits generated by the private LTC insurer, i.e., $\sum_{\mathbf{w}} \sum_f d_{\mathbf{w}} \Pi h(f, \mathbf{w}) = \Pi$.

Definition 1. Competitive Equilibrium. Given a distribution of individuals by frailty and endowments $h(f, \mathbf{w})$, a real interest rate r, and consumption floors $\{\underline{c}_{NH}, \underline{c}_o\}$, a competitive equilibrium consists of a set of insurance contracts $\{\pi^i_{f,\mathbf{w}}(a), \iota^i_{f,\mathbf{w}}(a)\}$, $i \in \{g, b\}$; profits Π; a government income tax rate τ; consumption allocations $\{c_y^{f,\mathbf{w}}, c_o^{f,\mathbf{w},i,\kappa}, c_{NH}^{f,\mathbf{w},i,\kappa}\}$, $i \in \{g, b\}$; and savings policy $a^{h,\mathbf{w}}$ such that the consumption allocations and saving policy solve the individuals' problems and the insurance contracts solve the insurer's problem, total dividend income is equal to total profits of the insurer, the distribution of agents by frailty, endowments and assets is such that

$$\tilde{h}(f, \mathbf{w}, a) = \begin{cases} h(f, \mathbf{w}), & \text{if } a = a^{f,\mathbf{w}}, \\ 0, & \text{otherwise}, \end{cases}$$

and the government budget constraint holds.

[22] In Braun and Kopecky (2024) we assume that administrative costs only apply to the Medicaid program.

Table 1: Government policy parameters

Parameter	Description	Value
τ	income tax	0.0153
τ_0	tax exemption	0.2744
γ_{gov}	Medicaid fixed admin. cost	0.0022

4 Parametrization

A key feature of US long-term care insurance arrangements that our framework captures is that people have heterogeneous exposures to LTC risk and demand for private insurance. In our model, the likelihood of an individual requiring long-term care, along with his ability to manage this risk, is influenced by the individual's frailty, mortality risk, and permanent earnings. Individuals in the model also have private information about their true NH entry probability, and parameterizing our model requires us to resolve some subtle identification issues. Our identification strategy and specific data targets for most model parameters are the same as in Braun et al. (2019). However, the model here is a general equilibrium framework, and there are consequently new parameters that we need to parameterize.

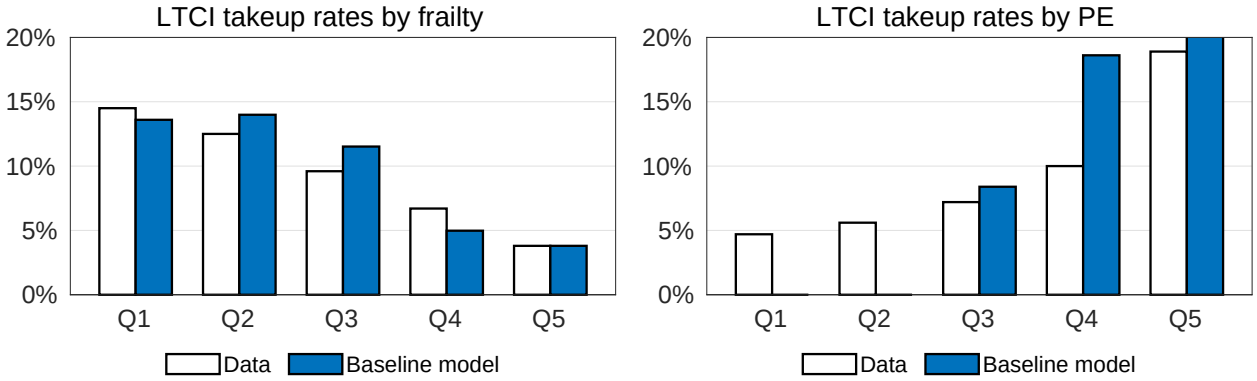
We assume that public insurance benefits are financed through taxation and that public insurance requires per-capita fixed costs of administration. Table 1 reports the values of the government policy parameters in the baseline economy. The income tax rate, τ, is set such that the government budget constraint, equation (21), holds, yielding an income tax rate of 1.53%. The tax exemption, τ_0, is set to \$7,200 per year or 27.44% of the average earnings per adult aged 18–64 in year 2000.[23] According to the 2008 Actuarial Report on the Financial Outlook for Medicaid, Medicaid spent \$17.3 billion on program administration in FY 2007, representing 5.2% of total outlays. The per-capita fixed cost of administering the two public insurance programs in the model, γ_{gov}, is set such that the total administrative costs of both means-tested welfare programs are 5.2% of total program outlays. This results in a value of γ_{gov} of 0.0022.

Consistent with the way the US long-term care insurance system works in practice, the public LTC insurance program in the baseline economy is significantly less costly to administer than private insurance. Private LTC insurers incur higher administrative costs because they pay broker commissions and conduct extensive medical underwriting, unlike Medicaid, which does neither. As in Braun et al. (2019), $\lambda - 1$, the proportional claims processing cost of providing private insurance is set such that total variable costs are consistent with commissions paid to brokers. These costs amounted to 12.6% of present-value premium on average in the year 2000.[24] The per-capita fixed cost, γ, is set such that total fixed costs capture underwriting costs and costs of paying claims. These costs amounted to 20% of present-value premium on average in 2000. The resulting values of λ and γ are 1.195 and

[23] In the model, endowments to the young are calibrated to permanent earnings. We normalize the mean young endowment to 1. This is equivalent to a mean permanent earnings of \$1,049,461 in 2000, or the average earnings per adult aged 18–64 in 2000 multiplied by 40 years.

[24] See Eaton (2016) for a breakdown of administrative costs as a share of premium revenue.

Figure 8: LTCI takeup rates by frailty and PE quintiles in the model and US data



Note: Data source is 62–72 year olds in our HRS sample. Frailty and PE increase across quintiles.

0.019, respectively.

Additionally, we assume that all the insurer's profits are distributed to the top 1 percent of earners. This assumption reflects the fact that the income of executives and other highly affluent individuals is more sensitive to fluctuations in profits compared to others. In the policy experiments we consider, the welfare of the top 1 percent is primarily influenced by changes in profit-based income and taxes. This is partly because the top 1 percent owns the private insurer, and partly due to the fact that this group is generally healthier, prefers to self-insure against LTC risk, and is highly unlikely to receive Medicaid LTCI benefits.

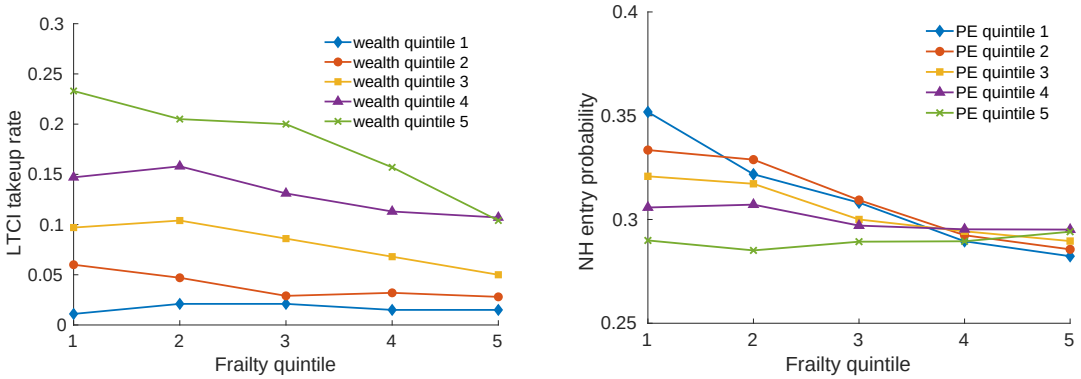
The remaining calibration of the model proceeds in the same way as in Braun et al. (2019).[25] We posit 750 distinct risk groups that differ by frailty and permanent earnings. Some parameters are set directly using the data, while others are estimated by minimizing the distance between data moments and model counterparts. Most data statistics are based on an HRS data sample period that runs from 1992 to 2012. Our frailty index is constructed to reflect the underwriting criteria used by LTC insurers. Finally, lifetime NH entry probabilities for HRS respondents are estimated using an auxiliary simulation model. In the parameterization, the consumption floor provided by Medicaid, c_{NH}, and the consumption floor for those who do not enter a NH, c_o, are both set to 1.855% of mean permanent earnings in the economy or \$6,540 a year. This value consists of a consumption allowance of \$30 per month and housing and food expenses of \$515 per month. These numbers are consistent with Medicaid and SSI transfer amounts to a single elderly individual in 2000.

We now compare statistics from our general equilibrium model with US data statistics on LTCI takeup rates and lifetime NH entry risk estimated in Health and Retirement Study (HRS) data. Figure 8 reports the private LTCI takeup rates in our HRS data sample and the model. The left panel reports LTCI takeup rates by frailty quintile. Our frailty index is constructed so that less frail individuals have a low value of an index. PE quintiles are organized to increase in PE. Thus, the individuals with the highest earnings appear in Q5. Observe that private LTCI takeup rates decline with frailty in the data and in our model while LTCI rates increase with PE in both the data and in our model.

These results are puzzling because lifetime NH entry risk is slightly decreasing in frailty and doesn't vary much with PE (Figure 9). According to our model, the dispersion of

[25]Table 5 in the Appendix reports many of the baseline parameter values.

Figure 9: LTCI takeup rates and lifetime NH entry rates in the data



(a) LTCI takeup rates (b) NH entry rates

Note: LTCI takeup rates are those of 62–72 year-olds in our HRS sample. NH entry rates are for an NH stay of 100 days or longer, and are based on our auxiliary simulation model, which is estimated using HRS data. Frailty, wealth, and PE increase across quintiles. The wealth and PE quintiles reported here are marginal and not conditional on the frailty quintile, so for example, only around 7% of people in frailty quintile 1 are in wealth quintile 1, while 33% are in wealth quintile 5.

Table 2: Standard deviation of self-reported NH entry probabilities by frailty and PE quintile

	Frailty quintile				
	1	2	3	4	5
Data	1.00	1.00	1.03	1.27	1.47
Model	1.00	1.08	1.20	1.32	1.47
	Permanent earnings quintile				
	1	2	3	4	5
Data	1.00	0.92	0.85	0.79	0.76
Model	1.00	0.96	0.91	0.80	0.58

Note: The standard deviations of frailty and PE quintile 1 are normalized to 1. Data values are standard deviations of self-reported probabilities of entering an NH in the next 5 years for HRS respondents ages 65–72, excluding observations where the probability is 0, 100% or 50%. The decline in standard deviation with PE in the data is robust to how we handle these observations.

private NH entry risk has to increase in frailty, f, and decline in PE/wealth, if the model is to account for the empirical patterns of LTCI takeup and NH entry. In particular, we set ψ, the overall fraction of individuals of type g to reproduce the overall dispersion in the self-reported NH entry probabilities in our HRS data. Then we vary the probabilities of NH entry $\{\theta^L_{f,\mathbf{w}}, \theta^H_{f,\mathbf{w}}\}$ by $(f, \mathbf{w})$ to reproduce the LTCI takeup rates and the NH entry rates by frailty and wealth/PE quintiles.

We do not directly target the dispersion of private information by frailty and PE quintile; consequently, the fit of these statistics provides a way to assess the model's fit with the data. Table 2 reports the standard deviation of self-reported (private) NH entry probabilities by frailty and PE quintile in our HRS data and in the model. Observe that the dispersion of private information increases with frailty and decreases with PE in both the data and our model.

Because savings responses are central to the impact of policy reforms on aggregate Medi-

Table 3: Savings responses to an increase in the Medicaid consumption floor by wealth for those with positive wealth only

	Wealth deciles									
	Mean	10th	20th	30th	40th	50th	60th	70th	80th	90th
Model	-0.026	-0.018	-0.018	-0.024	-0.030	-0.035	-0.044	-0.052	-0.059	-0.030
Maynard and Qiu (2009)	-0.025	-0.003	-0.019	-0.041	-0.051	-0.055	-0.056	-0.050	-0.033	-0.003

Note: The top row reports the change in retirement wealth due to a $661 (2000 dollars; $1000 in 1987 dollars) increase expected Medicaid outlays for agents with positive retirement wealth in the baseline. The bottom row reports the change in wealth over the first 10 years after a $1000 (1987 dollars) increase in expected Medicaid dollars for working-age SIPP households with positive net worth, from Table III of Maynard and Qiu (2009).

caid outlays, we assess whether the savings responses generated by our model are consistent with the empirical evidence. Using a quantile regression approach, Maynard and Qiu (2009) estimate the impact of changes in Medicaid generosity on the savings of working-age households with positive net worth in the Survey of Income and Program Participation (SIPP). They examine Medicaid reforms between 1984 and 1993 and measure the effect of an increase in Medicaid eligible dollars, defined as the product of a higher probability of coverage and greater benefits conditional on receipt. They find that a $1000 increase in Medicaid eligible dollars (in 1987 dollars) reduces household wealth by 2.6% on average, with a U-shaped response across the wealth distribution (Table 3, second row).

The top row of Table 3 reports the corresponding effects in our model. We increase Medicaid generosity by relaxing the consumption floor, which raises both the probability of receiving benefits and the benefit amount. The mean savings response in our model closely matches the empirical findings: a $1000 (1987 dollars) increase in expected Medicaid benefits lowers retirement wealth by 2.7% on average. We also find a U-shaped response across the wealth distribution, with smaller declines at the bottom and top and larger declines in the middle. As in Hubbard et al. (1995), the increase in the Medicaid consumption floor has a smaller impact on the savings behavior of wealthy individuals who have a low probability of qualifying for Medicaid benefits. In the model, increasing the consumption floor also has a smaller impact on poorer individuals, as they were already relatively well insured by Medicaid in the baseline.

While we get the same U-shape and a very similar average effect to Maynard and Qiu (2009), our model differs in the magnitude of the savings responses across the wealth distribution. Whereas Maynard and Qiu (2009) find the largest declines around the 60th percentile, our model produces the largest effect at the 80th percentile. Moreover, the declines are somewhat larger at the tails in our model. Several factors may explain these differences. First, their estimates capture changes in net worth within 10 years of a reform for working-age households, whereas changes in our model are changes in accumulated wealth at retirement. Second, their analysis concerns expected Medicaid dollars for acute medical expenses, while our model focuses on long-term care. As shown by Braun et al. (2017) and De Nardi et al. (2016), higher-wealth households are more likely to receive Medicaid in old age due to long-term care expenses, and households in PE quintile 4 (roughly the 60th–80th percentiles of positive wealth) save the most to self-insure against these expenses (Kopecky and Koreshkova, 2014).

5 Results

We present two sets of results. We start by documenting how public insurance, administrative costs and asymmetric information influence takeup rates of different risk groups. Then we use the model to analyze how three distinct reforms influence welfare of different individuals, government expenditures, and the functioning of the US private LTCI market.

5.1 The contributions of Medicaid, administrative costs, and asymmetric information to low takeup and coverage rates.

Our analysis of the 1-period model suggests that administrative costs and Medicaid have a potentially large impact on the private LTCI market. However, that analysis only considers the situation of a single risk group. Our quantitative model is a considerably more detailed model of public and private LTCI that reproduces some of the main features of US LTCI arrangements. We now use it to assess the quantitative significance of administrative costs, Medicaid, and asymmetric information for takeup and coverage rates of private LTCI.

Figure 10 reports LTCI takeup rates by PE quintile for the baseline and three alternative economies and Figure 11 reports coverage rates. The 'No Medicaid' economy sets the consumption floor provided by Medicaid to NH entrants, c_{NH}, to 0.001 of mean permanent earnings or approximately \$350 per year.[26] The 'No Administrative Costs' economy sets the fixed administrative costs to zero and the variable costs, λ, to one and the 'Full Information' economy assumes that the insurer can directly observe each individual's NH entry probability, θ.

A comparison of the Baseline and 'No Medicaid' economies in Figure 10 indicates that Medicaid has a pronounced crowding out effect on private LTCI takeup. Removing Medicaid increases private LTCI takeup from 9.6% to 90.6%. Takeup increases in all five PE quintiles and even in the top 10 percentiles of PE. There is essentially no basis for private insurers to trade with individuals in PE Q1–Q2 in the Baseline. Even at higher PE levels, Medicaid depresses LTCI takeup because it provides an outside option to individuals that tightens their participation constraints. When Medicaid is absent, all individuals in PE Q2–Q4 purchase private LTCI and nearly all in PE Q1.[27] An LTC event is very costly, even for individuals with moderate PE, and demand for private insurance is highly inelastic when public insurance is not available.

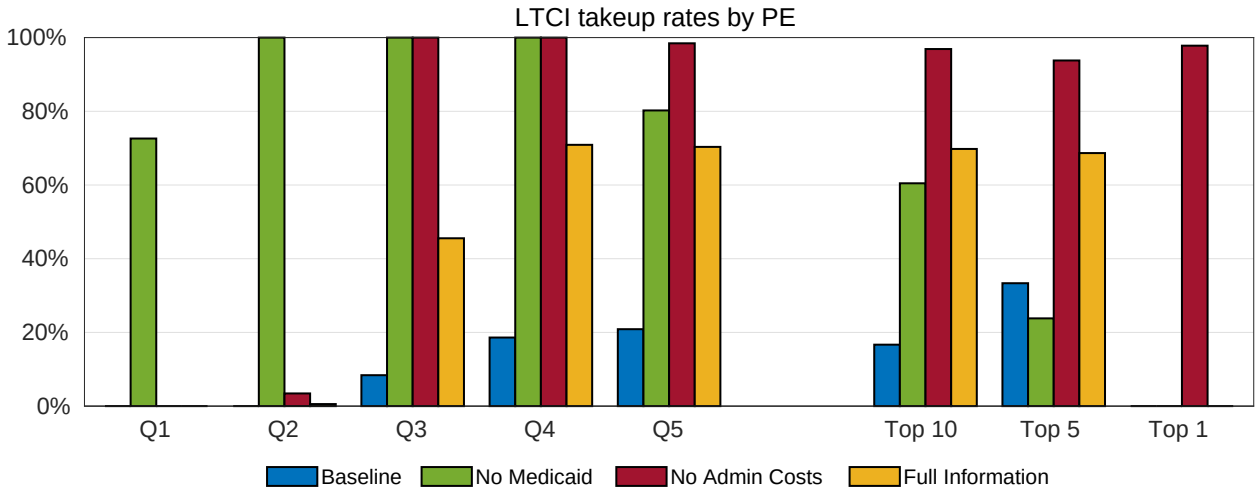
Figure 11 shows that removing Medicaid also impacts coverage rates, but the effects are smaller and more nuanced. Recall that, in the baseline economy, individuals do not want full private insurance contracts because Medicaid partially insures them against NH risk. Depending on the size of their consumption demand shock, they may or may not receive Medicaid benefits. Since they are partially insured in expectation against NH entry risk by Medicaid, they prefer partial insurance coverage from the private insurer. Consequently, removing Medicaid should increase private LTCI coverage levels. However, this is not necessarily the case due to two offsetting effects. First, removing Medicaid increases incentives to save. As saving rates go up, the willingness to pay for a marginal increase in private insur-

[26] We do not reduce c_{NH} to zero because then some individuals would experience negative consumption.

[27] The increase in Q1 is less than 100 percent because the consumption floor is very small but still positive.

Figure 10: LTCI takeup rates in alternative model scenarios

	Baseline	No Medicaid	No Admin Costs	Full Information
LTCI takeup rate (%)	9.6	90.6	60.4	37.5



ance declines, reducing coverage levels. Second, the composition of individuals who purchase private LTCI changes. Absent Medicaid, a larger share of private insurance purchasers are from the lower part of the PE distribution, where the ability to self-insure LTC risk with savings is lower and demand for private insurance is more inelastic. The net impact of these different effects is a small increase in the average coverage rate from 60% in the baseline to 66.2% in the 'No Medicaid' economy.

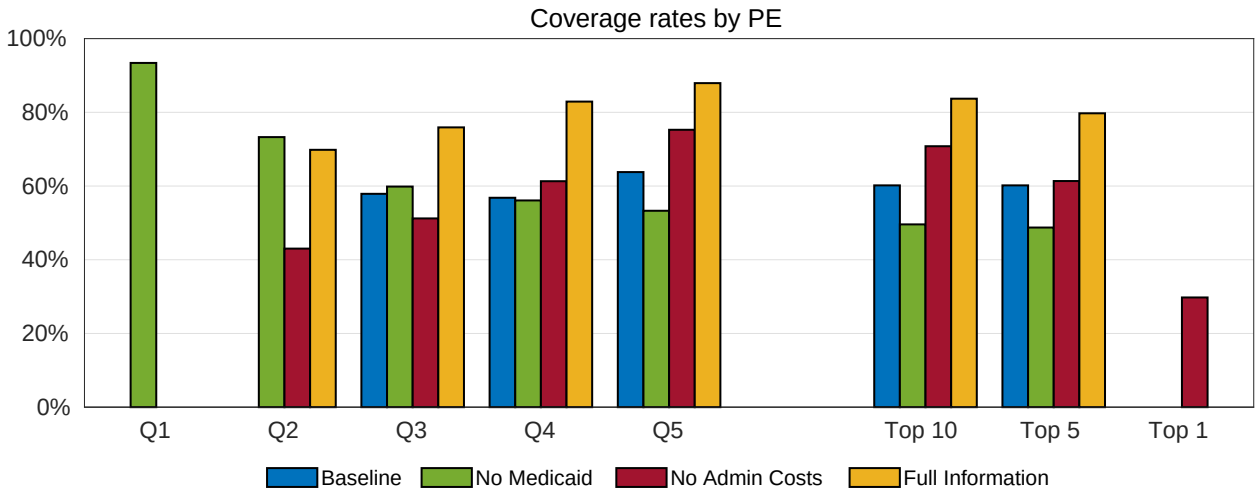
We next compare private LTCI takeup and coverage rates in the Baseline economy to those in the 'No Administrative Costs' economy. Removing administrative costs leads to a marked increase in takeup, from 9.6% to 60.4%. This overall increase is due to a sharp rise in takeup among affluent individuals in PE quintiles 3 through 5, including those in the top 10th, 5th, and 1st percentiles. In the absence of administrative costs, over 90% of individuals in these higher PE groups purchase private LTCI.

Coverage rates also go up slightly on average, rising from 60% to 62.3%. Coverage rates increase the most for individuals with PE around the 85th percentile. These individuals are the most exposed to LTC risk in the baseline. They have a relatively low probability of qualifying for Medicaid but are not wealthy enough to easily self-insure through savings. As PE falls, and the likelihood of qualifying for Medicaid benefits rises, individuals prefer less coverage from the private insurer. As explained above, this is true even though Medicaid is a secondary payer and private insurance replaces (as opposed to tops up) Medicaid benefits, because as income falls, the probability of being eligible for Medicaid goes up. Consequently, lower-income individuals' expected NH costs are smaller, and the amount of coverage they want from the private insurer is also smaller. Individuals in the top percentiles of PE also prefer less coverage compared to those with lower PE because they are better able to self-insure through savings.

Finally, removing private information also has a large impact on private LTCI takeup and

Figure 11: Coverage rates in alternative model scenarios

	Baseline	No Medicaid	No Admin Costs	Full Information
Coverage rate (%)	60.0	66.2	62.3	83.1



coverage levels. When the insurer has full information, take-up rates increase to 37.5% and the average coverage rate increases to 83.1%. Private insurance takeup rates in PE Q4–Q5 and the top 10 and top 5 percentile exceed 60 percent, with coverage rates of 80 percent or higher. The increases in take-up are due to a large increase in take-up rates of low-risk types, whose take-up rises from 9.5% to 52.1%. In contrast, take-up rates of high-risk types decline from 9.7% to 1.7%. Since the insurer directly observes each individual's risk type, he no longer has to design menus that satisfy incentive compatibility. As a result, high-risk types no longer cross-subsidize low-risk types or become excluded. Instead, the insurer offers them more coverage with a lower load. By the same token, the insurer also offers more coverage to high-risk types, but the loads on these contracts go up, as do denial rates.

The overall message that emerges from this analysis is that all three frictions depress private insurance markets. But Medicaid is most important for lower PE groups.

5.2 Policy Reforms

We have established that our quantitative model accounts for the empirical distributions of private LTCI takeup rates and the dispersion in self-reported NH entry probabilities.[28] We have also shown that Medicaid, administrative costs, and adverse selection depress takeup and coverage rates in distinct ways. Medicaid crowds out private insurance at all five PE quintiles and is particularly important for understanding takeup and coverage rates of individuals with low personal resources. Administrative costs and adverse selection, in contrast, are important contributing factors to low takeup and coverage rates of affluent individuals.

We now use our quantitative model to consider the aggregate and distributional consequences of three distinct policy reforms. We will assess each reform based on how it impacts

[28] Braun et al. (2019) provides a more detailed analysis of the empirical fit of the model.

the fiscal situation of the government, the functioning of the private market for LTCI, and individual and aggregate welfare. The ensuing analysis assumes that the government adjusts the income tax rate to balance its budget each period and that the private insurer's profits are distributed to individuals in the top 1 percent of PE. How profits get distributed across PE groups can influence our welfare conclusions, and it is well known that equity holdings of US companies are concentrated among high-income individuals. Our assumption implies that, for the most affluent individuals in the economy, LTCI reforms primarily impact household wealth via the LTCI profits channel.

The 'No Medicaid' economy. We have seen that Medicaid has a pronounced crowding out effect on private LTCI takeup rates (Figure 10) and coverage rates of policy holders (Figure 11). This raises the question of whether individuals would prefer a much smaller public insurance program for LTC risk. We investigate this possibility using the 'No Medicaid' economy discussed in Section 5.1.[29] Statistics related to public and private insurance arrangements and welfare for this economy are reported in column two of Table 4.

Lowering the Medicaid LTC consumption floor results in significant fiscal savings. The fraction of individuals receiving public LTC benefits falls from 49.3 to 5.4 percent and public outlays on social insurance decline by 88.2 percent as compared to the baseline (column one of Table 4). A smaller public insurance program for LTC risk reduces the financing needs of the government, and tax revenues fall from 0.016 to 0.002 as a share of average PE.

Reducing the scale of publicly funded LTCI results in a large increase in WTP for private LTCI (Table 4). All individuals in PE Q2–Q4 purchase private LTCI because the cost of a nursing home stay is large relative to their means. Private LTCI takeup increases to 72.6 percent in Q1 and is less than 100 percent because some individuals in PE Q1 still qualify for Medicaid. Takeup rates are also less than 100 percent in the highest PE quintiles, because some of these individuals prefer to self-insure LTC risk. Aggregate LTCI takeup rates rise from 10 to 91 percent. The insurer, recognizing that demand for private LTCI is now inelastic, responds by offering policies with higher premiums. Profits as a percentage of premium revenue are highest in PE Q1 (49.4 percent) and then fall monotonically with permanent earnings. Higher PE groups have the outside option of self-insuring LTCI and this is why profits decline. Aggregate profits increase from 0.07 to 31.5 percent of premium revenue and the aggregate fraction of NH costs covered increases from 60 percent in the baseline to 66.2 percent.

Medicaid constrains the private insurer's ability to use selection to extract rents from type-specific differences in demand in our 1-period model and our quantitative model has the same property. The average load for bad risk types increases from -0.016 in the baseline to 0.167 here and the average coverage level increases from 77.4 percent to 90.6 percent. For good types, the average load increases from 0.528 to 0.595 and average coverage levels only increase from 52.8 percent to 59.5 percent.

Welfare of a newborn is lower in the No Medicaid economy. A 23 percent supplement to consumption is required to make a newborn indifferent between the No Medicaid and the

[29] The consumption floor provided to poor elderly individuals who do not experience a NH event, c_o, is held fixed at its baseline value.

Table 4: Welfare and indicators of the private and public LTCI in the Baseline, 'No Medicaid', 'Universal Medicaid' and 'Medicaid Primary' economies

Scenario	Baseline	No Medicaid	Universal Medicaid	Medicaid Primary
Welfare (newborn)	-2.757	-3.390	-2.699	-2.749
Compensating variations (%)		-22.96	2.10	0.29
Average:				
Consumption of NH entrants relative to non-entrants (%)	-34.86	-18.32	0.00	-27.57
Medicaid outlays (% change from baseline)		-88.2	144.8	-3.32
Govt tax revenue	0.016	0.002	0.031	0.015
NH entrants on Medicaid (%)	49.29	5.42	100.0	47.94
Profits/Premium revenue (%)	0.072	31.508	0.000	5.438
LTCI takeup rate	0.096	0.906	0.000	0.633
Fraction of NH costs covered	0.600	0.662	0.000	0.370
Load	0.407	0.558	0.000	0.504
LTCI takeup rate by PE Quintile				
1	0.000	0.726	0.000	0.000
2	0.000	1.000	0.000	0.314
3	0.084	1.000	0.000	0.989
4	0.186	1.000	0.000	1.000
5	0.209	0.802	0.000	0.863
High PE				
top 10	0.167	0.605	0.000	0.726
top 5	0.333	0.238	0.000	0.452
top 1	0.000	0.000	0.000	0.000
Profits/Premium revenue (%) by PE Quintile				
1	0.000	49.37	0.000	0.000
2	0.000	37.56	0.000	0.747
3	0.057	22.84	0.000	3.030
4	0.109	16.83	0.000	5.879
5	0.046	9.97	0.000	8.469
High PE				
top 10	0.115	4.23	0.000	6.436
top 5	0.115	3.01	0.000	7.223
top 1	0.000	0.000	0.000	0.000
Compensating Variations (%) by PE Quintile				
1		-45.32	0.446	0.001
2		-12.47	3.527	0.081
3		-2.614	4.655	1.061
4		0.170	2.800	0.737
5		1.981	0.339	0.353
High PE				
top 10		2.964	-0.416	0.296
top 5		4.531	-1.063	0.223
top 1		16.25	-2.152	1.027

Note: Results are reported by permanent earnings (PE) quintiles and for the top 10, 5, and 1 percentiles of the PE distribution.

baseline economy.[30] On the one hand, individuals are receiving more coverage against a LTC event as can be seen from the fact that average consumption of NH entrants is only 18.32 percent lower than non-entrants in this scenario and 34.86 percent lower in the baseline. On the other hand, the insurer is extracting more rents. The average load is higher and profits relative to premium revenue are higher in all PE groups except the top 1 percentile. Profits are particularly high on contracts offered to low-income individuals because these

[30] A negative sign for a compensating variation indicates that welfare is lower in the counterfactual than the baseline.

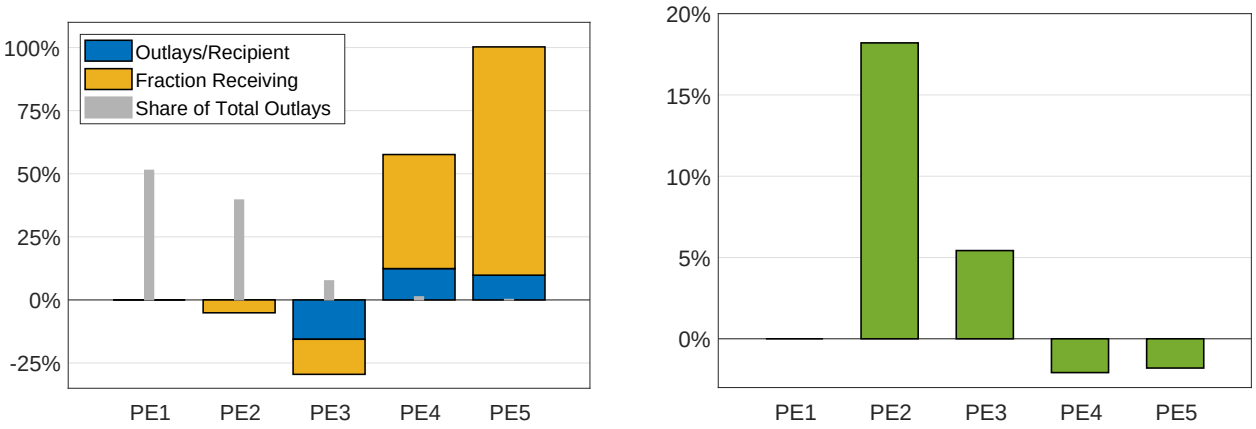
groups no longer qualify for (free) Medicaid benefits and they don't have the resources to self-insure a costly LTC events. It follows that low-income groups experience the biggest welfare losses. For instance, the compensating variation for individuals in the lowest PE quintile is -45.3 percent. High PE groups, in contrast, prefer the 'No Medicaid' economy to the baseline. They are not very likely to qualify for Medicaid benefits, and when Medicaid is scaled back, they benefit from lower taxes. This is the reason why compensating variations in PE quintiles four and five are positive. Individuals in the top 1 percent experience the largest welfare gain. They own the private insurer and benefit from lower taxes and higher dividends. Thee compensating variation for this group is 16.3 percent.

The universal Medicaid economy. Americans are aging, and the demand for long-term care services is rising; yet, the US private insurance market is small and has been declining over time. Private insurers are hampered by adverse selection and high marketing and underwriting costs. These frictions disappear when the government provides universal public LTCI. We now analyze an economy in which the medical expenses associated with an NH stay are fully covered by universal public insurance for LTC risk (column 3 of Table 4). In the 'Universal Medicaid' economy, the private market for LTCI is dormant and government LTC expenditures are nearly 145 percent higher than the baseline and are equivalent to approximately 1.2 percent of GDP (or about 20 percent of US Social Security outlays in 2023). Welfare of a newborn is 2.1 percent higher than the baseline and associated with this gain is a large redistribution of resources from high- to low- and middle- income individuals.

Universal coverage of the medical component of NH care allows agents to equate consumption when old in the NH and non-NH states and middle-class individuals are the biggest beneficiaries of this policy. Compensating variations are positive for PE quintiles 1 through 5 and are particularly significant for PE quintile 3 (4.655 percent). Interestingly, the welfare gains for those in PE quintile 1 are small. For these individuals, public insurance of LTC risk is similar in both economies, but some members of this group are now paying higher income taxes. All three high PE groups prefer the baseline. Individuals in these groups are relatively healthy and have the resources to self-insure LTC risk. They prefer not to pay higher income taxes to finance a public insurance program whose primary beneficiaries are lower- and middle-class individuals. The top 1 percent PE group experiences the largest welfare loss. Their tax burden is highest, their dividend income is zero, and their welfare declines by 2.15 percent.

The Medicaid primary economy. The two previous counterfactuals illustrate the significant obstacles to reforming US LTC insurance arrangements. On the one hand, reducing the safety net provided by Medicaid to the poor and frail increases WTP for private insurance but has a large negative impact on welfare of poor and middle-class individuals. On the other hand, universal public long-term care results in higher taxes which are borne disproportionately by the rich. Current Medicaid benefits are means-tested and subject to a secondary payer provision, and the intent of these provisions is to restrain aggregate public LTC expenditures. This intent is consistent with the workings of our simple 1- and 2- period models. In those models making Medicaid the primary payer increases private LTCI takeup

Figure 12: Change in Medicaid outlays and retirement savings by PE when Medicaid is made the primary payer



(a) Medicaid outlays

(b) Retirement savings

Note: Changes in Medicaid outlays are split into changes in outlays per recipient (blue) and changes in share receiving transfers (yellow). In PE quintile 2, outlays per recipient rise while the recipient share falls. The former explains –43% of the decline in total outlays and the latter 143%. Gray bars show each quintile's share of total outlays.

rates, but also increases Medicaid takeup rates and aggregate Medicaid expenditures.[31] Our quantitative model works differently. When Medicaid is the primary payer, private LTCI takeup increases from 10 to 63 percent and Medicaid outlays *fall* by 3.3 percent (Column 4 of Table 4).

Making Medicaid the primary payer has a large positive impact on the function of the private insurance market. The average LTCI takeup increases from 9.6 percent in the baseline to 63.3 percent when Medicaid is primary, and the increases are broadly based across the PE distribution. Private insurance takeup rates increase in Q2–Q5 and in the top 10 and top 5 percentile PE groups. Profitability also increases for all insured groups, even though the average coverage rate of private insurance policies declines from 60% to 37%.

Some intuition for why private LTCI rates increase in the quantitative model can be gleaned from our 1- and 2-period models. For instance, some previous non-holders of private LTCI who qualified for Medicaid benefits in most states of nature now have a higher WTP for private insurance because their Medicaid benefits do not cover the entire loss. Private insurance benefits no longer reduce their Medicaid transfers one-for-one and they opt to purchase small private policies to top up their free Medicaid benefits and thereby enhance consumption smoothing across states in their final period of life. Other more affluent individuals who were previously dissuaded from purchasing LTCI due to the secondary payer provision also are able to enhance consumption smoothing across states in their final period of life. If they meet the means test, they receive both free public and private insurance benefits. If they do not meet the means-test, they receive private LTCI benefits. In spite of the higher profits and loads on private LTCI insurance, the frictions associated with insuring

[31]Medicaid takeup rates increase in both models. Aggregate Medicaid expenditures unambiguously increase in the 1-period model and increase in the 2-period model if the increase in Medicaid expenditures on the new individuals qualifying for Medicaid benefits is larger than savings on existing Medicaid recipients who choose top off Medicaid benefits with private LTCI.

LTCI risk are smaller and aggregate consumption smoothing in the final period of life is enhanced. Consumption of NH entrants is 26.3 percent lower than non-entrants as compared to a baseline gap of 33.8 percent.

Our most surprising result is that aggregate Medicaid outlays are lower in the Medicaid primary economy. The fiscal savings are concentrated in PE quintiles 2 and 3 (Figure 12a) with outlays falling by 5.1 percent in Q2 and 29.5 percent in Q3. When Medicaid is a primary payer, individuals in PE Q2 and Q3 save more. Their retirement savings, prior to receiving their second-period endowment and making a private LTCI purchase decision, are 18% higher in PE Q2 and 5% higher in PE Q3 than the baseline (Figure 12b). First, they need more resources to purchase private LTCI. Second, they would like to consume more during retirement and less when young and are exposed to idiosyncratic risk due to uncertainty about their private type, their realization of the consumption demand shock, and their NH entry realization. Asset holdings and Medicaid eligibility at the time of the LTC shock are uncertain and their higher level of retirement savings at the start of retirement reduces their likelihood of receiving Medicaid transfers in the NH state which creates a stronger precautionary savings motive.[32] It follows that the fraction of PE Q2 and PE Q3 individuals qualifying for Medicaid benefits at the time of the NH shock falls by 5.9 and 6.4 percent, respectively (Figure 12a).

The fiscal savings from PE Q2 and Q3 individuals are partially offset by higher fiscal outlays to individuals in PE Q4 and Q5 who enter period 2 with lower retirement savings and qualify for Medicaid benefits in more states of nature. Retirement savings in PE Q4-Q5 decline (Figure 12b) for three reasons. First, as we just explained, the total cost of insuring LTC risk has fallen. Even though premia are higher, private insurance offers coverage in more states of nature because it can be combined with free public LTC benefits and thereby enhance consumption smoothing in situations where they satisfy the asset test. A second factor is that their overall coverage against a LTC event is higher, and this reduces their precautionary savings motive. The third factor is that individual savings incentives in these groups are distorted down by the asset test for Medicaid benefits. As in Hubbard et al. (1995), households recognize that saving less increases the probability of them receiving Medicaid NH benefits.

The next step in explaining why aggregate Medicaid expenditures decline is to observe that the share of Medicaid benefits paid out to PE Q4 and PE Q5 is relatively small and, in particular, is much smaller than the share of total benefits paid out to PE Q2 and Q3 individuals (Figure 12b). It follows that aggregate Medicaid expenditures are 3.3 percent lower than the baseline.

Finally, observe that aggregate Medicaid benefits per recipient decline by a small amount (-0.02 percent). This result is due to a large decline in benefits per recipient in PE quintile 3, which declines by 17 percent. Medicaid expenditures per recipient increase in PE quintiles 2, 4, and 5.

Welfare of a newborn is higher in the Medicaid primary scenario compared to the baseline. The increase is not as large as the 'Universal Medicaid' scenario, but that scenario exhibited considerable disagreement between high PE and other PE groups. There is no conflict in this scenario. Welfare increases in all PE quintiles as well as in the three High PE groups in

[32] In our 2-period model, in contrast, assets at the time of the LTC event is certain.

Table 4. In fact, this reform is Pareto improving; welfare is weakly higher for all individuals in the model. Most PE groups benefit because they have higher total insurance coverage compared to the baseline for LTC risk. The top 1 percentile PE group still prefers to self-insure LTC risk, but they benefit from higher dividend income (insurer profits increase) and lower taxes. Individuals in PE quintile 1 also benefit from lower taxes, but the magnitude of this benefit is small because in many cases their income is below the exemption threshold for income taxation.

Robustness Perhaps our most interesting result is that making Medicaid the primary payer is a Pareto improving. An important factor for this result is that aggregate expenditures and taxes on Medicaid fall. A lower tax rate is a central reason why welfare increases for affluent individuals. The welfare gain for them is small, which raises a question about whether aggregate Medicaid expenditures would increase if we changed the model. Medicaid LTCI benefits are means-tested, which keeps the program small and promotes targeting. Even relatively affluent individuals face some risk of having low resources when they experience a LTC shock, and Medicaid benefits are highly valued in this high marginal utility state (see Braun et al. (2017) for more details). Medicaid also only provides partial coverage against the loss. When combined with the primary payer provision, we have seen that some middle-income households prefer to save and purchase private LTC insurance, and Medicaid expenditures for them decline. Our Universal Medicaid simulation illustrates that a very large increase in the consumption floor and asset-test threshold results in higher Medicaid outlays and higher taxes.[33] However, that reform produces significant amounts of redistribution. We leave it to future research to analyze optimal second-best policies that are supported by tax transfer schemes. However, as long as the asset-threshold and consumption floor are kept reasonably close to their calibrated level, making Medicaid primary will increase total coverage against a costly LTC event for the middle class and have small impacts on the welfare of the affluent and poor.

Our model only has three periods and consequently abstracts from the possibility of an individual entering a nursing home as a private payer and subsequently qualifying for Medicaid benefits once the individual's wealth is exhausted. Braun et al. (2017) analyze this type of situation and find that means-tested Medicaid is highly valued by the affluent. Our consumption demand shock captures this effect in a parsimonious way. Adding more periods at the end of life to our current model could make it easier to build a consensus behind means-tested public LTC insurance because it reduces the tail risk associated with a persistent realization of high marginal utilities.

We have analyzed the positive and broad based welfare effects of making Medicaid primary. However, this is not the only way to relax the secondary payer provision of Medicaid in our model. For instance, allowing households to exempt assets from the Medicaid-asset test on a one-for-one basis with payouts from their private insurance policies also relaxes the secondary payer provision as we explain in Braun and Kopecky (2024). LTCIP policies, which are now offered in most US states, have this provision. However, there are other distinctions

[33]The asset-test formula used here has the property that the consumption floor determines the asset test threshold. Braun et al. (2017) consider more flexible means-test formulas in a lifecycle model with more periods but no private information.

between LTCIP and our proposal to make Medicaid the primary payer. Private insurance still pays first, and there is some uncertainty about whether, and in what circumstances, assets exempted from the Medicaid asset-test can be used to increase amenities for Medicaid recipients. In addition, the LTCIP program is not available in all US states, individuals still have to meet the Medicaid income test and also Medicaid rules about the treatment of the primary residence in the asset test.[34] Finally, other restrictions on minimum coverage levels of qualifying private LTCIP also constrain demand. A simpler way forward would be to make Medicaid the primary payer, maintain the asset test, but not restrict individuals choice of private LTCI policy.

We have modeled the LTC event as an expenditure shock and, thereby, abstracted from moral hazard. One way to introduce moral hazard into our model would be to model state-dependent preferences that are related to health status as in Ameriks et al. (2020). Copays or other partial coverage contracts are the standard way to mitigate moral hazard and US policymakers and private insurers are keenly aware of the problem and solution. Partial coverage of LTC expenses is a central feature of both public and private US insurance arrangements which our current model reproduces. Thus, we don't expect our results would change much if we modeled state dependent preferences. It is also worth noting that our model has the property that NH entrants with high wealth consume more than households with low wealth. Thus, our model is consistent with the observation that affluent individuals pay for and enjoy higher amenities if they experience a NH event than poor individuals.

Perhaps the biggest omission from our analysis is that we have abstracted from the bequest motives and informal care provided by families. Lockwood (2016) finds that modeling a warm glow bequest motive in conjunction with LTC risk accounts for the saving patterns of the elderly. Braun et al. (2017), in contrast, abstract from warm glow bequests and account for saving patterns of the elderly in US data with a richer model of long-term care risk. Mommaerts (2025) finds that individuals value informal care provided by their family members and suggests that allowing insurers to contract with family members could reduce public LTCI outlays. Our model implicitly assumes that insurers cannot contract with family members to provide LTC services. Under this assumption, informal care by family members is a source of adverse selection. Barczyk and Kredler (2021) propose a theory of two-sided altruism between a parent and a child, and Barczyk et al. (2022) find that owning a home helps the elderly pre-commit to compensating a child who provides informal care with a bequest. A challenge we leave to future work is jointly modeling private LTCI insurance, public LTC insurance, and informal insurance arrangements provided by families and the community.

6 Conclusion

The United States and other advanced economies are aging, and associated with aging is higher demand for LTC services. Yet, private LTCI insurance markets are shrinking, and most Americans find themselves paying for expensive long-term care episodes out of pocket. In this paper, we used a quantitative structural model of public and private insurance in the

[34] Alaska, Massachusetts, Mississippi, Utah, and Vermont do not currently participate, and California does not offer reciprocity benefits to private LTCI holders from other states.

US to consider reforms to the LTCI market.

Our results explain why it is difficult to build a consensus behind large-scale reductions or increases in public LTCI. A smaller public LTCI program increases the welfare of affluent individuals because their tax bills fall and they have the resources to pay their own LTC expenses. However, it has a large negative impact on the welfare of the poor, who are the main beneficiaries of the US Medicaid program. A larger public LTCI program benefits middle-class individuals who are too wealthy to be well covered by Medicaid but too poor to easily self-insure. But it results in welfare losses for the rich and very poor, who are paying higher taxes but experiencing no changes in their public insurance coverage levels. Even though individuals in our model have very different views about how to reform Medicaid, we are able to produce a Pareto improving reform. Making Medicaid the primary payer for LTC insurance while retaining the means-test increases private LTCI takeup rates, increases the profitability of insurers, and increases the welfare of low-, middle-, and high-income individuals.

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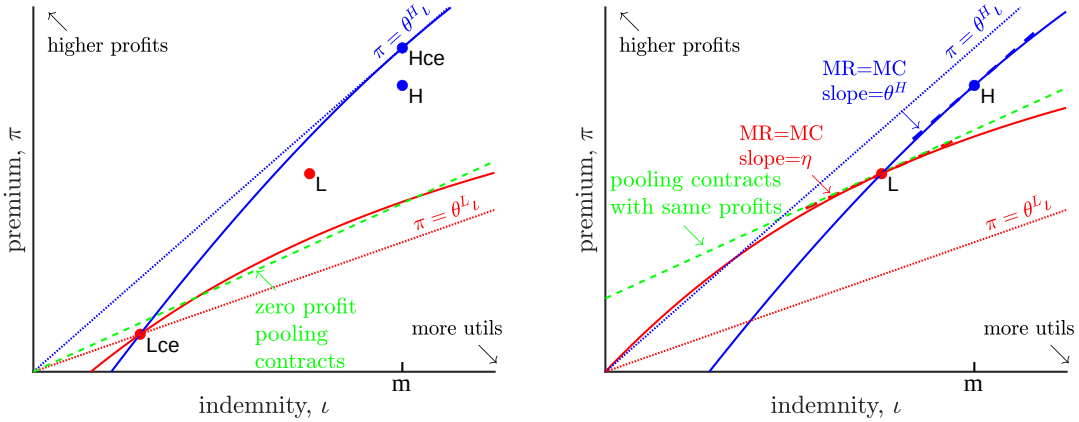
7 Appendix

7.1 Monopoly versus Competition

An equilibrium in the contract market may fail to exist under perfect competition. In contrast, with a monopolist insurer, a unique optimal contract always exists. To illustrate

Figure 13: Optimal contracts when the market is competitive



(a) Competitive Market (b) Monopoly

Note: Points H and L are the optimal contracts for type-H and type-L individuals under monopoly. Points Hce and Lce are the optimal zero-profit contracts under competition. The parametrization used to create both figures is $\sigma = 1.1$, $\psi = 0.8$, $\theta^L = 0.2$, $\theta^H = 0.5$, $w + a = 1.0$, $m = 0.8.$, $\lambda = 1$, and $\underline{c}_{NH} = 0$.

the source of this divergence, Figure 13 compares the contracting outcomes for the same calibration under competition and monopoly.

The key difference between the competitive market and the monopolist is that in the competitive market, the optimal menu of contracts must earn zero profits. For such a menu to constitute an equilibrium, no alternative contract menu can exist that both (i) earns positive profits and (ii) is strictly preferred by both private information types. If such a menu exists, an entrant could profitably offer a pooling contract that attracts both types, undermining the original zero-profit menu. Since this alternative contract earns positive profits, it cannot be part of a competitive equilibrium—implying that no equilibrium exists.

In Figure 13a, the points Hce and Lce represent the optimal zero-profit contracts. However, contracts located above the green dashed line and below the indifference curve of the low-risk type yield positive profits and are preferred by both types. Pooling contracts in this region sufficiently increase insurer profits from low-risk types to offset losses incurred from attracting high-risk types. The existence of these profitable and attractive pooling contracts renders the zero-profit menu $\{\mathsf{Hce}, \mathsf{Lce}\}$ unsustainable as a competitive equilibrium.

The likelihood of such pooling contracts arising is higher when the cost of pooling for low-risk types is low—either because the proportion of high-risk types is small, or because the incremental risk associated with high-risk types is modest. In these cases, insurers can profit by offering contracts with more generous coverage to low-risk types, since the cost of also attracting high-risk types is small.

By contrast, under monopoly (Figure 13b), no pooling contract exists that is strictly preferred by both types relative to the monopolist's optimal menu $\{\mathsf{H}, \mathsf{L}\}$ and earns higher profits. The only pooling contracts that yield higher profits lie northwest of the green dashed line but make the low-risk type worse off. The monopolist, by fully extracting consumer surplus subject to the participation and incentive compatibility constraints of the individuals, leaves no room for further profitable deviations and, hence, the equilibrium always exists.

7.2 Medicaid's Impacts on Savings in a Simple 2-Period Model

Here we present and further analyze the simple 2-period model used in Section 3.2 to illustrate how switching Medicaid from a secondary-payer to a primary-payer impacts savings and aggregate Medicaid outlays.

7.2.1 The two-period model with Medicaid Secondary

Consider an individual who lives for 2 periods: young and old. Resources when young are w_y and when old are w_o. The risk of entering a nursing home (NH) in period 2 and incurring NH expenses $m > 0$ is $\theta \in (0, 1)$. Assume the discount factor and interest rate are such that $\beta = 1 + r = 1$. The individual can purchase actuarially fair private insurance for the NH event at the beginning of period 2. Medicaid also provides insurance by guaranteeing a consumption floor of $\underline{c}_{NH}$ in the NH state. Medicaid is a secondary payer, which means that private insurance payments reduce the Medicaid transfer T dollar-for-dollar. Assume $w_o - m < \underline{c}_{NH} < w_o$, which means that if the agent's savings are low enough and he does not purchase private insurance, he will be eligible for Medicaid benefits, but Medicaid coverage is incomplete.

The individual chooses how much to consume, c_y, and save, a, in period 1 and how much private insurance to purchase, $q \geq 0$, at unit price p at the beginning of period 2 by solving

$$\max_{c_y, a, q \geq 0} u(c_y) + \theta u(c_{NH}) + (1 - \theta) u(c_o), \tag{22}$$

where

$$c_y + a = w_y, \tag{23}$$
$$c_o = w_o + a - p, \tag{24}$$
$$c_{NH} = w_o + a - m + q + T, \tag{25}$$
$$T = \max\Big\{0, \underline{c}_{NH} - \big[w_o + a - m + q\big]\Big\}, \tag{26}$$
$$p = \theta q / (1 - \theta), \tag{27}$$

and $u(c) = c^{1-\sigma}/(1 - \sigma)$ with $\sigma > 0$.

The first-order condition for savings is

$$u'(c_y) = (1 - \theta) u'(c_o) + \theta u'(c_{NH}) I_{T=0}, \tag{28}$$

and the first-order condition for private insurance is

$$[u'(c_o) - u'(c_{NH}) I_{T=0}] q = 0. \tag{29}$$

Two types of local maxima exist. One where the agent relies on Medicaid and does not purchase private insurance and one where he purchases private insurance and does not receive Medicaid transfers. If the agent is receiving Medicaid transfers, the marginal value of private insurance is zero because all this insurance will do is reduce Medicaid transfers dollar-for-dollar. It is easy to see that when Medicaid transfers $T > 0$, the amount of private

insurance, q, must be 0 for equation (29) to hold. Equation (29) also shows that if the agent is not receiving Medicaid transfers, he will purchase the amount of private insurance needed to equate consumption in the NH and non-NH state. Agents with lower levels of the endowments w_y and w_o are more likely to rely on Medicaid, while higher endowment agents are more likely to purchase private insurance.

7.2.2 The two-period model with Medicaid Primary

If Medicaid is instead a primary payer then

$$T = \max\Big\{0, \underline{c}_{NH} - \big[w_o + a - m\big]\Big\}. \tag{30}$$

Under this arrangement, the first-order condition for savings, equation (28), does not change. The first-order condition for private insurance becomes

$$u'(c_o) - u'(c_{NH}) = 0. \tag{31}$$

Note that when either $q = 0$ (no private insurance) or $T = 0$ (no Medicaid), there is no difference between the Medicaid secondary and primary scenarios.

7.2.3 Case 1: Low-endowment agent who relies on Medicaid when it is a secondary payer

Consider the case of a low-endowment agent who prefers to rely on Medicaid when Medicaid is a secondary payer. Let Medicaid transfers at the optimal allocations be given by $T^S > 0$. Since $T^S > 0$, for equation (29) to hold it must be that $q^S = 0$ and consequently $p^S = 0$. The first-order condition for savings, equation (28), becomes

$$u'(w_y - a) = (1 - \theta)u'(w_o + a). \tag{32}$$

Now consider the same agent when Medicaid is a primary payer. By revealed preference, the agent will still prefer to rely on Medicaid ($T^P > 0$), but may top up Medicaid by purchasing some private insurance. To see this, note that since $q^S = 0$, the optimal allocation under Medicaid secondary gives the agent the same level of utility under Medicaid primary. At the optimum, this level of utility is higher than the level of utility the agent would get if Medicaid transfers were zero ($T = 0$), which is also independent of Medicaid's payer status. Thus, when Medicaid is a primary payer, the agent is always better off at the Medicaid secondary optimum where $T > 0$ and $q = 0$ over any choice that results in $T = 0$ and $q > 0$.

While relying solely on Medicaid is preferred to relying solely on private insurance, the agent can achieve even higher utility by purchasing some private insurance and relying on both. Since Medicaid is a primary payer, his optimal quantity of private insurance, q^P, is determined by equation (31). This equation is satisfied when $c_o = c_{NH}$ or when

$$q^P = (1 - \theta)(w_o + a - \underline{c}_{NH}) > 0, \tag{33}$$

which implies that

$$p^P = \theta(w_o + a - \underline{c}_{NH}) > 0. \tag{34}$$

In other words, it was not optimal for the agent to purchase private insurance when Medicaid was a secondary payer, but it is optimal when Medicaid is a primary payer. Medicaid as a primary payer allows the agent to use private insurance to increase consumption in the NH state above the level provided by Medicaid. This increases the value of resources in period 2, and the first-order condition for savings, equation (28), becomes

$$u'(w_y - a) = (1-\theta)u'(w_o + a - p^P), \tag{35}$$
$$= (1-\theta)u'(w_o + a - \theta(w_o + a - \underline{c}_{NH})). \tag{36}$$

Since

$$w_o + a - \theta(w_o + a - \underline{c}_{NH}) < w_o + a, \tag{37}$$

the marginal benefit of saving is higher when Medicaid is primary compared to Medicaid secondary, i.e.,

$$(1-\theta)u'(w_o + a - \theta(w_o + a - \underline{c}_{NH}) > (1-\theta)u'(w_o + a). \tag{38}$$

While the marginal benefit of savings is higher under Medicaid primary, the marginal cost remains the same. Consequently, the optimal level of savings must be higher: $a^P > a^S$.

Figure 14 illustrates how changing Medicaid from a secondary payer to a primary payer impacts the marginal benefits of savings, utility, the private insurance indemnity, and Medicaid transfers for the low-endowment agent. Two local maxima can be observed when Medicaid is a secondary payer. Utility is maximized at the local maximum with lower savings, no private insurance, and positive Medicaid transfers. When Medicaid is a primary payer, the marginal benefit of savings is higher when receiving Medicaid transfers as now savings can be used to top up Medicaid with private insurance. The optimal level of savings increases, utility goes up, private insurance take-up becomes positive, and (since assets increase) Medicaid transfers decline.

7.2.4 Case 2: High-endowment agent who purchases private insurance when Medicaid is a secondary payer

Now consider the case of a higher-endowment agent who, even though when Medicaid is a secondary payer he is eligible for Medicaid if he saves nothing and purchases no private insurance, prefers to purchase private insurance and receives zero Medicaid transfers, i.e. $T^S = 0$. Since $T^S = 0$, for equation (29) to hold it must be that $c_o = c_{NH}$ which occurs when

$$q^S = (1-\theta)m > 0, \tag{39}$$

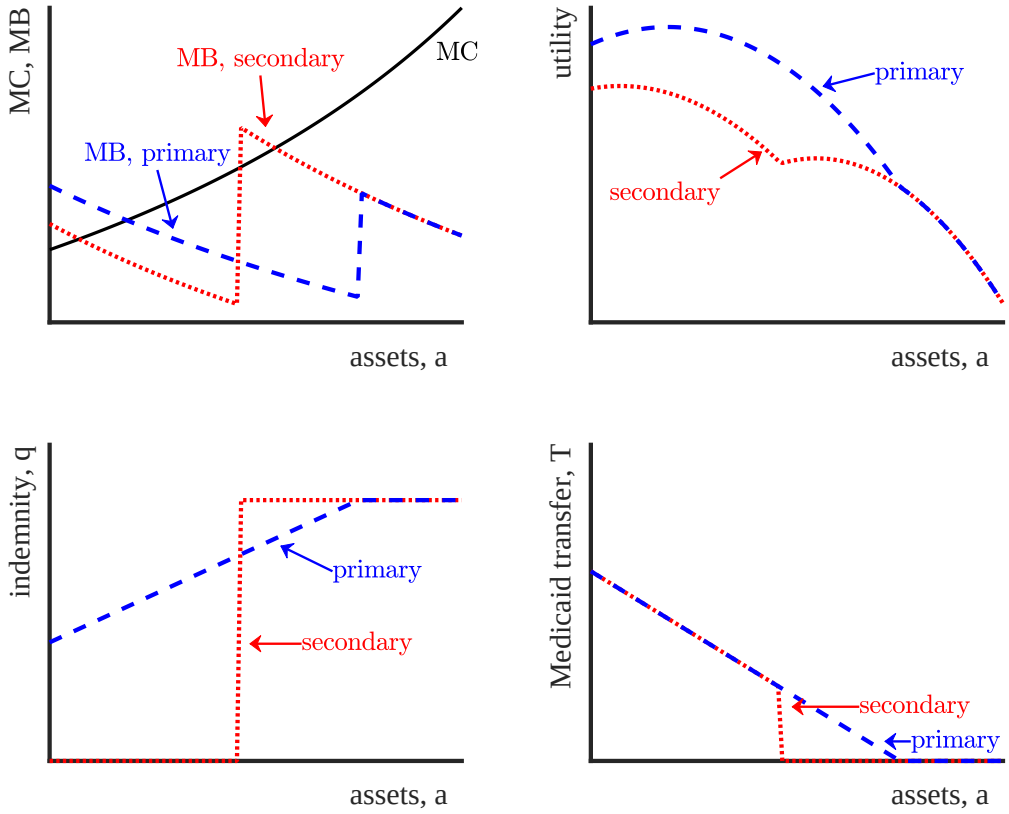
and

$$p^S = \theta m > 0. \tag{40}$$

Consumption in period 2 will be

$$c_o = c_{NH} = w_o + a - \theta m. \tag{41}$$

Figure 14: The marginal cost (MC) and benefit (MB) of saving, and utility, indemnity, and Medicaid transfer by asset choice for the low-endowment agent



Note: The parameterization used to create the figure is $\sigma = 1$, $\theta = 0.25$, $w_y = 2$, $w_o = 1.4$, $\underline{c}_{NH} = 0.9$, and $m = 1.1$. Assets vary from 0 to 0.8 along the x-axes.

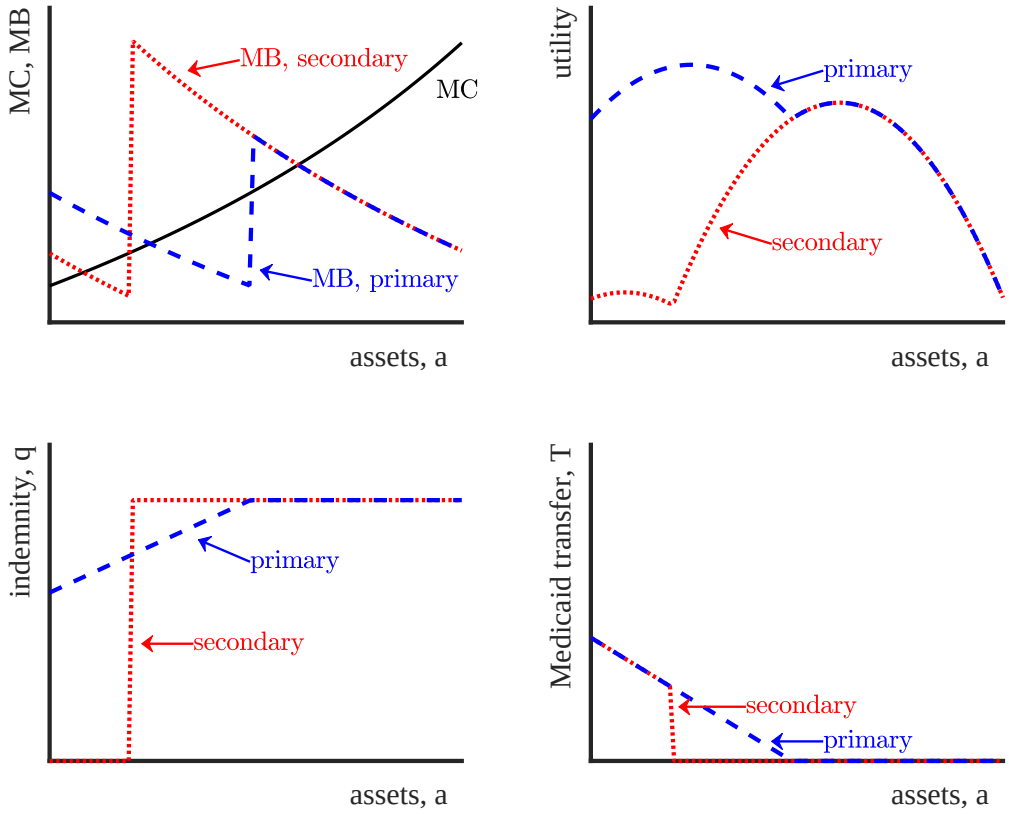
The FOC for savings, equation (28) becomes

$$u'(w_y - a) = (1 - \theta)u'(w_o + a - \theta m). \tag{42}$$

Now consider the same agent when Medicaid is a primary payer. By revealed preference, since the agent prefers to purchase private insurance when Medicaid is secondary ($q^S > 0$), he will prefer to purchase it when Medicaid is primary ($q^P > 0$). Suppose the agent chooses the same level of savings a^S and private insurance q^S when Medicaid is primary as when it was secondary. Under Medicaid secondary, $T^S = 0$ at this point and by equation (30), $T^P = T(a^S, q^S) \geq 0$. Thus, the optimal allocation under Medicaid secondary gives the agent the same or a higher level of utility under Medicaid primary. As the optimum, this level of utility is higher than the level of utility the agent would get if the agent does not purchase private insurance ($q^P = 0$), which is independent of Medicaid's payer status. Thus, when Medicaid is a primary payer, the agent is always better off at the Medicaid secondary optimum where $q > 0$ and $T \geq 0$ than at any point where $q = 0$.

With Medicaid primary, q must satisfy equation (31). This equation is satisfied when $c_o = c_{NH}$. There are two possibilities: the agent gets Medicaid transfers at the optimum, and the agent doesn't. If the agent doesn't get Medicaid transfers at the optimum, then the optimal allocation is the same as in the Medicaid secondary case and $T^P = T^S = 0$,

Figure 15: The marginal cost (MC) and benefit (MB) of saving, and utility, indemnity, and Medicaid transfer by asset choice for the high-endowment agent



Note: The parameterization used to create the figure is $\sigma = 1$, $\theta = 0.25$, $w_y = 2.3$, $w_o = 1.6$, $\underline{c}_{NH} = 0.9$, and $m = 1.1$. Assets vary from 0 to 0.8 along the x-axes.

$q^P = q^S$, and savings don't change ($a^P = a^S$). If the agent gets Medicaid transfers at the optimum, then q^P and p^P are given by equations (33) and (34), and the first-order condition for savings is given by equation (36). Since $T^P > 0$ if must be that $\underline{c}_{NH} > w_o + a - m$ which means that $m > w_o + a - \underline{c}_{NH}$ which means that

$$w_o + a - \theta(w_o + a - \underline{c}_{NH}) > w_o + a - \theta m, \tag{43}$$

which means that the marginal benefit of savings is lower when Medicaid is primary compared to Medicaid secondary:

$$(1-\theta)u'(w_o + a - \theta(w_o + a - \underline{c}_{NH})) < (1-\theta)u'(w_o + a - \theta m). \tag{44}$$

Since the marginal benefit of savings is lower under Medicaid primary, while the marginal cost remains the same, savings must be lower, i.e., $a^P < a^S$.

Figure 15 illustrates how changing Medicaid from a secondary payer to a primary payer impacts the marginal benefits of savings, utility, the private insurance indemnity, and Medicaid transfers for the high-endowment agent. Two local maxima can be observed when Medicaid is a secondary payer. Utility is maximized at the local maximum characterized by higher savings, no Medicaid transfers, and positive private insurance. Notice that if the agent

makes no change to his savings, then he achieves the same level of utility under Medicaid primary as under Medicaid secondary. However, he can achieve higher utility by reducing his savings. Lowering savings allows him to qualify for Medicaid benefits, which, under Medicaid primary, he can top up with private insurance. At the optimal level of savings with Medicaid primary, the agent purchases less private insurance, instead relying in part on free Medicaid benefits.

To summarize, the overall impact on aggregate Medicaid outlays of switching Medicaid from a secondary payer to a primary payer is ambiguous. The savings behavior and Medicaid benefits of individuals whose resources are so limited that they can't afford to top up Medicaid with private insurance do not change. Nor do the savings behavior or Medicaid benefits of the most affluent individuals, who have little chance of ever qualifying for Medicaid. Individuals with some, but limited, resources who choose to forgo private insurance and rely on Medicaid when it is a secondary payer behave like the low-endowment agent above. With Medicaid as a primary payer, they increase their savings and purchase private insurance to top up Medicaid benefits, and the size of their Medicaid benefit declines. Individuals with higher levels of resources who purchase private insurance when Medicaid is a secondary payer, but, absent private insurance, could have received Medicaid benefits, behave like the high-endowment agent. With Medicaid as the primary payer, they do not need to purchase as much private insurance to achieve the same level of consumption in the NH state as they can now rely in part on Medicaid benefits. This reduces the value of saving, and they save less. Since Medicaid outlays fall for some individuals and rise for others, the net effect on aggregate Medicaid expenditures is ambiguous.

Figure 6 in the paper summarizes how savings, private insurance, Medicaid transfers, and consumption vary with endowments for agents whose endowment when old satisfies $w_o - m < \underline{c}_{NH} < w_o$. The parameterization used to create the figure is $\sigma = 1$, $\theta = 0.25$, $\underline{c}_{NH} = 0.9$, and $m = 1.1$. The endowments increase proportionately from $w_y = 2$ and $w_o = 1.4$ to $w_y = 2.6$ and $w_o = 1.82$ along the x-axis in each panel.

7.3 Calibration

Table 5 reports the calibrated values of the main model parameters. More details on our calibration strategy can be found in Braun et al. (2019).

Table 5: Model parameters

Description	Parameter	Value
Risk aversion coefficient	σ	2
Preference discount factor	β	0.94
Retirement preference discount factor	α	0.20
Interest rate (annualized)	r	0.00
Frailty distribution	f	BETA(1.54,6.30)
Young endowment distribution	w_y	$\ln(w_y) \sim \mathcal{N}(-0.32, 0.64)$
Copula parameter	ρ_{f,w_y}	-0.29
Demand shock distribution	κ	$1-\kappa \sim$ truncated log-normal
Demand shock mean	μ_κ	0.6
Demand shock standard deviation	σ_κ	0.071
Fraction of good types	ψ	0.709
Nursing home cost	m	0.0931
Insurer's variable cost of paying claims	λ	1.195
Insurer's fixed cost of paying claims	γ	0.019
Medicaid consumption floor	$\underline{c}_{NH}$	0.01855
Welfare consumption floor	$\underline{c}_o$	0.01855