Private Health Insurance and Government-Provided Care: The Effects of Regulation

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Abstract

The coexistence of private health insurance and government-provided healthcare is common and patients with private insurance often access both systems. How should this interaction be regulated? I examine how to design reimbursement policies that require insurers to pay the government when patients with private insurance use public facilities. Using data from Brazil, I find that privately insured patients frequently undergo costly procedures (e.g., transplants, dialysis) in public hospitals, especially when they have a narrower insurance network. Insurers may limit networks to steer patients toward public care, but this can reduce enrollment, as broader networks attract more enrollees. Using a structural model, I analyze individuals' choice to enroll in private insurance and insurers' decisions regarding premiums and network size under different reimbursement policies. Simulations show that prohibiting private use of public services is less effective than the current reimbursement policy. Reducing reimbursement rates could increase welfare and enrollment through lower premiums and expanded networks, though this approach is costly for the government. A tax on insurers' profits could offset the impact on government budgets while improving welfare and enrollment in private insurance.

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1. Introduction

Expanding health coverage may involve the government directly providing care. However, private health plans are normally also available for individuals seeking greater provider choice, shorter wait times, or potentially higher-quality care typically found in private facilities. Consequently, private enrollees may receive coverage for various treatments from both government services and private insurance. Regulatory policies typically govern this intersection, particularly addressing how to manage cases when private enrollees utilize public facilities.

When privately insured patients use government-provided healthcare services, should private insurance companies cover these costs, or should they be borne by the public system? Alternatively, should public facilities stop treating privately insured patients altogether? Globally, policies regulating dual coverage (public and private) typically fall into two categories: access limitations and reimbursement policies. Access limitations prioritize patients without private coverage for specific treatments, while reimbursement policies vary widely. These can range from no reimbursement to requiring private insurers to reimburse public facilities as they would private ones. Determining which policy yields the best welfare outcomes remains an empirical question

I leverage Brazil's "reimbursements to the public system" policy to evaluate the effects of different reimbursement strategies on welfare. Additionally, I compare these policies to a scenario where private enrollees have no access to public facilities. Brazil offers nearly universal, government-funded healthcare through public facilities, while private insurance provides faster care at private in-network facilities. Since similar care is available in both, private enrollees are effectively covered by both systems. The private health market regulator requires insurers to reimburse the government when an enrollee receives medium or high-complexity care in public facilities. This regulation allows the government to shift costs to the private sector depending on how the rates are structured. It can also influence private enrollment and utilization patterns, as insurers may adjust plan generosity, affecting cost-sharing between the government and private sector. For example, high reimbursement fees enable the government to recover more revenue per visit but may prompt insurers to raise premiums, potentially reducing private enrollment and increasing reliance on the public system, thereby raising government costs.

I use data from 2015, published by National Agency for Supplementary Health (ANS), to document enrollment and utilization patterns, premium and network choices, and use a structural model to assess the welfare of different reimbursement policies. Three key facts motivate the model. First, reimbursements to the government are as important as 5% of the sector's medical profits, making them a significant factor for insurers when maximizing profits. Moreover, the relevance of this policy increased in 2015 when it was expanded to cover outpatient procedures, whereas previously only inpatient care was eligible. Second, reimbursing the government is generally cheaper than reimbursing private facilities for care received by enrollees, giving insurers a financial incentive to steer patients toward the public system. Third, public system utilization by enrollees is more pronounced in areas with narrower plan networks, while enrollment tends to be higher for plans offering more generous coverage. Thus, insurers may strategically narrow their networks to lower utilization costs, though this could reduce enrollment. This trade-off is explored when firms optimally choose their network.

The structural model consists of demand and supply. On the demand side, individuals decide whether and which plan to enroll in, and subsequently make utilization decisions once enrolled. Enrollees choose between seeking care at in-network private facilities or using the public system based on the share of available facilities through their plan and the overall quality of the private care in their region. The binary utilization choice is made separately for six categories of medical treatment: basic care, surgery, obstetric care, cancer, dialysis and transplants. Plan choices are driven by premiums and the expected value of care. The supply side is composed by private health insurance companies choosing premiums and the share of facilities to have in-network to maximize profit. Insurers' revenue comes from premiums, while their costs arise from enrollees utilizing in-network private facilities, reimbursing the government when enrollees seek care at public facilities, and forming their network.

Estimation is performed separately for the demand and supply components. I estimate the parameters related to utilization choices by directly matching the probability of enrollees utilizing private in-network facilities. I follow Berry (1994) to estimate the parameters related to private health insurance choices. The average cost in private facilities and the marginal cost of forming the network are recovered from the model. Finally, I use regression analysis to estimate how these costs vary with network breadth.

The sensitivity of enrollment and utilization to changes in premiums and networks guides decisions about network formation and pricing when the reimbursement policy changes. Estimation results indicate that if all insurers added one facility to their network, 225 enrollees would opt for care through their plans for basic procedures instead of using public facilities. This shift would also lead to the public system performing 60 fewer surgeries, treating 9 fewer cancer patients annually, providing weekly dialysis to 20 fewer patients, and handling 47 fewer deliveries. Demand for insurance is sensitive to premium changes, with elasticities ranging from -2.5% to almost -3%. Although demand is less sensitive to network changes, adding one facility to all networks would still increase enrollment by 80,000 people, or 1.14%. Broad networks are costly to form and they also increase the cost of providing care. The average cost per enrollee increases by less than 0.05%, on average, if one facility is added to the network. The marginal cost of network expansion varies with the insurer's size, with a median plan paying the equivalent of about 13 elderly enrollees' yearly premiums to add one facility to their network.

I analyze four main sets of counterfactual policies. First, I prohibit enrollees from utilizing the public system, implementing the strictest form of "access restriction" policy. Second, I equalize the reimbursement rate to the government with the average reimbursement to private facilities, thereby eliminating incentives to steer patients toward the public system. Third, I abolish the policy by setting the reimbursement to the public system to zero. Fourth, I eliminate the reimbursement requirement for costly medical treatments—such as transplants, dialysis, and cancer care—while retaining it for other treatments. Most of these policies are equivalent to a change in the reimbursement rates.[1]

When determining network shares, insurance companies trade off the profit from additional enrollees against the increased costs of providing easier access to care, while considering the cost of establishing their network. Changes in the reimbursement rate influence this bal-

[1]Prohibiting enrollees from utilizing the public system brings more complexity to the analysis, which is further discussed in Section 7.

ance. Higher reimbursement rates reduce firms' profits, diminishing the value of network expansion—this is the *scale effect*. At the same time, offering more in-network care becomes cheaper than reimbursing the government, reducing the cost of maintaining network-affiliated facilities—this is the *substitution effect*. Whether insurers expand or shrink their networks depends on which effect prevails. For premiums, higher reimbursement rates increase the cost per enrollee, which is then passed on to consumers through higher premiums.

The counterfactual results indicate that the *scale effect* dominates, leading firms to expand their networks when reimbursements decrease. Total surplus increases by 7%, and private enrollment grows by 7.67% when reimbursements are set to zero, as insurers offer lower premiums and broader networks. Conversely, as the reimbursement rate rises, total surplus declines due to narrower networks, higher premiums, and consequently lower enrollment. Aligning public reimbursements with those in the private sector boosts government revenue by nearly 180%, but this comes at the cost of reduced profits and consumer surplus. Finally, prohibiting private enrollees from accessing public facilities reduces welfare for consumers, insurers, and the government, making it a strictly dominated policy.

The findings suggest that, among the options analyzed, a zero reimbursement policy yields the greatest welfare gains. This policy remains socially efficient even if insurers collectively pay a lump sum to offset government losses. To mitigate concerns about insurers benefiting at the government's expense, the government could impose a tax of approximately 7% on insurers' profits per enrollee to create a budget-neutral policy. Although the enrollment gains would be smaller—with about a 4% increase compared to an 8% increase under the no-tax policy—total surplus would still rise by more than 3%.

With this research, I contribute to the literature that examines the interaction between government-funded healthcare and private health insurance companies by showing how government policies affect insurance enrollment and utilization patterns in a setting where the government directly provides care. Existing studies have explored how governments can encourage insurance enrollment (Limwattananon et al., 2015; Finkelstein et al., 2012; Cabral et al., 2018; Tebaldi, 2024; Jaffe and Shepard, 2020; Decarolis, 2015) and influence healthcare provision and utilization (Kolstad and Kowalski, 2012; Finkelstein and McKnight, 2008; Cabral et al., 2021; Carey et al., 2020; Buchmueller et al., 2016; Clemens and Gottlieb, 2014).

Another body of work investigates how government generosity in providing care or funding public insurance increases utilization (Balsa and Triunfo, 2021; Kondo and Shigeoka, 2013) and improves welfare (Gaynor et al., 2016; Cabral and Cullen, 2019). However, I am the first to provide evidence on the welfare effects of policies that regulate the overlap in care offered by insurance companies and the government.

Public healthcare systems are often criticized for failing to provide timely care through their facilities. In Brazil, where the most complex and expensive treatments are typically carried out in public hospitals, a zero-reimbursement policy effectively acts as a subsidy across medical treatments. Preventive and basic care are subsidized as individuals who enroll in private insurance gain better access to essential services. Lowering the cost of primary care has been shown to significantly improve health outcomes (Miller et al., 2013; Gruber et al., 2014) and reduce more expensive healthcare interventions (Baicker et al., 2015). This paper also builds on research that explores how insurers strategically choose non-price characteristics of their plans—such as network breadth—to minimize costs (Ho and Lee, 2019; Dafny et al., 2017; Gruber and McKnight, 2016; Serna, 2022). Here, network size is seen as a tool for steering patients toward the public healthcare system.

This paper is organized as follows: Section 2 presents the Brazilian healthcare system. Section 3 discusses the data sources. Section 4 brings descriptive evidence to motivate the model. Section 5 lays out the model, which is followed by the estimation procedure in Section 6. Section 7 discusses counterfactual policies, and Section 8 concludes the paper.

2. Institutional background

The Brazilian public healthcare system, known as the Unified Health System (SUS), was established by the 1988 constitution with the goal of providing comprehensive, universal preventive and curative care. The public sector operates its own facilities, which are intended to offer care without any out-of-pocket costs to the entire population. In parallel, there is a private health insurance market, where individuals can purchase private health plans and access in-network private facilities.

About 24% of the Brazilian population had private health insurance in 2015. This percentage rises to 42% in capital cities but can be negligible in several municipalities. The heterogeneity of enrollment across Brazil is illustrated in Appendix Figure A1. On average, individuals with private health plans have better access to preventive services and higher utilization rates compared to those who rely solely on the public system (Paim et al., 2011). The private healthcare market overrepresents utilization expenses. In 2015, private health insurance plans reimbursed private facilities approximately R$120 billion, while the public sector spent about R$46 billion on inpatient and outpatient care, in addition to R$18 billion on primary care.

The National Supplementary Health Agency (ANS) was established in 2000 to oversee the legal and administrative regulation of the private health insurance market. Its tasks include monitoring premium rates and their changes, assessing the quality of services provided, and establishing a list of mandatory procedures that insurers must cover. Because individuals enrolled in private health insurance plans can utilize public facilities, given the nature of the public health system, these individuals have "duplicated coverage". These private enrollees have access to the same range of procedures in both the public system and in-network private facilities, allowing them the flexibility to seek care in either system. To regulate such cross-system utilization, ANS mandates and enforces that private health insurance companies reimburse the government for any medium or high-complexity procedure that an enrollee undergoes in a public facility, provided the procedure is within the mandatory set of procedures covered by the plan.

The exact reimbursement rate has changed over the years since the reimbursement policy was established in 1998. In 2008, the regulatory agency introduced the Reimbursement Valuation Index (RVI), which determines the final reimbursement to the government as the RVI multiplied by the amount registered by the public system as the cost of care. Public health facilities use the SUS Procedures, Medications, and OPM Table Management System (SIGTAP/SUS)[2], commonly known as the SUS Table, to categorize and value the care provided. Reimbursements within the public system are based on the SUS Table, and therefore, the reimbursement that insurers pay the government also follows it. Since its creation, the RVI has been defined as 1.5. Appendix Section B further discusses the

[2]OPM refers to Orthotics, Prostheses and Auxiliary Means of Locomotion.

SIGTAP/SUS table.

The policies regarding reimbursable medical treatments have evolved over the years. Prior to 2015, only procedures performed in an inpatient setting were covered by the policy. Starting in 2015, outpatient procedures were also included, with insurers reimbursing retroactively for those conducted since 2012. As of 2015, the average fully paid or negotiated payment rate of all debts was about 60%, with the median being 80%. Firms that fail to comply with these regulations are considered to have active debt with the government, which can hinder their ability to obtain loans. The amounts collected by the regulator are sent to the National Health Fund, which manages health expenses at the federal level and allocates funds to states and municipalities for public healthcare provision.

It is common for individuals with private health insurance to utilize public healthcare facilities. People with private plans often rely on the public system for vaccines, high-cost treatments, and complex procedures such as hemodialysis, chemotherapy, and transplants. The public system typically has specialized reference centers and a broader network of facilities, designed to serve the entire population. Additionally, when nearby in-network facilities are unavailable or scarce, individuals may turn to public healthcare for other types of care. In 2015, over 600,000 medical treatments were conducted in public facilities for these enrollees, amounting to nearly R$1 billion in expenses for the public system.

3. Data

3.1. Enrollment, premium and network

Enrollment levels, premiums, and network information at the health plan and municipality levels are published annually by the National Supplementary Health Agency (ANS). I focus exclusively on individual plans that offer both inpatient and outpatient care in 2015. Enrollment is calculated separately for males and females across ten different age brackets (0-18, 19-23, 24-28, 29-33, 34-38, 39-43, 44-48, 49-53, 54-58, 60 and over). Premiums vary according to these same age brackets and also by municipality. I consider that insurance companies offer combinations of plans with the following characteristics: copay or no copay, with private or shared hospital rooms.[3] A plan is considered to operate in a municipality if it is within its selling geographic region published by ANS.

The regulatory agency also releases information on all health establishments within a plan's network, including the start and end dates of each agreement.[4] Since enrollees may seek care in neighboring municipalities, I group the network at the macro health region level, which consists of clusters of municipalities.

I analyze 75 macro health regions, encompassing virtually all municipalities in the country. Appendix Section A discusses the macro region definition and Appendix Figure A.A1 illustrates the health regions. These regions account for approximately 15% of all enrollees in the country, which amounts to about 7 million consumers.

Appendix Table A1 presents the average premium and enrollment percentages across different age groups. Premiums increase with age, with the largest hike occurring in the oldest age group since insurers cannot adjust premiums afterward. Premiums are not adjusted based on health status and vary solely by age, plan characteristics, and the municipality of residence. Moreover, Law 9656/98 prohibited insurance companies from denying coverage to patients with pre-existing conditions or imposing limits on the use of specific procedures. On average, plans have low market shares, with the outside option (no insurance) being highly prevalent.

On average, insurers offer plans with nearly 25 in-network facilities per health region (see Appendix Table A2). When adjusted for enrollment, this number rises to 40.8, reflecting differences in network availability and enrollment between large and small areas, as well as the tendency for people to purchase more comprehensive plans.

3.2. Utilization among enrollees

The regulatory agency is responsible for tracking the public system utilization among enrollees. It matches overall public utilization data with enrollment records and charges insurance companies when an enrollee utilizes the public system (SUS) to receive any medium

[3]When a company offers more than one plan within the same combination of characteristics, I use the average premium.

[4]I excluded all health establishments without a health facility identifier, which account for about 5% of the total establishments.

to high complexity care that should be covered by their insurance. The matched data contains the primary procedure performed, as well as the sex and age bracket of the patient.[5] The dataset contains the insurance company code and plan attributes (e.g., local/national coverage, individual or employer-sponsored, among others), but does not identify the plan precisely. Furthermore, it does not include the municipality of the patient's residence, providing only the facility identifier and, consequently, the municipality of treatment.

The private utilization among enrollees is depicted through a de-identified claims dataset, which the regulatory agency releases separately for inpatient and outpatient care. The dataset lacks identifiers for the plan, company, hospital, or patient; however, it includes plan characteristics, sex, age categories, municipality of the patient's residency and treatment, and indicates whether the visit resulted in a death.[6]. For each hospital visit, the data distinguish all procedures performed and the price paid by the insurance company to the provider. I designate the most expensive procedure as the main procedure performed.

I calculate the utilization in both the public and private systems among enrollees, categorized by sex (female and male), age groups, and macro health regions for each group of medical treatment using data from 2015. The age groups are: below 19, 19-29, 30-39, 40-49, 50-59, 60 and over. By analyzing the utilization at the health region level, I assume that enrollees seek care within the macro health region where they reside.

3.3. Medical treatment categorization

I categorized the medical treatment into six groups: basic treatment, oncology, dialysis, transplant, obstetrics, and surgery. Basic treatment includes diagnostic tests, hospital visits, primary care treatments, and in-hospital care for mild conditions. Surgery encompasses all non-cancer and non-delivery surgeries. The procedures are categorized according to the SUS Procedures, Medications, and OPM[7] Table Management System (SIGTAP/SUS), the SUS Table, which is used for the management and reimbursements of procedures within the

[5] The brackets in the raw data are: below 1, [1,4], [5,9], [10,14], [15,19], [20,24], [25,29], [30,34], [35,39], [40,44], [45,49], [50,54], [55,59], [60,64], [65,69], [70,74], [75,79], and 80 and over.

[6] The age categories are: below 1, [1,4], [5,9], [10,14], [15,19], [20,29], [30,39], [40,49], [50,59], [60,69], [70,79], and 80 and over.

[7] OPM refers to Orthotics, Prostheses and Auxiliary Means of Locomotion.

public system.[8] I exclude the medication, OPM, health promotion and prevention actions, and complementary health care actions major groups, and the subgroups related to dental care, treatment of poisoning resulting from an external cause, diagnosis in epidemiological and environmental surveillance, and rapid test diagnosis subgroups. Besides dental care, these subgroups mostly refer to procedures performed by the public system only, and some of them are not carried in-health facilities.[9] Therefore, I virtually include all medium and high complexity inpatient and outpatient procedures performed in health facilities. Appendix Table A.B1 illustrates the SIGTAP/SUS subgroups included in each of the six major groups.

The selection of the six medical treatment groups is informed by the pattern of enrollees' utilization in the public system. Figure 1 illustrates the proportion of procedures undergone in public facilities among enrollees within each group. Transplants are the most commonly utilized treatment in the public sector, with around 85% of all transplants undergone by insured individuals being performed in public facilities. On the other hand, basic treatment is predominantly conducted in private facilities (within network) by enrollees. Appendix Table A3 displays the five most common procedures performed in public facilities among enrollees for each treatment group.

3.4. Health infrastructure

3.4.1. Health facilities

The Information Technology Department of the Brazilian Unified Health System (DATASUS) releases information on all health facilities in the country. This data is used to calculate the number of facilities a plan could potentially partner with. Only facilities that either report treating patients with insurance or appear in a plan's network in the network dataset are considered available for negotiation with private health plans.

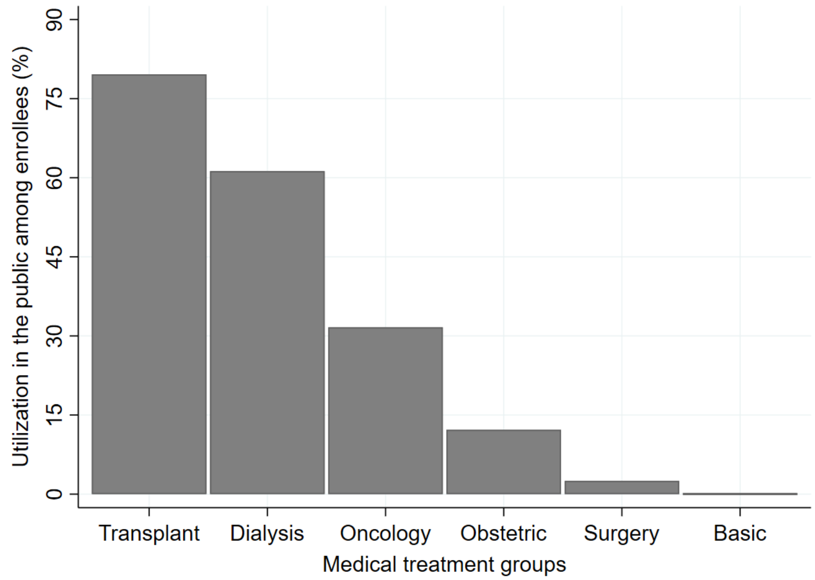
3.4.2. Quality variables

The quality variables for the public healthcare system, and partially for the private system, are sourced from DATASUS. This quality information influences enrollees' utilization choices

[8] Appendix Section B further discusses the SIGTAP/SUS table.

[9] For example, educational courses and workshops, and facilities inspections.

Figure 1: Utilization in public facilities among enrollees by medical treatment group



Notes: The figure depicts the percentage of the utilization among enrollees done in public facilities by medical treatment group. The plot uses utilization occured in 2015.

and is considered in the utilization model.

Mortality: the mortality probability in public facilities is computed using the inpatient data (SIHSUS/DATASUS) at the sex, age, and health region level for cancer, transplant, obstetric care, and surgery medical treatment groups. The mortality probability for private facilities is computed from the claims data. I only use deaths following in-patient care.

Waiting time: the waiting time in the public system is only available for a subset of procedures. Therefore, I compute the average waiting time for dialysis only at the age, sex and health region level.

Professionals: I consider the number of oncologists, obstetricians, gynecologists, and other birth professionals. The dataset divides professionals into those who provide service to the public system, and those who do not. I use this numbers as the number for the private and public system, respectively.[10]

Infrastructure: I consider the number of clinic rooms, imaging equipment, dialysis equip-

[10]Note that professionals could provide service to both public and private systems; however I include these professional as workers of the public system only.

ment, inpatient beds, surgical beds, and obstetric and neonatal rooms.

3.5. Reimbursements

The reimbursement paid by insurance companies can be either to the private or to the public system, depending on where the utilization occurred. The reimbursement to private facilities at the insurer level is recovered in the structural model. I calculate the reimbursement to the public healthcare system for each medical treatment category and for each sex and age groups using the following factors: 1) the cost of a single procedure in the public system as published in the SUS Table, 2) the average cost of hospitalization to account for procedures that require additional, more expensive care, and 3) the number of occurrences of each procedure by age, sex, and health region. This approach accounts for varying medical needs across sex and age groups, and adjusts the expected reimbursement within each medical treatment group accordingly. Details on the construction of the reimbursement to the public system can be found in Appendix Section C.

4. Descriptive evidence

Three pieces of descriptive evidence motivate the model structure. First, I discuss how reimbursement rates were salient to insurers and considered when making premium and network decisions. This motivates insures considering the reimbursement rates when maximizing profits. Second, I demonstrate that, on average, the prices insurers pay to private facilities for treatments are higher than what they pay the government for an enrollee's utilization. This creates an incentive for insurers to steer patients toward the public system. Third, I suggest that network design could influence enrollees' utilization decisions, as utilization within a network positively correlates with its breadth. However, enrollment levels tend to be lower for plans with narrow networks, which should be considered when determining the optimal network breadth.

Insurance companies observe the reimbursement rates to the public system: reimbursements to the government were equivalent to 4.5% of private insurers' medical profits in 2015.[11] The reimbursement amount exceeded their net profit when operational and administrative revenues and expenses were considered. Two pieces of anecdotal and suggestive evidence further corroborate that insurers are observant of the reimbursement rates.

First, a policy change in 2015 alerted firms to the possibility of increased dues to the government. Since 1998, plans have been mandated to reimburse the government whenever an enrollee receives medium- or high-complexity treatment in an inpatient setting. In May 2015, the health ministry announced that insurers must also reimburse for treatments of the same complexity received in an outpatient setting. This regulation took effect immediately, and insurers were required to retroactively reimburse for outpatient care provided from 2012 to 2015. According to the regulator, 60% of the utilization in public facilities by enrollees are outpatient care, meaning that the changes would significantly affect health insurance companies.

Second, press announcements expressed firms' discontentment with the inclusion of outpatient care in the reimbursement policy. After the announcement, officials from the regulatory agency endorsed the regulation, stating, "When an operator sells a health plan contract, it needs to ensure that its network can cover the contracted range of procedures without the beneficiary needing to resort to the public network". However, the Brazilian Association of Group Medicine, the National Union of Group Medicine Companies, and the National Union of Group Dentistry Companies expressed their dissatisfaction in their quarterly publication on the private healthcare market: "The reimbursement to SUS is a controversial process, surrounded by various issues, ranging from the beneficiaries' right to access public health services, the ANS charging 50% more than what was spent by SUS, and possible fraud, such as double billing for the same service, among others. Until all these issues are resolved, it is essential to continue monitoring and raising awareness about the impacts of the reimbursement process.".[12]

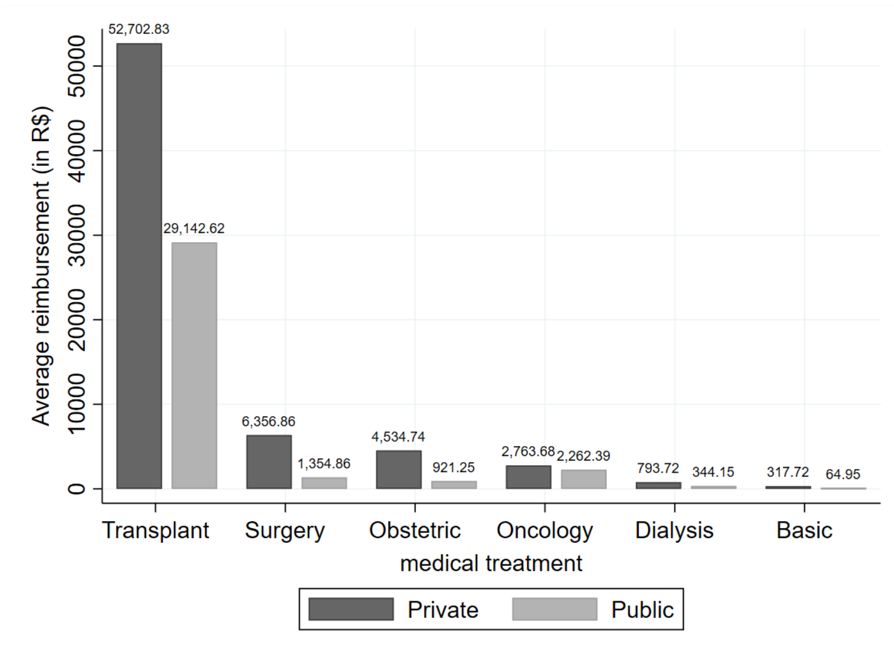
Reimbursements to the government are cheaper than those to private providers: the reim-

[11] Medical profit is defined as the difference between premium revenues and the direct costs of providing healthcare. Data are available through the ANS data portal: https://www.ans.gov.br/anstabnet/.

[12] The original quotes can be found in https://abramge.com.br/wp-content/uploads/2023/10/cenario_da_saude_ed3.pdf and https://dssbr.ensp.fiocruz.br/ampliacao-do-ressarcimento-do-sus-levanta-alertas-sobre-relacao-com-operadoras/.

bursement rates charged by the government when an enrollee utilizes the public system are, on average, lower than the reimbursement rates that insurance companies negotiate with private facilities. Figure 2 displays the average reimbursement to the government and to private facilities by medical treatment category. Reimbursements range from being 22% higher in the private sector for chemotherapy sessions to nearly 400% higher for childbirth. The lower prices faced by insurers in the public system suggest that having enrollees utilizing the public system might be profitable for firms.

Figure 2: Average reimbursement to private facilities and to the government



Notes: The figure displays the average reimbursement to private facilities (private) and to the government (public) for each medical treatment category. Oncology and dialysis prices roughly represent the price of one session of chemotherapy and dialysis, respectively.

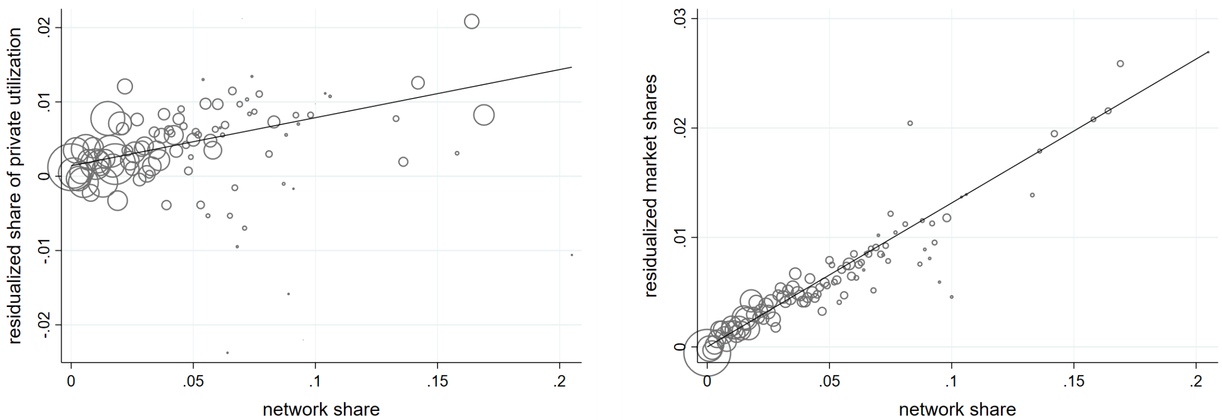
Utilization and plan choice correlate with network: utilization patterns are correlated with the availability of care. It is expected that enrollees would be more inclined to use public services if access to in-network facilities is scarce. Figure 3a supports this idea by illustrating a positive correlation between utilization rates and the share of facilities in the network.

A greater share of in-network facilities indicates the availability of medical treatment through the health plan. Therefore, if enrollees' decisions to utilize the public system are

Figure 3: Relationship between network breadth and utilization in (in-network) private facilities and plans' market shares

(a) Utilization in private facilities

(b) Market shares



Notes: The figure illustrates the relationship between the residualized probability of an enrollee utilizing the public system and the share of facilities in the network, as well as the relationship between network shares and residualized market shares. The probability is defined as the proportion of utilization that occurred in private facilities within each health region and sex-age combination. This measure is adjusted for medical treatment categories, which are interacted with health region, insurer, sex and age groups of enrollees, and plan attributes fixed effects. It also controls for the private-public difference in health infrastructure available at the municipality level. Plans' market shares are adjusted for municipality, age groups, sex, and plan identifier fixed effects.

influenced by network breadth, insurers can leverage this as a tool to manage their care costs by directing patients toward the public system.

Plans with broader networks have greater market shares, as indicated by Figure 3b. The positive correlation between network size and enrollment and private utilization suggests that insurers face a trade-off when selecting their networks. While a broader network attracts more enrollees and increases revenue, it also raises costs as enrollees are likely to seek more care within the network.

5. Model

The model is structured into demand and supply components. On the demand side, individuals decide on their health plan and whether to seek care at a private or public facility (a binary choice). On the supply side, insurance companies determine the network breadth and set premiums. All choices are made considering the health infrastructure fixed, being it owned by the government or private companies. Consequently, the model does not account for hospital entry decisions or government healthcare expansions.

5.1. Demand

5.1.1. Utilization choice

An individual i enrolled in plan j in municipality m chooses whether or not to seek private in-network care for each procedure c. Each municipality belongs to a health region, r, such that $\mathcal{M}_r$ denotes the set of municipalities within health region r. This binary decision is guided by the latent utility specified as follows:

$$u_{ijcm} = \delta_{\theta cm} + \beta_{1c}\mathrm{H}_{jr} + \beta_{2c}[\text{offer lc}]_{jcm} + \beta_{3c}[\text{copay}]_j + \beta_{4c}[\text{room}]_j + \varepsilon_{ijcm}$$

Each individual belongs to a group of demographics denoted by $\theta = \{\theta_1, \theta_2\}$, such as θ_1 denotes the individual's sex, and θ_2 age brackets. H_{jr} represents the share of facilities in network in health region r for each plan j. $[\text{offer lc}]_{jcm}$ indicates the presence of network facilities offering c in the individual's municipality of residence. This captures the increased likelihood of utilizing the public system if there is no easily accessible network facility. $[\text{copay}]_j$ and $[\text{room}]_j$ indicate whether the plan includes a copay policy and whether it covers private hospital accommodations. These plan attributes may influence enrollees' decisions on whether to seek care within the network. Note that while network-specific preferences vary by medical treatment, the network itself represents the overall share of facilities included. As shown in Appendix Figure A2, there is a monotonic positive correlation between the overall network share and the treatment-specific network share, which suggests that plans do not specialize in treating certain conditions.

$\delta_{\theta cm}$ captures heterogeneous preferences for the private system, and is defined as:

$$\delta_{\theta cm} = \beta_{5c}\Delta\text{facility}^{capita}_{cr} + \beta_{6c}\Delta\text{quality}^{capita}_{\theta cm} + \delta_{\theta c} + \delta_{cr}$$

$\Delta\text{facility}^{capita}_{cr}$ represents the difference between the number of private and public health facilities offering treatment c, adjusted for population size. I also include several terms to capture the quality differences between private and public facilities, denoted by $\Delta\text{quality}^{capita}_{\theta cm}$. Table A4 outlines the quality terms considered for each treatment c. These terms generally include infrastructure variables (e.g., imaging equipment, beds, and healthcare professionals) and quality of service indicators (e.g., mortality rate and waiting time). Including the terms as the private-public difference normalizes the utility of public care to be zero. Using per capita variables adjusts for differences in health region and municipality sizes. Appendix Table A5 presents descriptive statistics of care availability and quality. I also account for variations in enrollees' preferences for private facilities based on their sex and age ($\delta_{\theta c}$), as well as their location (δ_{cr}), which reflects the size of the municipality and the state they reside in for treatments such as cancer, dialysis, and transplants, or health region-specific preferences for other medical treatments.[13][14]

Assuming that ε_{ijcm} follows an Extreme Value Type 1 distribution, the probability of an enrollee seeking private in-network care is:

$$\lambda_{\theta jcm} = \frac{exp(\delta_{\theta cm} + \beta_{1c}\mathrm{H}_{jr} + \beta_{2c}[\text{offer lc}]_{jcm} + \beta_{3c}[\text{copay}]_j + \beta_{4c}[\text{room}]_j)}{1 + exp(\delta_{\theta cm} + \beta_{1c}\mathrm{H}_{jr} + \beta_{2c}[\text{offer lc}]_{jm} + \beta_{3c}[\text{copay}]_j + \beta_{4c}[\text{room}]_j)}$$

5.1.2. Insurance choice

The indirect utility of individual i in municipality m from enrolling in plan j is:

$$U_{ijm} = \alpha_\theta P_{\theta jm} + \eta_\theta \sum_c q_{\theta cm} E\{max(u_{ijcm})\} + \delta_\theta + \delta_j + \delta_m + \xi_{\theta jm} + \epsilon_{ijm}$$

$P_{\theta jm}$ denotes the premium, and $q_{\theta cm}$ is the probability of needing procedure c for individuals with characteristics θ in municipality m. I assume that an individual i knows no more about themselves than the econometrician knows about the group of people with similar characteristics. $E\{max(u_{ijcm})\}$ represents the maximum utility expected to be obtained in the utilization decision. I account for consumers' varying preferences for health plans based on their individual characteristics, δ_θ, and the municipality they reside in, δ_m. δ_j captures the intrinsic preferences for plan j. $\xi_{\theta jm}$ represents a demand shock not accounted for by the

[13] Due to the lack of comprehensive data on complex and costly treatments across all sex and age combinations in every health region, I do not include health region fixed effects for cancer, dialysis, and transplants, opting instead for less restrictive geographic fixed effects.

[14] When health region-specific preferences are included, I incorporate the differential number of facilities and quality at the municipality level only. For cancer, dialysis, and transplants, I consider these terms separately for the municipality of residence and other municipalities within the same health region.

previously described heterogeneous preferences. ϵ_{ijm} represents an idiosyncratic taste shock that follows a Extreme Value Type I distribution. The outside option consists of not buying insurance, such that $u_{i0m} = \epsilon_{i0m}$. The market share of plan j in municipality m among the population of type θ is:

$$s_{\theta jm} = \frac{exp(\alpha_\theta P_{\theta jm} + \eta_\theta \sum_c q_{\theta cm} E\{max(u_{ijcm})\} + \delta_\theta + \delta_j + \delta_m + \xi_{\theta jm})}{1 + \sum_{j'} exp(\alpha_\theta P_{\theta j'm} + \eta_\theta \sum_c q_{\theta cm} E\{max(u_{ij'cm})\} + \delta_\theta + \delta_{j'} + \delta_m + \xi_{\theta j'm})}$$

5.2. Supply

Private health insurance companies play a two-stage game. In the first stage, they decide on the network, H_{jr}, which represents the proportion of available facilities that the insurance company successfully contracts and makes accessible to enrollees for care. In the second stage, they set the premium, $P_{\theta jm}$. The premium is the annual amount in Brazilian Reais (R$) that an enrollee pays to the insurance company, regardless of their actual healthcare utilization. The firms' revenue comes from selling health plans, while their costs stem from providing healthcare services to enrollees and covering administrative expenses, particularly those related to contracting private healthcare facilities.

The two-stage game follows this timing assumption: First, firms choose the network breadth, H_{jr}. Second, insurance demand shock, $\xi_{\theta jm}$, and average cost shock, $\zeta_{\theta jm}$, are realized. Then, firms set their premiums, and individuals decide which insurance plan to purchase based on their expected utilization. Finally, utilization shocks, ε_{ijcm}, occur, and individuals make their actual utilization choices. A similar timing assumption has been considered by Wollmann (2018), Fan and Yang (2020), and others.

The annual profit per enrollee of type θ enrolled in plan j is defined as:

$$\pi_{\theta jm}(P_{\theta jm}, H_{jr}) = P_{\theta jm} - \underbrace{\sum_{c \in C_{jr}} q_{\theta cm} \lambda_{\theta jcm}(H_{jr}) R^{priv}_{\theta jcm}(H_{jr})}_{AC^{priv}_{\theta jm}(H_{jr})} - \sum_{c \in C_{jr}} q_{\theta cm}(1 - \lambda_{\theta jcm}(H_{jr})) R^{pub}_{\theta cr}$$
$$- \sum_{c \notin C_{jr}} q_{\theta cm} R^{pub}_{\theta cr}$$

such that $P_{\theta jm}$ represents the premium received, H_{jr} denotes the network breadth, $q_{\theta cm}$ indicates the probability of seeking care and $\lambda_{\theta jcm}$ the probability of utilizing in-network private facilities. $R^{priv}_{\theta cr}$ represents the reimbursements insurers pay to private facilities for enrollee utilization, which is not directly observed in the data. $R^{pub}_{\theta cr}$ represents to the reimbursement to the public system. $c \in C_{jr}$ indicates the procedures offered within network H_{jr}.

The utilization costs originate from three sources: 1) utilization in private facilities within the network for procedures offered at these facilities. This utilization occurs with probability $q_{\theta cm}\lambda_{\theta jcm}$. This term is also referred to as the average cost in private facilities, $AC^{priv}_{\theta jm}$. 2) enrollees seeking care in public facilities despite the treatment being available in-network, which occurs with probability $q_{\theta cm}(1 - \lambda_{\theta jcm})$. In this scenario, the insurer is required to reimburse the government at the rate $R^{pub}_{\theta cr}$. 3) treatments received in the public system that are not available in-network but are supposed to be offered in-network according to regulations. In this case, the insurer must reimburse the government.

The average cost incurred by firm j in private facilities with enrollee of type θ in municipality m is modeled as a function of the network breadth:

$$AC^{priv}_{\theta jm} = \sum_{c \in C_{H_{jr}}} q_{\theta cm}\lambda_{\theta jcm}[\kappa H_{jr} + \delta_j + \delta_m + \delta_\theta] + \zeta_{\theta jm}$$

A broader network is expected to directly increase utilization costs by making care more accessible. Additionally, broader networks raise costs in private facilities as they attract more enrollees to seek care in-network. Network breadth directly increases costs when there is a greater likelihood that enrollees will need care and seek it within the network, represented by $\sum_{c \in C_{jr}} q_{\theta cm}\lambda_{\theta jcm}$. The parameter κ translates this into monetary terms. The set of fixed effects controls for the firm's bargaining power in negotiating prices, variations in medical costs across municipalities, and differences in care costs based on enrollees' age and sex. $\zeta_{\theta jm}$ represents the average cost shock that is orthogonal to the network choice given the timing assumption.

The *ex-ante* annual profit of firm f in health region r is computed as the expected sum of profits earned from enrollees across all plans offered by the firm in all municipalities within health region r. The expectation accounts for firms' *ex-ante* uncertainty regarding their market share and average costs. Here, $s_{\theta jm}$ denotes the market share of plan j in municipality m, and $N_{\theta m}$ represents the market size.[15] Firms also incur costs for forming networks for each plan, denoted by NF_{jr}, which reflect the administrative expenses associated with contracting and negotiating with private facilities.

$$\pi_{fr} = E_{(\xi,\zeta)}[\sum_{m\in\mathcal{M}_r}\sum_{j\in\mathcal{J}_{fr}}\sum_{\theta} s_{\theta jm}(P_{\theta m}, H_r)N_{\theta m}\pi_{\theta jm}(P_{\theta jm}, H_{jr})] - \sum_{j\in\mathcal{J}_{fr}} \text{NF}_{jr}(H_{jr})$$

The first term represents the revenue a firm receives from enrollees, net of utilization costs. $s_{\theta jm}(P_{\theta m}, H_r)$ denotes plan j's market share, which is a function of all premiums set for individuals of type θ in municipality m, as well as the network breadth chosen by all insurers, including insurer j. $\pi_{\theta jm}(P_{\theta jm}, H_{jr})$ represents the profit per enrollee, which depends on the premium and network set by firm j.

The cost of forming the network, represented by the last term, is defined as a convex function of the agreements already made, reflecting the increasing costs of contracting with new facilities. These rising costs are primarily due to the need to hire additional workers, negotiate prices based on previously agreed terms, and manage paperwork. As a result, the network formation cost is structured so that the marginal cost of network formation increases with the number of agreements.[16]

$$\text{MCNF}_{jr} = \frac{\partial NF_{jr}}{\partial H_{jr}} = exp(\omega H_{jr} + \delta_j + \delta_r + \upsilon_{jr})$$

The plan fixed effects capture the plan's bargaining power and its ability to negotiate better rates. Health region fixed effects account for variations in negotiating conditions and market medical prices across different regions.

Modelling the network choice as a convex function of the share of facilities was previously done by Serna (2022). I model network choice as a single decision across all procedures, with enrollees having different preferences for the network depending on the treatment they seek,

[15] I exclude individuals enrolled in non-individual plans from the market size calculation.

[16] The cost of network formation remains increasing and convex as long as the term within the exponential is positive and ω is positive. Both conditions can be verified empirically.

which reflects the Brazilian context. In Brazil, once a facility is in-network, enrollees have access to all of its treatments, except for those provided by third parties, which are recorded in my data as separate facilities. Insurers selecting an overall share of facilities may either diminish or enhance the role of networks in directing patients toward the public system. For example, adding a hospital to the network with the intent of expanding obstetric care would also increase the availability of basic treatments and surgeries, potentially raising costs beyond initial expectations. Conversely, enrollment is likely to respond more strongly to the overall network rather than to a network focused on specific treatments.

5.2.1. Premium and network breadth choices

The first-order condition with respect to $P_{\theta jm}$ is:

$$\frac{\partial \pi_{fr}}{\partial P_{\theta jm}} = \sum_{j' \in \mathcal{J}_f, j' \neq j} \frac{\partial s_{\theta j'm}}{\partial P_{\theta jm}} N_{\theta m} \pi_{\theta j'm} + \frac{\partial s_{\theta jm}}{\partial P_{\theta jm}} N_{\theta m} \pi_{\theta jm} + s_{\theta jm} N_{\theta jm} = 0$$

The first and second terms represent the profit changes resulting from marginal enrollees. Specifically, an increase in premiums may lead enrollees to switch to other plans or to opt out entirely, thereby reducing the overall profit of plan j. This effect is partially offset by the influx of new enrollees into other plans offered by the same firm. The final term reflects the mechanical increase in revenue from individuals already enrolled in plan j when premiums rise. Premiums are set to balance these effects.

Note that premium decisions are made after insurers observe insurance demand shocks, $\xi_{\theta jm}$, and average cost shocks, $\zeta_{\theta jm}$. Therefore, firms face no uncertainty regarding market shares or profit per enrollee, $\pi_{\theta jm}$. As a result, *ex-post* profit is used when deriving the first-order condition with respect to premiums. Conversely, the *ex-ante* profit is used to compute the first-order condition with respect to the network, as insurers make network choices under uncertainty regarding average costs and enrollment levels. In the absence of uncertainty about market shares and average costs, deciding on the network would exactly determine the premium levels.

The first-order condition with respect to H_{jr} is:

$$\frac{\partial \pi_{fr}}{\partial H_{jr}} = E_{(\xi,\zeta)}[\sum_{m' \in \mathcal{M}_r} \sum_{j' \in \mathcal{J}_{fr}} \sum_{\theta} \underbrace{\frac{\partial s_{\theta j'm'}}{\partial H_{jr}} N_{\theta m'} \pi_{\theta j'm'}}_{\substack{\text{Effect on}\\ \text{enrollment}}} + \underbrace{s_{\theta j'm'} N_{\theta m'} \frac{\partial \pi_{\theta j'm'}}{\partial H_{jr}}}_{\substack{\text{Effect on}\\ \text{average cost}}}] - \underbrace{\frac{\partial NF_{jr}}{\partial H_{jr}}}_{\substack{\text{Cost of increasing}\\ \text{the network}}} = 0$$

such that $\frac{\partial s_{\theta j'm'}}{\partial H_{jr}} = \frac{\partial s_{\theta j'm'}(P_{\theta m}(H_r), H_r)}{\partial H_{jr}}$ and $\frac{\partial \pi_{\theta j'm'}}{\partial H_{jr}} = \frac{\partial \pi_{\theta j'm'}(P_{\theta j'm'}(H_{j'r}), H_{j'r})}{\partial H_{jr}}$.

The *effect on enrollment* measures the change in profit caused by variation in enrollment due to an expanded network. A more generous network enhances the attractiveness of plan j by increasing the value of care provided. This boosts enrollment in plan j while potentially reducing enrollment in competing plans, including those offered by the same firm. This effect is partially offset by broader networks being linked to greater premiums, which discourage enrollment.

The *effect on average cost* indicates the rise in utilization costs due to an expanded network. Utilization costs per enrollee increase through two channels: 1) higher utilization of network facilities instead of using the public system, which raises costs when reimbursements to private facilities exceed those to the government; and 2) higher average costs in private facilities, as a broader network makes access to care easier. Increased utilization costs lead to reduced profit for any given premium. This effect is partially offset by broader networks normally leading to higher premiums, thereby increasing profit per enrollee. The *effect on enrollment* and *effect on average cost* together represent the marginal revenue associated with changes in network breadth. Ultimately, firms adjust their network to ensure that the marginal revenue from expanding the network equals the marginal cost of doing so. The marginal cost is referred to as the *cost of increasing the network* or the marginal cost of network formation.

6. Estimation

The demand and supply-related parameters are estimated separately. First, I estimate the probability of enrollees utilizing in-network private facilities. Second, I estimate the market share of health plans. Third, I recover the annual profit per enrollee and estimate the parameters associated with the average cost per enrollee in private facilities. Last, I use the first-order condition with respect to the network to recover the marginal cost of network formation and subsequently estimate its parameters.

6.1. Utilization choice

I estimate the utilization choice using Generalized Method of Moments (GMM). Specifically, I match the probability of enrollees utilizing in-network private facilities at the health region-sex-age level for each procedure. Due to the absence of plan identifiers in the utilization dataset, I do not match probabilities at the plan level. Additionally, I focus on the health region level rather than the municipality level because seeking care in nearby municipalities is common in Brazil. Furthermore, utilization at the municipality level may be too low in some areas depending on the enrollment level. I aggregate the probabilities predicted by the model to the θcr level using the enrollment level as the weight. Appendix Table A6 presents points along the distribution of λ for different sex and age groups. I estimate β_c and δ_c by solving the following problem:

$$\min_{\beta_c,\delta_c} \sum_{r}\sum_{\theta}[(\lambda_{\theta cr} - (\sum_{j\in J_r}\sum_{m\in\mathcal{M}_r}\frac{N_{\theta jm}}{N_{\theta r}}\lambda_{\theta jcm}(\beta_c,\delta_c))]^2$$

Variation in the probability of utilizing private facilities within age and sex groups enables the identification of age- and sex-specific preferences for private facilities. Geographic-specific preferences are identified through variation within these groups. The variation used to estimate the network coefficient comes from more generous plans in terms of network having more enrollees in health regions with lower observed public utilization.[17] Appendix Figure A3 presents the average observed and estimated probabilities.

[17]The intuition behind identification in this context is analogous to how heterogeneous preferences by demographics are identified in typical Industrial Organization models. Here, the products are either public or private healthcare options. Individuals differ by sex and age, and have access to a certain share of facilities where they may seek care. Thus, the network variable is the interaction between individual characteristics and the inside option indicator (private facilities). The literature (e.g., Petrin (2002)) typically models demographic variables through random draws and incorporates additional moments to identify demographic-specific preferences. In my scenario, however, I directly observe the network of plans being purchased. Additionally, I leverage geographic variation in utilization patterns and plan generosity to identify the network coefficient. Similar parameters could be obtained using a BLP-style estimation procedure.

Table 1 shows the network coefficients and the implied elasticities.[18] The network coefficients are anticipated to reflect an individual's preference for network when making utilization choices. Consequently, it is expected that a larger network would be preferred, implying that the coefficients should be positive. However, the model does not distinguish the effect of an expanded network on diagnosis and treatment separately. For example, an increase in network size might lead to more diagnoses of conditions like the need for transplants. By itself, this increase in diagnoses is expected to boost private basic treatment utilization. However, if patients choose to receive treatment within the public system, a larger network might actually decrease the utilization of private facilities. Transplants fall under high-complexity treatments, making it not uncommon for patients to seek treatment in the public system after receiving a diagnosis at an in-network private facility. The network coefficient for cancer treatment and dialysis could be underestimated due to people being diagnosed in the private system but receiving the treatment in the public system. Although a high percentage of dialysis treatments are performed in public facilities, their complexity is not nearly as high as that of cancer and transplant treatments. Therefore, for complex care, the network coefficient should be interpreted as a lower bound.

[18]The implied elasticities are computed using the average private utilization and network breadth. Averages are computed using the enrolled population as weights.

Table 1: Network coefficients for utilization choices

	Coefficients	Elasticities
Basic	12.1507	0.00013
	(2.6867)	
Surgery	6.5557	0.00380
	(2.2603)	
Obstetric	65.7455	0.19058
	(27.9628)	
Cancer	1.1130	0.00816
	(0.6405)	
Dialysis	18.9678	0.26859
	(2.1357)	
Transplant	−60.1425	−1.11174
	(626.2542)	

Notes: This table presents the network coefficients from the utilization choice model and their implied elasticities. The coefficients are estimated separately for each medical treatment using Generalized Method of Moments (GMM) to match the probability of enrollees utilizing in-network private facilities. Elasticities are computed using the weighted average utilization probability and network breadth, with the enrolled population serving as weights.

Despite the small elasticities, a significant number of treatments would shift from public facilities to in-network private facilities. If all insurers added one facility to their network, there would be 225 fewer basic care visits and about 60 less surgeries performed in the public system. Additionally, about 9 enrollees would receive cancer treatment through their plans, 20 patients would receive weekly dialysis sessions in a private clinic throughout the year, and 47 fewer deliveries by female enrollees would be performed in public facilities.

6.2. Probability of seeking care

The probability of seeking care among enrollees is defined as the overall utilization (public plus private) divided by the enrollment level. The probability of seeking care is the same as the probability of getting sick. I compute the probability of getting sick, q, for each medical condition, c, sex, θ_1, and age brackets as in the utilization analysis, θ_2, macro health region, r, and municipality size, $\tilde{m}$.[19]. In order to avoid the influence of rare events or occasional incidents on the probabilities, I use the predicted probability of the following Logit model:[20]

[19]Municipalities are classified as big if the total population in greater than 500,000 inhabitants, medium if population is in between 100,000 and 500,000, and small if below 100,000.

[20]I use the enrolled population as weights in the regression.

$$log(q_{\theta c\tilde{m}}) - log(1 - q_{\theta c\tilde{m}}) = \delta_{c\theta_1} + \delta_{c\theta_2} + \delta_{c\tilde{m}} + \varepsilon_{\theta c\tilde{m}}$$

Because the basic treatment group includes any visits to a health facility, I consider $q_{\theta\{basic\}\tilde{m}r}$ as 1, meaning that every enrollee seeks care for a basic treatment in a given year. Therefore, I do not run the Logit model above for that group. Appendix Figure A4 shows how the predicted probability is distributed for each group of medical treatment.

6.3. Insurance choice

The expected utility of the utilization decision before ε_{ijcm} is realized follows Small and Rosen (1981), also known as the Logit inclusive value:

$$E\{max(u_{ijcm})\} = log(1 + exp(u_{ijcm}))$$

I estimate the insurance choice model using an instrumental variable approach following Berry (1994):

$$log(s_{\theta jm}) - log(s_{\theta 0m}) = \alpha_\theta P_{\theta jm} + \eta_\theta \sum_c q_{\theta c\tilde{m}} log(1 + exp(u_{\theta jcm})) + \delta_\theta + \delta_j + \delta_m + \xi_{\theta jm}$$

The timing assumption assumes that the demand shock, $\xi_{\theta jm}$, is not correlated with the inclusive value of care, but it is correlated with the premium. This is because firms observe $\xi_{\theta jm}$ before making their premium choices, but after having set the network. I use the average premium of the same plan in other municipalities as instrument for the premium in municipality m.[21] Table 2 presents α_θ in the first two columns followed by the implied elasticities. The results for η_θ are displayed in columns 5 and 6, also followed by the implied elasticities. Appendix Figure A5 displays how well the model predicts the true market shares.

[21] For companies that operate in only one municipality, I consider the premium as exogenous. This accounts for less than 0.1% of the observations, and therefore it is not a major concern.

Table 2: Insurance choice parameters

	Premium				Network			
	Coefficient		Elasticity		Coefficient		Elasticity	
	Male	Female	Male	Female	Male	Female	Male	Female
[0,18]	−0.0013	−0.0013	−2.9201	−2.9212	0.2127	0.2096	0.3074	0.3111
	(0.00035)	(0.00035)			(0.01361)	(0.01343)		
[19,23]	−0.0010	−0.0010	−2.9045	−2.9251	0.2679	0.1435	0.3428	0.3035
	(0.00028)	(0.00029)			(0.01781)	(0.00957)		
[24,28]	−0.0009	−0.0009	−2.7826	−2.7613	0.2692	0.1464	0.3382	0.3080
	(0.00025)	(0.00025)			(0.01785)	(0.00961)		
[29,33]	−0.0008	−0.0008	−2.7661	−2.7585	0.2393	0.1461	0.3307	0.3291
	(0.00025)	(0.00025)			(0.01590)	(0.00966)		
[34,38]	−0.0007	−0.0007	−2.8139	−2.7394	0.2413	0.1462	0.3289	0.3295
	(0.00022)	(0.00022)			(0.01587)	(0.00963)		
[39,43]	−0.0006	−0.0006	−2.8505	−2.8952	0.1954	0.1333	0.3241	0.3366
	(0.00018)	(0.00018)			(0.01293)	(0.00882)		
[44,48]	−0.0005	−0.0005	−2.7978	−2.8215	0.1942	0.1318	0.3202	0.3294
	(0.00013)	(0.00013)			(0.01289)	(0.00879)		
[49,53]	−0.0004	−0.0004	−2.6197	−2.7176	0.1661	0.1146	0.3287	0.3216
	(0.00011)	(0.00011)			(0.01101)	(0.00763)		
[54,58]	−0.0003	−0.0003	−2.4718	−2.5301	0.1646	0.1136	0.3088	0.3047
	(0.00008)	(0.00008)			(0.01100)	(0.00763)		
60+	−0.0002	−0.0002	−2.6866	−2.6554	0.1265	0.1037	0.2794	0.2617
	(0.00006)	(0.00006)			(0.00827)	(0.00676)		
F-statistic	134.29	134.29			134.29	134.29		
Observations	929,120	929,120			929,120	929,120		

Notes: This table presents the results for the premium and inclusive value of care coefficients from the insurance choice model. Premiums are instrumented by the average premium of the same plan in other markers. All coefficients are derived from the same regression, which also includes plan, municipality, and sex-age fixed effects. Standard errors are clustered at the plan level. Implied elasticities are computed using the weighted average premium and market share, with the enrolled population serving as the weight. The F-statistic represents the Kleibergen and Paap F-statistic.

The validity of the instruments requires satisfying both relevance and exogeneity conditions. Relevance is satisfied as premiums in other municipalities capture cost shocks faced by firms that influence premium decisions. The F-statistic for the joint significance of the instruments, reported in Table 2, indicates a strong correlation between premiums set by the same firm. Exogeneity requires that demand shocks are independent across municipalities; otherwise, the instrument would also be correlated with the demand shock. This concern is alleviated by including municipality fixed effects and plan fixed effects. The former accounts for aggregated demand shocks, while the latter accounts for a firm-specific component affecting premium decisions that remains constant across municipalities. Appendix table A7 presents the insurance choice parameters without instruments for premium, suggesting an upward bias when premium endogeneity is not accounted for.[22]

Because people value better care but dislike paying premiums, η_θ is expected to be positive, while α_θ to be negative, which are both verified in Table 2. Previous studies have estimated premium elasticities ranging from -0.2 to -1.15, as summarized by Gruber and McKnight (2016) and Abraham et al. (2017). My findings suggest that consumers are more price-sensitive, likely due to two key factors. First, I focus on individual plans, whereas much of the existing literature examines employer-sponsored plans. Second, the presence of the public system and the absence of insurance mandates might make people respond more strongly to premium changes. My elasticity estimates are more closely aligned with those of Tebaldi (2024). As expected, the older population is less responsive to both premium and network changes.

On average, a 1% increase in the network share leads to at least 0.27% increase in enrollment, indicating that individuals are not highly responsive to changes in the network. In practical terms, if all plans added one facility to their network, enrollment levels would rise by nearly 1.14%, or approximately 80,000 new enrollees. Conversely, if premiums increase by 1%, insurers would lose, on average, 3 enrollees.

6.4. Average cost in private facilities

I recover the profit per enrollee, $\pi_{\theta jm}$, from the first-order condition with respect to premium. The expression of the annual profit per enrollee allows me to write the average cost in private facilities as a combination of known variables once the demand model is estimated:

$$AC^{priv}_{\theta jm} = -\pi_{\theta jm} + P_{\theta jm} - \sum_{c \in C_{H_{jr}}} q_{\theta c\tilde{m}}(1 - \lambda_{\theta jcm}) R^{pub}_{\theta cr} - \sum_{c \notin C_{H_{jr}}} q_{\theta c\tilde{m}} R^{pub}_{\theta cr}$$

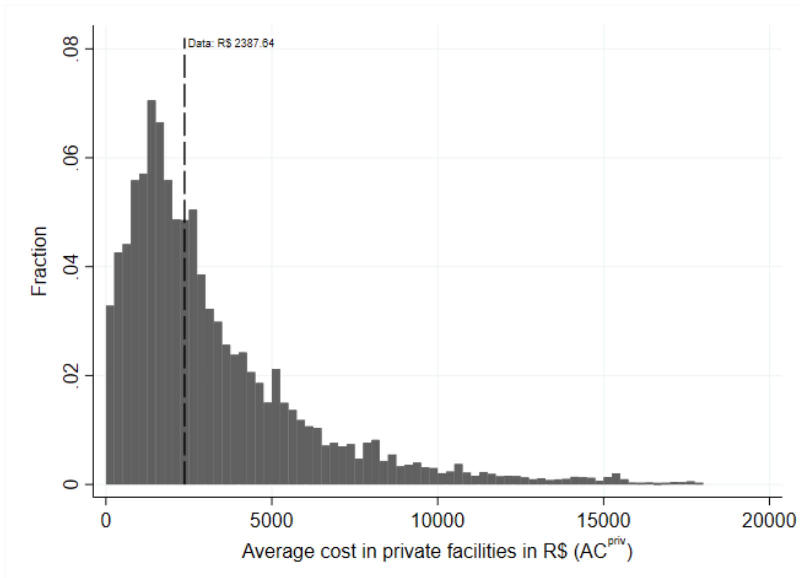
Figure 4 shows the distribution of the recovered average cost in private facilities. The vertical dashed line represents the total medical cost of the private healthcare market divided by the number of enrollees in 2015, according to IESS Data.[23] Reassuringly, the recovered

[22] In the OLS model, the premium coefficient may capture the quality of the plan in a given market that is not accounted for by the included variables or fixed effects. For instance, if having a star hospital in-network makes a plan more attractive and expensive, consumers might seem non-reactive to price changes, when in reality, their continued enrollment is driven by access to that specific facility.

[23] IESS refers to the Brazilian Institute of Supplementary Health Studies. The data are available in

cost closely aligns with real-world observations. Additionally, the cost distribution increases with age, as demonstrated in Appendix Figure A6.

Figure 4: Recovered average cost in private facilities



Notes: The figure displays the average cost in private facilities recovered from the first-order condition with respect to premium. The data is at the plan, sex-age and municipality level. The 99th and 100th percentile are not depicted. Each bin represents to R$ 250. The vertical dashed line indicates the total medical cost divided by the number of enrollees as of the last quarter of 2015 observed in the data.

I estimate the parameters of the average cost in private facilities using an Ordinary Least Squares Model. Because firms observe $\zeta_{\theta jm}$ after having made their decisions on networks, H is treated as exogenous. Note that the model does control for plan, municipality and age-sex specific cost shocks that might be correlated with network choices. Therefore, only shocks that are specific to a certain demographic group and vary across plans and municipalities are considered orthogonal to the network.

The estimate for κ is reported in the first column of Table 3. Changes in the network directly raise average costs by making access to care easier, while also adding to costs due to increased utilization of private facilities. An increase in 1 p.p. in the network breadth directly increases the average cost by $\kappa \times \sum_{c \in C_{H_{jr}}} q_{\theta c \tilde{m}} \lambda_{\theta jcm}$. Because the second averages to 1 in the data, a 1 percentage point increase in network breadth directly raises the average

https://iessdata.iess.org.br/home.

cost per enrollee by R$ 9.35, or about 0.40% using the mean average cost observed in the data. Additionally, there is an extra 69 cents or 0.03% increase due to changes in utilization decisions. If one extra facility is added to the network, the average cost per enrollee would increase from a few cents to R$ 65, with an average increase of R$ 1.

Table 3: Average cost to public facilities and marginal cost of network formation coefficients

	AC^{priv}	log(MCNF)
H	934.80	28.70
	(603.527)	(5.416)
R-Squared	0.91	0.55
Observations	929,120	2,313

Notes: This table shows the average cost to private facilities parameters, κ_0 and κ_1, and the network coefficient of the marginal cost of network formation, ω. The regression results report in the first column also include plan, municipality and sex and age combination fixed effects. The regression represented in the second column is performed at the plan - health region level and includes health region, and insurance company and plan attributes interacted with state as fixed effects. Standard errors are clustered at the plan level.

6.5. Marginal cost of network formation

The first-order condition with respect to network breadth, H, recovers the marginal cost of network formation under the equilibrium network. Firms make their network choices based on their expectations of enrollment, utilization, and cost in private facilities. Therefore, I estimate the parameters of the marginal cost of network formation using the expected marginal revenue with respect to the network:

$$log(E_{(\xi,\zeta)}[\sum_{m'\in\mathcal{M}_r}\sum_{j'\in\mathcal{J}_{fr}}\sum_{\theta}\frac{\partial s_{\theta j'm'}}{\partial H_{jr}}N_{\theta m'}\pi_{\theta j'm'}+s_{\theta j'm'}N_{\theta m'}\frac{\partial \pi_{\theta j'm'}}{\partial H_{jr}}]) = \omega H_{jr}+\delta_j+\delta_r+\upsilon_{jr}$$

I use random draws from the empirical distribution of ξ and ζ to compute the expectation of the marginal revenue. I compute $\frac{\partial P_{\theta j'm}}{\partial H_{jr}}$ in equilibrium by taking the total derivative of the first-order condition with respect to premium, assuming that the premium function is smooth with respect to network breadth. A similar approach has been used by Fan (2013) and Villas-Boas (2007).

The identification of ω relies on fixed effects. I include insurer-state and plan attributes-health region fixed effects instead of plan and health region fixed effects separately, as not all plans operate in more than one health region.[24] Therefore, I assume that any shock specific to a plan within a health region that is not common across the insurer or attributes, or plan-specific shocks that vary across health regions, are orthogonal to the network choice. Appendix Figure A8 plots the predicted logarithm of the marginal cost of network formation against the observed variable, suggesting that the model accurately predicts the data.

The result for ω is presented in the second column of Table 3.[25] A 1 percentage point increase in network breadth raises the cost of network formation by an average of 28.70%, illustrating the convexity of the cost function. Naturally, the distribution of the marginal cost of network formation is skewed. For instance, an average insurer pays about R$ 540 thousand to include one additional facility in-network, while a median insurer pays R$ 170 thousand. This is equivalent to the annual premiums for 41 elderly enrollees and 13 elderly enrollees, respectively. The high average is primarily driven by plans with a large number of enrollees.

7. Counterfactual simulations

For each counterfactual simulation, I solve a nested fixed-point problem. First, I search for the vector of premiums that satisfies the first-order condition with respect to premiums, given the network breadth. Next, I search for the vector of network breadth that satisfies the first-order condition for the firm's profit with respect to H_{jr}. Importantly, network changes do not alter whether a firm offers medical care in a municipality. This binary decision remains fixed, meaning that changes in the network only affect utilization choices by directly changing H_{jr}. I also consider that firms that have chosen null network in a given health region will not

[24] In practice, I estimate the following equation: $log(E_{(\xi,\zeta)}[\sum_{m'\in\mathcal{M}_r}\sum_{j'\in\mathcal{J}_{fr}}\sum_{\theta}\frac{\partial s_{\theta j'm'}}{\partial H_{jr}}N_{\theta m'}\pi_{\theta j'm'} + s_{\theta j'm'}N_{\theta m'}\frac{\partial \pi_{\theta j'm'}}{\partial H_{jr}}]) = \omega H_{jr} + \delta_{fr} + \delta_{[copay]r} + \delta_{[room]r} + \upsilon_{jr}$, such that f refers to the insurers, [copay] and [room] indicate plans with any co-payment policy and private hospital accommodation, respectively.

[25] There are 2,978 combinations of health plans and health regions. I exclude 545 observations from the regressions, corresponding to plans with zero network share, as I assume these plans will not reconsider extensive margin choices. An additional 120 observations are excluded for insurers offering only a single plan within a state, resulting in a total of 2,313 observations used in the regression.

change their binary choice of having or not network in such places due to the reimbursement policy change.

7.1. Economic incentives

Most counterfactual policies involve changes in the reimbursement rate. For any given network breadth, an increase in reimbursements to the public system leads to higher premiums due to cost pass-through. Higher reimbursements increase the cost of providing care, reducing the profit per enrollee. As a result, losing some enrollees becomes less costly for insurers if they set higher premiums.

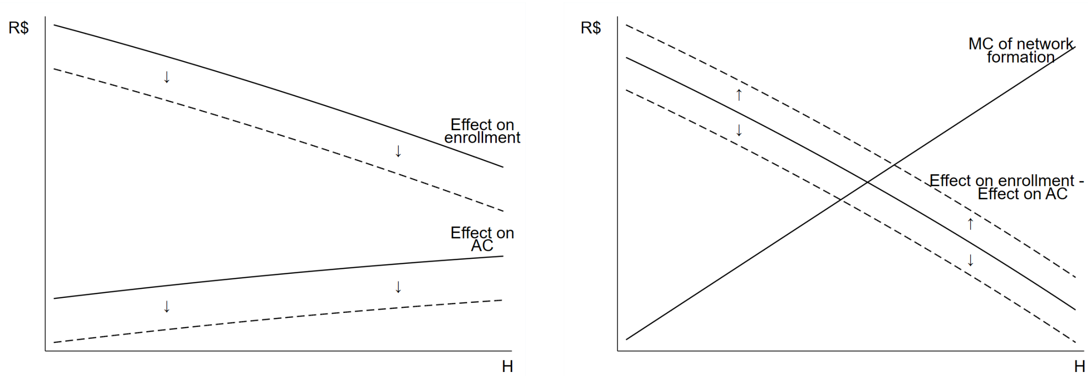
Any policy that changes the net gains of having a broader network, as known as the marginal revenue with respect to network, will lead to a new equilibrium network level. Whether the marginal revenue shifts upward or downward depends on which effect dominates: the *scale effect* or the *substitution effect*. For a given premium, higher reimbursement rates result in lower profit per enrollee, which reduces insurers' incentives to offer a more generous network to attract new enrollees. This is known as the *scale effect*. Conversely, higher reimbursements to the government decrease the difference between reimbursing in-network facilities and reimbursing the public system, assuming no changes in the average cost of private facilities. This relates to whether an insurer is incentivized to offer certain care in-network or delegate it to the public system, and is referred to as the *substitution effect*. These effects are analytically captured in the first-order condition with respect to the network when there is a change in reimbursements. The derivative of the marginal revenue (with respect to the network) with respect to the reimbursement to the government is illustrated below, with π being the only term directly dependent on R^{pub}.

$$\underbrace{\frac{\partial}{\partial R^{pub}}[\sum_{m'\in\mathcal{M}_r}\sum_{j'\in\mathcal{J}_{fr}}\sum_{\theta}\underbrace{\frac{\partial s_{\theta j'm'}}{\partial H_{jr}}N_{\theta m'}\pi_{\theta j'm'}}_{\text{Effect on enrollment}}]}_{\text{Scale effect}}+\underbrace{\frac{\partial}{\partial R^{pub}}[\sum_{m'\in\mathcal{M}_r}\sum_{j'\in\mathcal{J}_{fr}}\sum_{\theta}\underbrace{s_{\theta j'm'}N_{\theta m'}\frac{\partial \pi_{\theta j'm'}}{\partial H_{jr}}}_{\text{Effect on average cost}}]}_{\text{Substitution effect}}$$

Figure 5 illustrates the derivatives that make up the first-order condition with respect to the network and the potential shifts resulting from an increase in the reimbursement rate to the government. In Figure 5a, the solid curves represent the *effect on enrollment* and the *effect on average cost* as captured by the FOC with respect to H. The difference between these curves gives rise to the marginal revenue with respect to the network, depicted by the downward-sloping curve in Figure 5b. The dashed curves show the new effects when the reimbursement to the public system increases. The equilibrium network breadth will be determined at the intersection of the marginal revenue and the marginal cost of network formation. If the scale effect outweighs the substitution effect, insurers will choose narrower networks following an increase in reimbursement rates. Conversely, if the substitution effect dominates, broader networks will be selected.

Figure 5: Illustration of the effect of increasing the reimbursement rates to the government

(a) Effect on enrollment and on average cost (b) Marginal revenue and marginal cost



Notes: This figure illustrates the pieces of the first order condition with respect to the network breadth. Plot (a) displays the effect on enrollment and the effect on average cost. The difference between them is represented by the marginal revenue curve in plot (b), which also displays the marginal cost of network formation.

The impact of network adjustments in response to changes in reimbursement rates becomes less straightforward under the two-stage game framework with the timing assumptions of this study. Even if insurers maintain their existing network choices, premiums rise due to cost pass-through, counterbalancing the profit reduction from higher reimbursement payments to the government.[26] However, the premium increase leads to a decline in market shares, making the net effect on network decisions ambiguous. Importantly, all these dynamics are captured by the model in the counterfactual simulations.

[26]The scale effect changes because $\frac{\partial s}{\partial H}$ is proportional to s(1-s), which goes down when s decreases for lower levels or market share, which is the case for most of the health plans.

7.2. Counterfactual policies

To assess the welfare effects of different reimbursement policies, I evaluate several policy changes based on their impact on network breadth, premiums, costs, profits, enrollment, and surplus. First, I prohibit enrollees from utilizing public facilities, representing the strictest form of "access restriction" policy. Second, I align the reimbursement rate to the public system with the average reimbursement for private facilities in the private insurance market, eliminating incentives to steer patients toward the public system. Third, I set the reimbursement to the government at zero to assess the effects of the current reimbursement rule. Lastly, I establish a zero reimbursement rate specifically for dialysis, cancer treatment, and transplants, then expand this rule to include obstetric care, as these treatments are among the most commonly utilized by enrollees in public facilities. These policies can be interpreted as changes in the reimbursement rate.

In addition to consumer surplus and insurer profit, I also compute the variation in government net revenue, which comprises three components. First, government direct revenue from private companies reimbursing the government. Second, costs incurred by public hospitals for treating enrolled patients, calculated using SUS Table prices. Third, savings for the public system when more people enroll in private health insurance, as these individuals will shift to private facilities and follow previously estimated utilization patterns.

Table 4 presents the results alongside the baseline values. The numbers represent the difference from the baseline scenario. All variables computed per enrollee use a simple average across plans and age-sex groups to accurately reflect supply responses. Appendix Table A8 displays the results using a a weighted average, where the enrolled population serves as the weighting factor.

No public option for enrollees: removing the public system as an option for enrollees means that all treatments undergone by enrollees will be conducted in private facilities.[27] This increases the average cost with private facilities while decreasing to zero the reimbursement an insurer pays to the government per enrollee. If treating patients in-network is more

[27] When treatments are not available at any in-network private facility, I considered that insurers would reimburse a private facility not in-network by the average reimbursement in the private sector.

expensive than reimbursing the government, we should expect premiums to rise.

Opposing forces drive changes in network breadth. On one hand, insurers have fewer incentives to provide narrow networks, as they can no longer direct patients to public facilities. Additionally, this policy directly lowers the inclusive value of care, which could lead to lower enrollment if the network remains unadjusted. Together, these effects weaken the *substitution effect*, favoring network expansion. On the other hand, insurers have incentives to shrink their networks because the network itself becomes less effective in attracting consumers. Enrollees are now more costly and yield lower profits, and any network improvements are tempered by the fact that, once enrolled, individuals lose access to public facilities. This creates a negative *scale effect*. Moreover, network expansion will increase treatment costs since public facilities are not available as options, thereby strengthening the *substitution effect*. Ultimately, the net impact depends on the balance between these opposing forces.

The findings indicate an average increase of about one in-network facility. Coupled with greater utilization of private facilities, this leads to a 21% rise in the cost per enrollee, which is passed on to consumers through higher premiums. Consequently, enrollment declines, and the government's surplus decreases, as it not only loses revenue from treatments reimbursed at 1.5 times the public system cost, but also faces increased treatment of uninsured individuals in public facilities. Consumer surplus also declines driven by health plans becoming more expensive. Additionally, lower enrollment and a broader network reduce insurers' profits.

Matching reimbursements between the government and private facilities: this policy effectively increases the reimbursement rate to the government for most firms. Since enrollees are more costly, premiums are expected to increase. The changes in the network will depend on how offering more in-network care to offset the increased costs of reimbursing the government compares with insurers' weakened incentive to attract enrollees, who are now more expensive.

Compared to the baseline, the number of in-network facilities shows a slight decrease, indicating that reduced profit margins, or the *scale effect*, are driving network decisions. However, the decline in network size is not substantial enough to meaningfully reduce costs in private facilities. As a result, the additional costs with reimbursements to the government are passed on to consumers, leading to an 8% increase in premiums. The narrower network and higher premiums result in a 7.38% drop in enrollment. Insurers' total profits decline by a little over 18%. Although government reimbursements per enrollee more than triple on average, total net revenue increases by less than double due to dis-enrollment. Plan cancellations not only reduce revenue but also lead to higher overall healthcare expenditures for the government.

No reimbursement rates: a no-reimbursement policy for some or all treatments reduces costs associated with enrollees for all insurers, which is expected to result in lower premiums for consumers. Insurers now have heightened incentives to expand their networks to attract more enrollees, but they also have increased motivation to steer patients toward public facilities, potentially by offering narrower networks. Ultimately, network changes will depend on how these competing incentives balance out.

The results in Table 4 show that insurers, on average, expand their networks by two facilities. This suggests that the increased profit from marginal enrollees outweighs the potential cost savings from steering patients toward the public system through narrower networks, leading insurers to offer broader networks. Additionally, lower costs associated with the reduced R^{pub} make health plans more affordable. As a result, purchasing a private health plan becomes more attractive, leading to higher enrollment levels. Note that while insurers accept slightly lower profits per enrollee, this is more than offset by the overall increase in enrollment. The gains for firms and consumers surpass the decrease in government revenue, resulting in a net increase in welfare.

Null reimbursements result in a significantly higher surplus gains, 7.20% versus 3.21% or 3.26%, and greater enrollment levels compared to partial exemptions, 7.67% versus roughly 4.05%. The government experiences a greater loss in reimbursement revenue when all treatments are exempt, which is only partially offset by new enrollees seeking care in private facilities rather than in the public system. The decline in government net revenue under partial exemptions is comparable to the scenario where enrollees are barred from using public services, though partial exemptions increase surplus for both consumers and insurers.

Table 4: Counterfactual results

	Baseline (1)	No public option for enrollees (2)-(1)	R^{pub} = avg R^{priv} (3)-(1)	$R^{pub}=0$ for all treatments (4)-(1)	R^{pub} only for basic, surgery, and obstetrics (5)-(1)	R^{pub} only for basic, and surgery (6)-(1)
Avg # of facilities	24.83	1.11	−0.47	2.02	2.19	2.18
Premium/enrollee	5779.97	553.26	464.86	−183.70	−78.42	−79.81
CS/enrollee	128.01	−9.05	−11.44	10.37	7.96	7.34
Insurers profit/enrollee	2706.79	135.50	−104.17	−5.57	−5.77	−5.85
AC^{priv}/enrollee	2893.00	597.93	−0.27	2.05	2.38	2.32
Reimbursement to govt/enrollee	180.17	−180.17	569.31	−180.17	−75.03	−76.27
Surplus						
Enrollment (M)	6.91	−0.29	−0.51	0.53	0.28	0.28
CS of enrollees (R$M)	2765.60	−131.58	−319.37	415.66	321.43	308.68
Insurers profit (R$M)	11637.43	−1672.19	−2132.46	1546.43	635.50	648.44
Govt net revenue (R$M)	337.23	−493.74	599.36	−927.23	−476.46	−484.24
Total surplus (R$M)	14740.26	−2297.51	−1852.47	1034.86	480.47	472.88
Govt finances						
Govt revenue (R$M)	1011.70	−1011.70	656.65	−1011.70	−592.63	−595.82
Govt savings (R$M)	0.00	−156.50	−247.72	281.51	159.63	155.79
Govt costs (R$M)	674.46	−674.46	−190.43	197.05	43.46	44.21
Govt net revenue (R$M)	337.23	−493.74	599.36	−927.23	−476.46	−484.24

Notes: This table presents the results for five counterfactual policies and compares them with the baseline scenario. The results are shown as the difference with respect to the baseline. The first column displays the baseline results. The second column shows the variation in the outcomes when enrollees are not allowed to utilize the public system unless a treatment is unavailable at any facility. The third column considers reimbursing the government at the average rate observed for private facilities in the data. The last three columns set reimbursements (partially) to zero: the fourth column sets it to zero for all treatments, the fifth column sets it to zero for transplant, cancer, and dialysis treatments, and the sixth column includes obstetrics in the non-reimbursable treatments. All variables per enrollee are computed as simple averages.

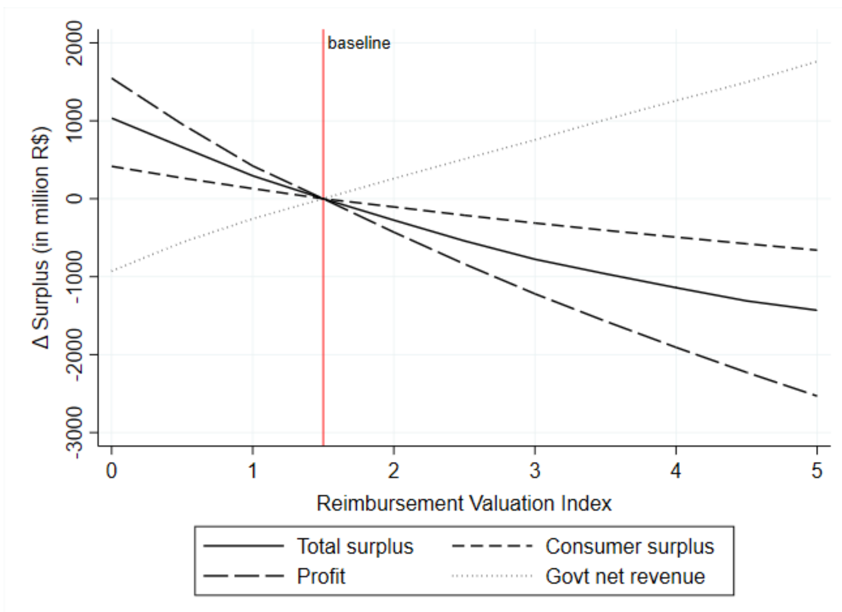
Appendix Table A8 shows enrollee sorting across plans for each policy. When enrollees are prohibited from using the public system, they tend to select relatively cheaper plans with broader networks. When reimbursements are waived for certain treatments, enrollees opt for plans with more generous network coverage, accepting slightly higher premiums than the average offered by insurers. Appendix Table A9 breaks down the variation in consumer surplus into the effects of network and premium changes. Policies that cause a surplus decrease do so primarily due to premium increases. Conversely, policies that increase surplus attribute about 80% of the growth to premium reductions and 25% to network expansions.

Appendix Figure A9 shows the percentage of plans that adjust their network and premium choices for each counterfactual policy relative to the baseline. For a significant portion of insurers, the scale and substitution effects nearly cancel each other out, resulting in no meaningful change in network choices. As expected, all firms modify their premiums. When enrollees are excluded from the public system, about 80% of insurers reduce premiums, even though the average premium increases. For the other policies, firms adjust their premiums in the same direction.

7.3. Changes in the Reimbursement Valuation Index

The current Reimbursement Valuation Index (RVI) is set at 1.5, meaning that the final reimbursement per visit is calculated as 1.5 times the prices recorded by the public system. However, there is no clear rationale for why policymakers chose this specific value. Thus, what are the welfare effects of changing the RVI? Figure 6 presents the variation in welfare under different RVI levels. As the RVI increases, both consumer and insurer surplus decrease, along with enrollment. Government revenue rises because the additional revenue from reimbursements outweighs the increased public healthcare costs due to higher dis-enrollment. Appendix Table A10 presents the numerical results of these counterfactual scenarios.

Figure 6: Welfare effects of different Reimbursement Valuation Index



Notes: The figure depicts the variation in total surplus, consumer surplus, insurers profit and government net revenue for different Reimbursement Valuation Index (RVI). The variation is computed with respect to the baseline, represented by the vertical line, in which the RVI equals 1.5.

Whether a lower or higher RVI is preferable depends on the government's goal of taxing or subsidizing the private healthcare market. The government's decision also hinges on its efficiency compared to private insurers in providing adequate coverage and whether public facilities can accommodate the increased demand resulting from plan cancellations due to higher RVIs. Nevertheless, the government could still reduce the RVI to 1 without subsidizing the private system, thereby addressing concerns about the need for a 50% markup on treatments provided to enrollees.

7.4. No reimbursement policy combined with taxation

Counterfactual simulations indicate that a zero reimbursement rate to the government yields the highest welfare gains among the policies analyzed, while also producing the worst outcomes for the government. This supports the public sentiment that reimbursements are meant to prevent insurers from profiting off public services. In fact, the increase in insurer profit is the primary driver of surplus. To reconcile these outcomes, I propose two approaches to keep government net revenue constant while taxing firms accordingly: 1) insurers collectively pay a lump sum to the government, or 2) the government taxes insurer profits on a per-enrollee basis.

Insurers paying a lump sum to the government is equivalent to considering insurers' profits and government revenue from Table 4 together. In other words, compared to the status quo, the government's budget remains unchanged if insurers collectively transfer the amount of the government's losses. Even so, insurers would still have welfare gains under the no-reimbursement policy. However, if each R$1 in the government's hands can generate at least R$1.67 in social benefits, the current policy would be more beneficial than a zero-reimbursement scenario.

Taxing insurers' profit per enrollee is a more practical policy to implement, as it directly specifies how much each insurer pays, unlike the lump-sum approach. This type of tax would influence network decisions, which in turn would affect premium choices—though a profit-per-enrollee tax would not impact premiums if networks remain constant. Table 5 presents the results for tax rates ranging from 5% to 10%, assuming a zero-reimbursement policy. A tax of about 7% would balance government gains and losses. Enrollment and surplus increases would decline by just over half compared to the zero-tax, no-reimbursement scenario. However, a tax within this range would still produce gains compared to the baseline scenario without burdening the government.

Table 5: Tax on profit per enrollee under a no-reimbursement policy

	Baseline (1)	tax = 0% (2)-(1)	tax = 5% (3)-(1)	tax = 6% (4)-(1)	tax = 7% (5)-(1)	tax = 8% (6)-(1)	tax = 9% (7)-(1)	tax = 10% (8)-(1)
Avg # of facilities	24.83	2.02	−1.71	−2.37	−3.10	−3.71	−4.29	−4.98
Premium/enrollee	5779.97	−183.70	−187.07	−187.53	−188.24	−188.58	−189.44	−189.95
CS/enrollee	128.01	10.37	6.71	6.11	5.43	4.88	4.20	3.63
Insurers profit/enrollee	2706.79	−5.57	−141.05	−168.09	−195.17	−222.23	−249.34	−276.39
AC^{priv}/enrollee	2893.00	2.05	−0.88	−1.32	−1.95	−2.23	−2.97	−3.43
Reimbursement to govt/enrollee	180.17	−180.17	−45.13	−18.13	8.87	35.88	62.87	89.87
Surplus								
Enrollment (M)	6.91	0.53	0.34	0.30	0.27	0.24	0.20	0.16
CS of enrollees (R$M)	2765.60	415.66	260.61	233.08	203.93	177.17	149.40	124.16
Insurers profit (R$M)	11637.43	1546.43	633.15	450.85	270.34	88.87	−91.89	−275.02
Govt net revenue (R$M)	337.23	−927.23	−236.02	−138.36	−0.69	122.06	197.97	296.22
Total surplus (R$M)	14740.26	1034.86	657.74	545.56	473.57	388.10	255.49	145.35
Govt finances								
Govt revenue (R$M)	1011.70	−101170	−33.19	157.32	345.44	532.87	717.04	900.33
Govt savings (R$M)	0.00	281.51	189.43	173.11	155.15	139.81	121.21	104.82
Govt costs (R$M)	674.46	197.05	392.26	468.79	501.29	550.62	640.27	708.93
Govt net revenue (R$M)	337.23	−927.23	−236.02	−138.36	−0.69	122.06	197.97	296.22

Notes: This table presents the counterfactual results for different taxes on profit per enrollee under a no-reimbursement policy. The results are shown as differences from the baseline, while the baseline column displays the actual values. "Government revenue" refers to the revenue from reimbursements, and "Government savings" reflects the reduction in healthcare expenses due to enrollment changes. "Government cost" represents the expense of providing care to enrollees based on the SUS Table. "Government net revenue" is calculated by adding government revenue and savings, then subtracting government costs. M denotes million R$.

8. Conclusion

As governments worldwide provide free healthcare while allowing citizens to purchase private insurance for faster access and more provider options, the overlap between public and private healthcare coverage has expanded. This dual coverage raises questions about how to regulate the interaction, particularly regarding the extent to which private insurers should reimburse the government when their enrollees utilize public facilities. Brazil offers an ideal setting to examine the effects of such regulations, as private enrollees can access public facilities, and the country has implemented a policy requiring insurers to reimburse the government when private enrollees do so.

I use a structural model with demand and supply components to examine the welfare impacts of different reimbursement policies. I also explore whether prohibiting private enrollees from accessing public facilities could improve welfare. Counterfactual simulations suggest that restricting enrollees from public facilities decreases welfare significantly compared to the current policy. Policies that increase reimbursement rates lead to higher premiums and narrower networks for consumers. In contrast, reducing reimbursements to the government—either across all treatments or only for high-cost ones—yields welfare gains and boosts enrollment due to lower premiums and broader networks. Although this approach reduces government revenue, the influx of new private enrollees avoiding public services for basic treatments helps offset this loss. To address public concerns about insurers profiting from public services under a no-reimbursement rule, imposing a tax of around 7% per enrollee's profit would be budget-neutral while still delivering welfare gains.

These findings suggest that government and private insurers could collaborate more effectively. If consumers choose private insurance for quicker care and broader physician and facility options, the government might consider encouraging private enrollment to focus its resources on those in greatest need by improving care in public facilities. Relieving private insurers of the burden of funding high-cost, rare treatments can make private plans more attractive. Such policies are not unprecedented; for example, some private plans in the United Kingdom reduce costs by not covering high-cost treatments while still providing adequate coverage for more common care.

Further research is needed to explore alternative regulatory approaches across broader contexts. For example, there is limited understanding of whether allowing plans greater flexibility in choosing the generosity of their coverage for medical treatments could lead to welfare gains. Additionally, how increased private enrollment alleviates pressure on public facilities and improves health outcomes should be considered when designing regulatory policies. In regions where the government directly provides care, whether the public sector should serve as the sole provider of certain types of care ultimately depends on its efficiency in delivering those services.

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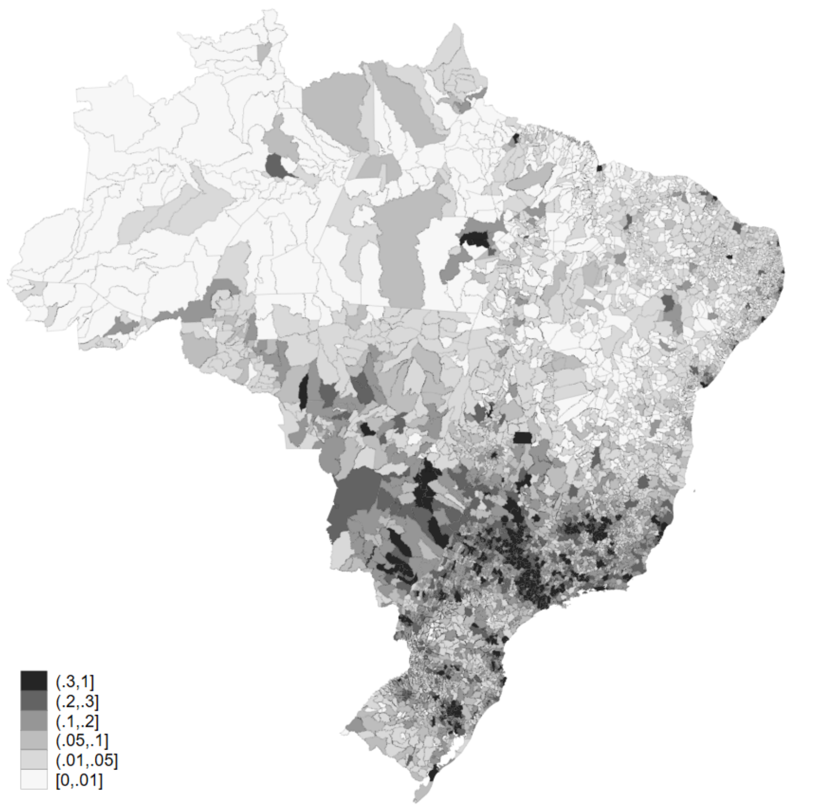
9. Appendix

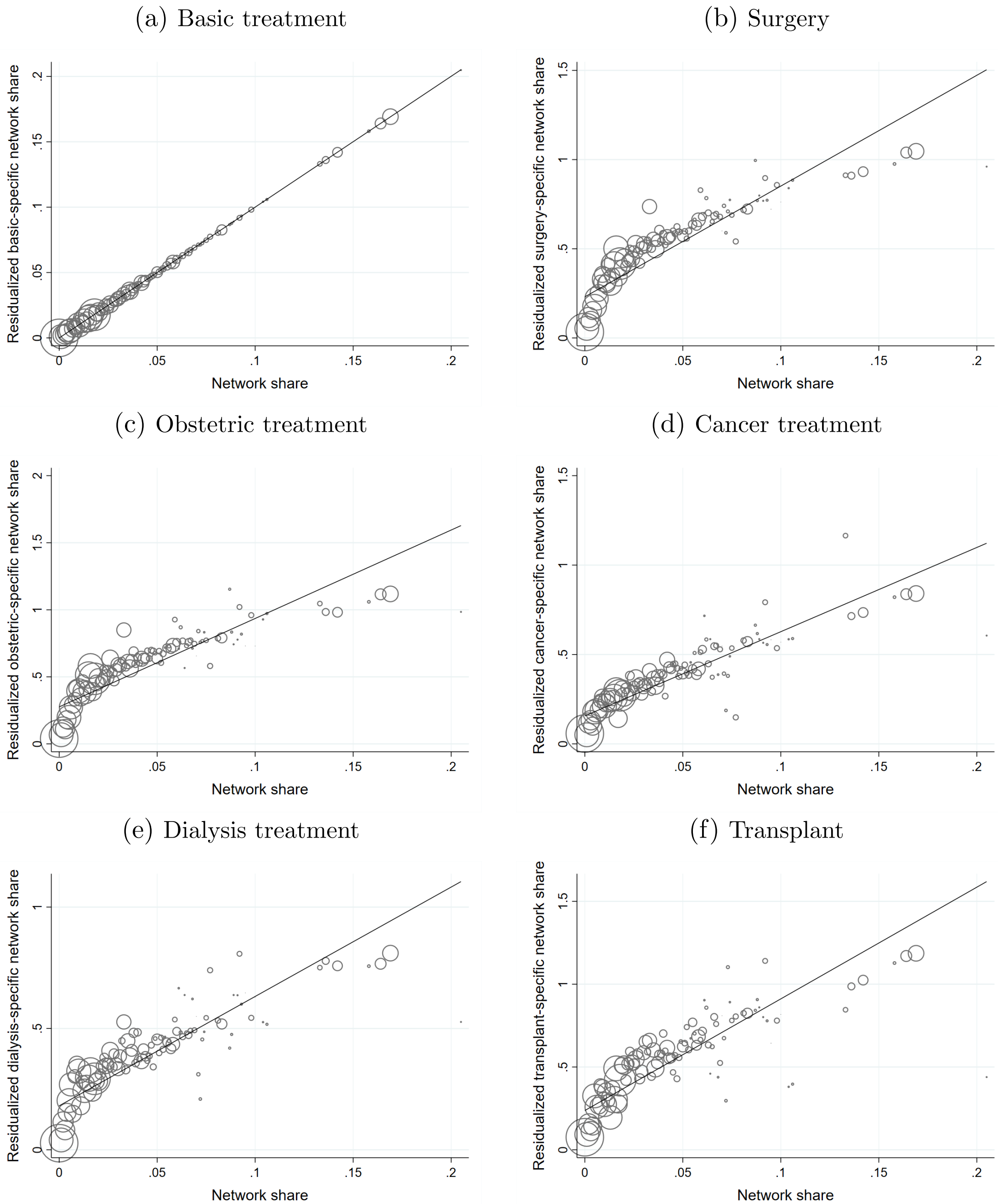
Appendix figures

Figure A1: Enrollment shares by municipality



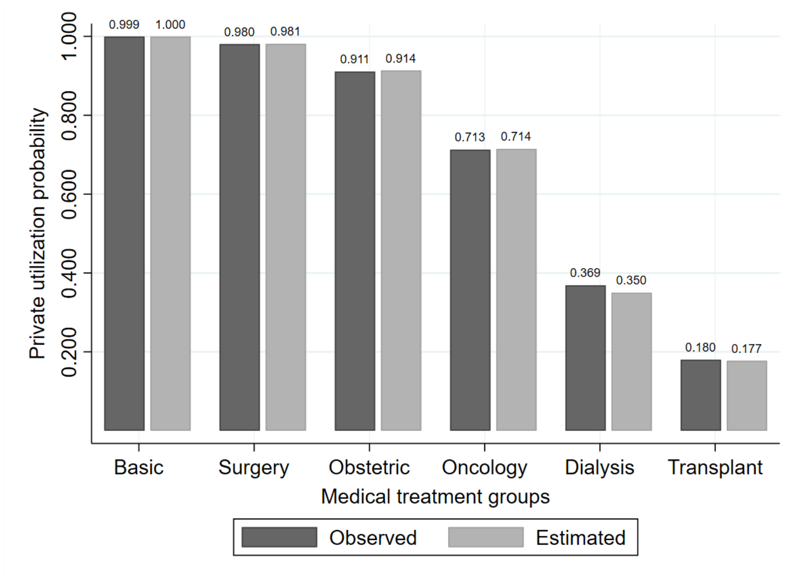
Notes: The figure displays the share of the population with private health insurance plan by municipality on 2015.

Figure A2: Correlation between treatment-specific network share and overall network share



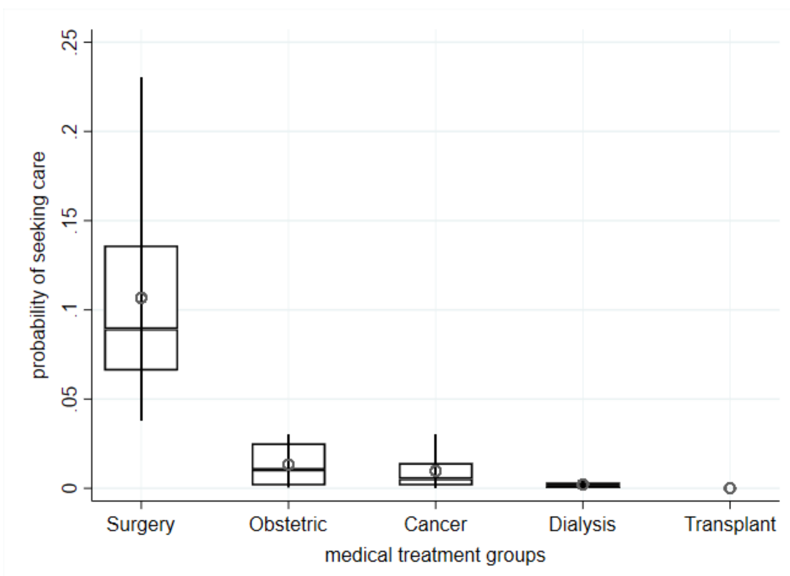
Notes: This figure illustrates the relationship between treatment-specific network share and overall network share across six medical treatments. The y-axis shows the treatment-specific network share cleaned for health region and plan fixed effects.

Figure A3: Observed and estimated probability of utilizing private facilities



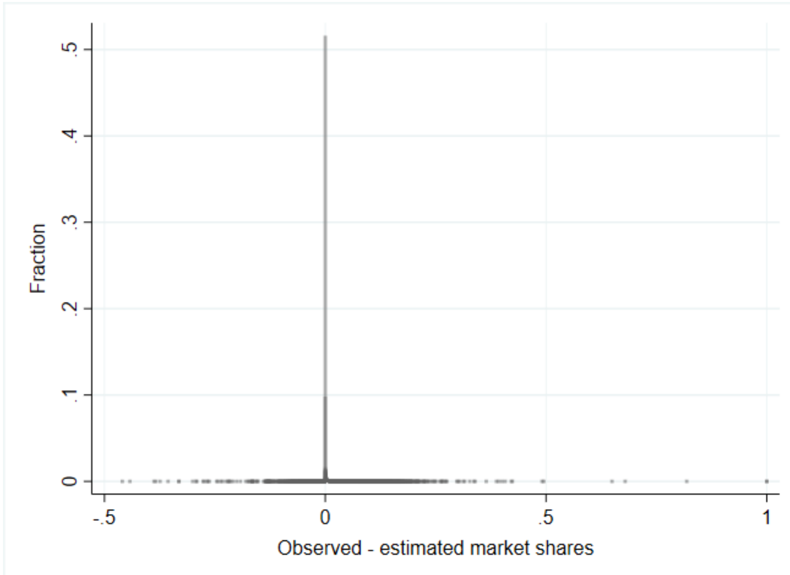
Notes: The figure displays the average observed and estimated probability of utilizing private facilities by medical treatment.

Figure A4: Predicted probability of seeking care



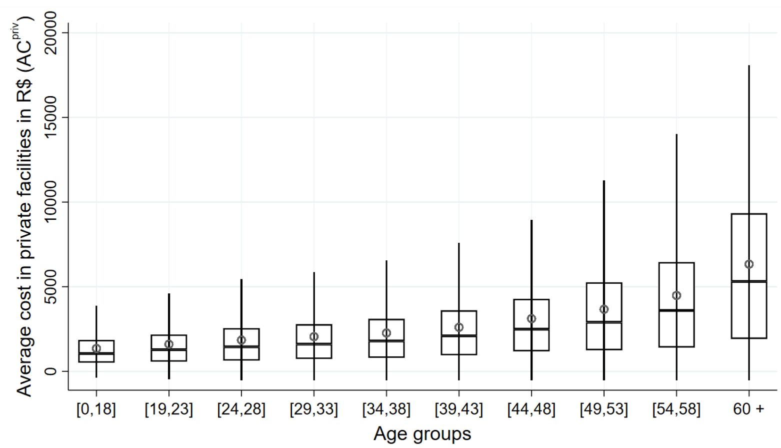
Notes: The figure displays the distribution of the probability of seeking care from a logit model by medical treatment. The box indicates the median, 25th percentile, and 75th percentile. The whiskers represent 1.5 $\pm$ the interquartile range. The scatter plot illustrates the mean. The probability of seeking care for basic treatments is 1.

Figure A5: Difference between predicted and estimate health plan market share



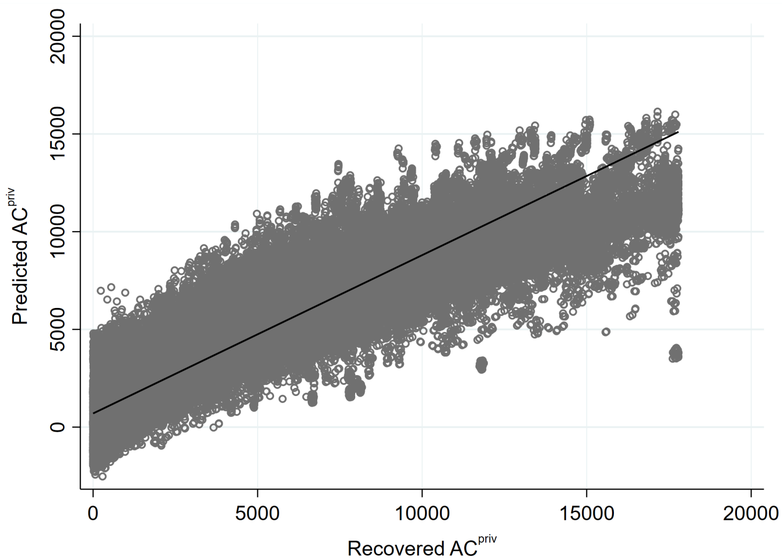
Notes: This figure displays a histogram of the difference between the observed and estimated plan market shares. The bin width is 0.0001.

Figure A6: Distribution of the average cost in private facilities by age group



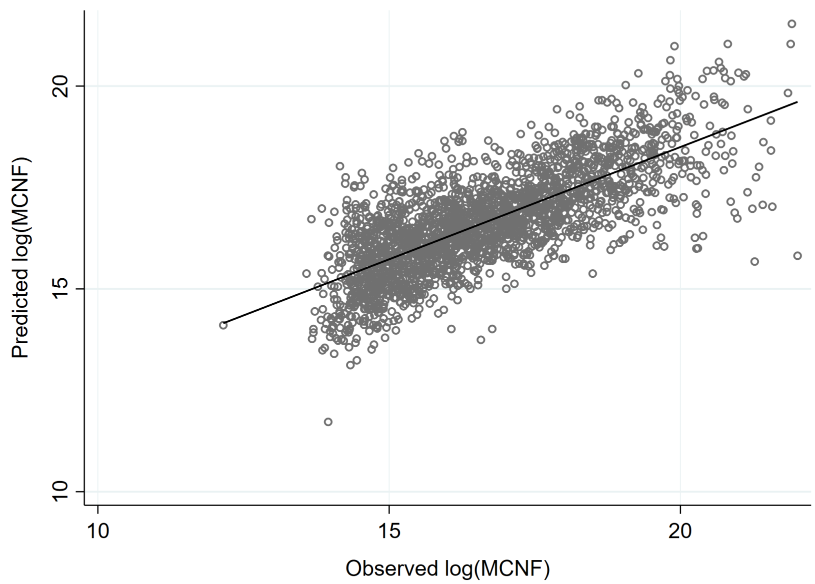
Notes: The figure displays the distribution of the average cost in private facilities by age group, recovered from the first-order condition with respect to the premium. The box indicates the median, 25th percentile, and 75th percentile. The whiskers represent 1.5 $\pm$ the interquartile range. The scatter plot illustrates the mean.

Figure A7: Observed and predicted average cost in private facilities



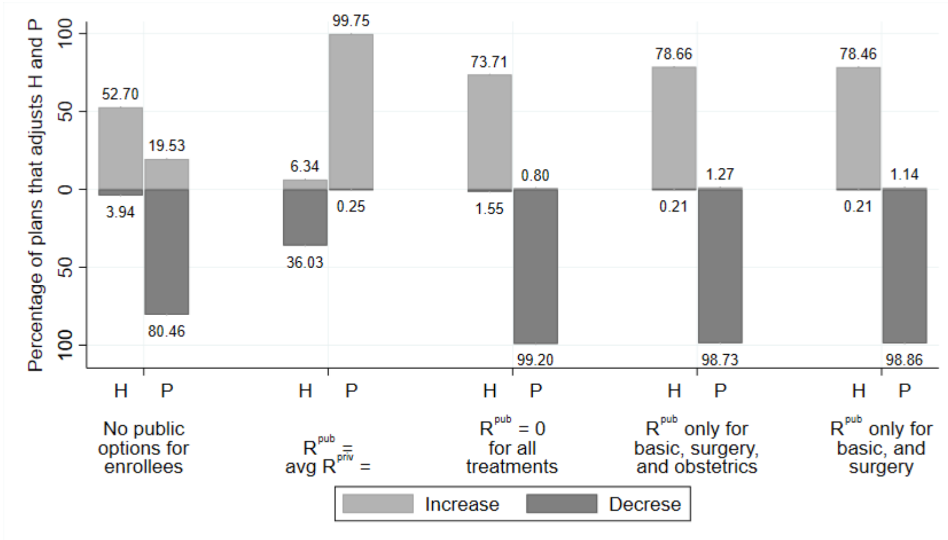
Notes: The figure displays the observed and predicted average cost in private facilities. The observed AC^{priv} is recovered from the first order condition with respect to premium.

Figure A8: Observed and predicted logarithm of the marginal cost of network formation



Notes: The figure displays the observed and predicted log of marginal cost o network formation. The observed marginal cost of network formation is recovered from the first order condition with respect to the network breadth, and represents the marginal revenue of network.

Figure A9: Percentage of Plans with Premium or Network Increases/Decreases



Notes: The figure depicts the percentage of plans that increase or decrease premiums and network breadth for each counterfactual policy compared to the baseline. The light grey bar represents the percentage that increases.

Appendix tables

Table A1: Premium and enrollment averages

	Premium (R$)		Enrollment (%)	
	Simple mean	Weighted mean	Simple mean	Weighted mean
$[0, 18]$	2305.51	2271.50	0.24	0.24
$[19, 23]$	2797.20	2822.08	0.15	0.16
$[24, 28]$	3231.16	3104.06	0.20	0.20
$[29, 33]$	3601.43	3450.09	0.23	0.23
$[34, 38]$	3971.54	3833.59	0.23	0.24
$[39, 43]$	4556.27	4474.98	0.19	0.21
$[44, 48]$	5631.20	5694.63	0.17	0.20
$[49, 53]$	7029.68	7223.87	0.19	0.22
$[54, 58]$	8967.98	9091.30	0.19	0.23
60+	12751.60	13243.24	0.25	0.32
Observations	929,120	929,120	929,120	929,120

Notes: This table presents the simple and weighted means of the premium (in R$) and enrollment percentage number of in-network facilities, the overall number of facilities a plan could negotiate with, and the premium by age group. The weighted mean is calculated using the number of enrollees as the weight. The number of observations reflect the combinations of plans, age-sex, and municipality for the simple mean.

Table A2: Facilities and premium averages

	Simple mean	Weighted mean
Facilities in-network	24.56	40.80
Facilities	2062.67	2395.46
Observations	3,023	3,023
Share of utilization in private facilities		
Basic	1.00	1.00
Surgery	0.98	0.97
Obstetric	0.91	0.88
Cancer	0.71	0.68
Dialysis	0.37	0.39
Transplant	0.18	0.20
Observations	4,166	4,166

Notes: This table presents the simple and weighted means of the number of in-network facilities, the overall number of facilities a plan could negotiate with, and the share of utilization in in-network private facilities among enrollees. The weighted mean is calculated using the number of enrollees as the weight. The average number of facilities is calculated using data at the plan-health region level. The average share of utilization in in-network private facilities is computed using data at the health region-sex-age level for each medical treatment. The total number of observations reflects the sum of those used for each treatment.

Table A3: Top 5 procedures undergone by insured individuals in public facilities within each medical treatment group.

	Share	Occurrences
Basic treatment		
Diagnosis of hearing impairment	0.095	2239
Adaptation of individual sound amplification device	0.082	1923
Evaluation of glaucoma by fundoscopy and tonometry	0.072	1703
Treatment of pneumonia or influenza	0.071	1677
Reassessment of hearing impairment (over 3 years old)	0.042	990
Surgery		
Phacoemulsification with foldable intraocular lens implant	0.153	1903
Treatment with multiple surgeries	0.040	495
Debridement of ulcer/devitalized tissue	0.017	207
Appendicectomy	0.017	206
Other procedures with sequential surgeries	0.015	188
Obstetric treatment		
Cesarean delivery	0.316	647
Post-abortion/puerperal curetage	0.256	525
Cesarean delivery in high-risk pregnancy	0.188	385
Natural childbirth	0.165	339
Natural childbirth in high-risk pregnancy	0.049	101
Cancer treatment		
Hormoniotherapy of breast carcinoma in stage I	0.211	11827
Hormoniotherapy of breast carcinoma in stage II	0.178	9962
Hormoniotherapy for advanced prostate adenocarcinoma - 1st line	0.112	6262
Hormoniotherapy for advanced breast carcinoma - 2nd line	0.096	5383
Hormoniotherapy of breast carcinoma in stage III	0.075	4195
Dialysis treatment		
Hemodialysis	0.831	15086
Home monitoring of patients undergoing APD	0.112	2035
Hemodialysis in a patient with HIV and/or hepatitis B and/or hepatitis C	0.019	345
Arteriovenous fistula for hemodialysis	0.016	286
Dialysis catheter placement	0.006	109
Transplant		
Kidney transplant (deceased donor organ)	0.420	134
Corneal transplant	0.323	103
Kidney transplant (living donor organ)	0.091	29
Allogeneic stem cells transplant	0.060	19
Simultaneous pancreas and kidney transplantation	0.038	12

Notes: This table shows the five most common procedures performed in public facilities for insured individuals. The first column lists the procedure names as per the SUS Table. The second column indicates the share of each procedure within its respective medical treatment group. The final column presents the absolute number of occurrences for each procedure in 2015.

Table A4: Quality variables used for each procedure

Procedure (c)	Quality
Basic	imaging $\text{equipment}^{lc}_{mr}$, clinic rooms^{lc}_{mr}
Surgery	mortality $\text{rate}_{\theta r}$, surgical beds^{lc}_{mr},
Obstetric	mortality $\text{rate}_{\theta r}$, neonatal units^{lc}_{mr}, obgyn^{lc}_{mr}
Cancer	mortality $\text{rate}_{\theta r}$, $\text{oncologist}^{lc}_{mr}$, $\text{oncologist}^{nb}_{mr}$
Dialysis	waiting $\text{time}_{\theta r}$, dialysis machine^{lc}_{mr}, dialysis machine^{nb}_{mr}
Transplant	mortality $\text{rate}_{\theta r}$, beds^{lc}_{mr}, beds^{nb}_{mr}

Notes: This table displays the quality terms included in the mean utility for different medical treatments. The subscripts denote at which level the variable is specified. The superscript lc stands for "local", meaning that the variable is computed at the municipality level. nb stands for "neighbor", meaning that the variable is computed using all municipalities within health region r but municipality m. All variables but waiting time and mortality rate are in *per capita* terms.

Table A5: Availability and quality of private and public systems

	Public				Private			
	Mean	p25	Median	p75	Mean	p25	Median	p75
Basic treatment								
Facilities per 1000 population	0.4382	0.3151	0.4387	0.5732	0.6157	0.2554	0.6019	1.0119
Clinic rooms per 1000 population	0.6024	0.5258	0.5905	0.6636	1.0180	0.5530	1.0312	1.3920
Imaging equipment per 1000 population	0.1205	0.0962	0.1169	0.1383	0.4584	0.2544	0.4858	0.6335
Surgery								
Facilities per 1000 population	0.0269	0.0195	0.0264	0.0357	0.0269	0.0195	0.0264	0.0357
Surgical beds per 1000 population	0.3676	0.3169	0.3656	0.4260	0.1872	0.1251	0.1983	0.2368
Mortality per 1000 admissions	17.9877	15.8527	18.0199	19.6177	2.3387	0.4708	1.9416	3.3874
Obstetric treatment								
Facilities per 1000 population	0.0235	0.0146	0.0213	0.0336	0.0145	0.0065	0.0128	0.0185
Obstetricians per 1000 population	0.0635	0.0416	0.0631	0.0818	0.0289	0.0108	0.0222	0.0362
Neonatal units per 1000 population	0.0275	0.0099	0.0248	0.0353	0.0259	0.0172	0.0244	0.0323
Mortality per 1000 admissions	0.4270	0.1606	0.3002	0.6040	2.1414	0.0000	0.0000	1.6026
Cancer treatment								
Facilities per 1000 population	0.0022	0.0013	0.0021	0.0028	0.0036	0.0019	0.0034	0.0049
Oncologist per 1000 population	0.0144	0.0053	0.0119	0.0183	0.0039	0.0010	0.0032	0.0055
Mortality per 1000 admissions	98.7039	78.3798	95.2037	114.7374	1.3209	0.0000	0.2109	0.8664
Dialysis treatment								
Facilities per 1000 population	0.0047	0.0030	0.0045	0.0057	0.0037	0.0023	0.0036	0.0048
Dialysis equipment per 1000 population	0.0075	0.0010	0.0041	0.0101	0.0680	0.0523	0.0674	0.0844
Waiting time (months)	1.5819	0.6992	0.7939	0.9702	0.0000	0.0000	0.0000	0.0000
Transplant								
Facilities per 1000 population	0.0019	0.0010	0.0016	0.0026	0.0024	0.0012	0.0021	0.0037
Beds per 1000 population	1.5617	1.3189	1.5565	1.7782	0.5821	0.3655	0.5661	0.7238
Mortality per 1000 admissions	25.5781	17.4426	24.1524	32.9655	0.0000	0.0000	0.0000	0.0000

Notes: This table highlights key statistics that reflect the availability and quality of public and private healthcare provision across 75 health regions. The variables are listed in the rows, while the corresponding statistics are presented in the columns.

Table A6: Probability of utilizing in-network private facilities by sex and age groups

	Male				Female			
	Mean	p25	Median	p75	Mean	p25	Median	p75
Basic treatment								
[0,19]	0.9993	0.9990	0.9995	0.9997	0.9994	0.9993	0.9996	0.9997
[20,29]	0.9996	0.9995	0.9997	0.9998	0.9997	0.9997	0.9998	0.9998
[30,39]	0.9997	0.9996	0.9998	0.9999	0.9998	0.9998	0.9999	0.9999
[40,49]	0.9996	0.9995	0.9997	0.9998	0.9998	0.9998	0.9999	0.9999
[50,59]	0.9995	0.9994	0.9997	0.9998	0.9997	0.9996	0.9998	0.9999
60+	0.9987	0.9983	0.9990	0.9995	0.9990	0.9989	0.9995	0.9997
Surgery								
[0,19]	0.9598	0.9440	0.9750	0.9827	0.9683	0.9571	0.9813	0.9885
[20,29]	0.9801	0.9728	0.9846	0.9912	0.9807	0.9759	0.9860	0.9909
[30,39]	0.9806	0.9726	0.9835	0.9899	0.9839	0.9782	0.9869	0.9929
[40,49]	0.9857	0.9851	0.9908	0.9922	0.9872	0.9856	0.9910	0.9943
[50,59]	0.9851	0.9778	0.9910	0.9949	0.9879	0.9864	0.9930	0.9951
60+	0.9836	0.9783	0.9870	0.9921	0.9827	0.9778	0.9873	0.9926
Obstetric treatment								
[0,19]	0	0	0	0	0.8268	0.7946	0.8564	0.8976
[20,29]	0	0	0	0	0.9131	0.8828	0.9364	0.9683
[30,39]	0	0	0	0	0.9506	0.9201	0.9635	0.9853
[40,49]	0	0	0	0	0.9471	0.9398	0.9504	0.9584
Cancer treatment								
[0,19]	0.7442	0.5690	0.9539	0.9877	0.7788	0.6347	0.9636	0.9821
[20,29]	0.8026	0.7370	0.9539	0.9887	0.8484	0.8232	0.9562	0.9855
[30,39]	0.8253	0.7073	0.9838	0.9938	0.7184	0.5324	0.7800	0.9725
[40,49]	0.8114	0.6414	0.9255	0.9908	0.5695	0.3266	0.6211	0.8041
[50,59]	0.7841	0.6709	0.9079	0.9889	0.5323	0.3127	0.5489	0.7727
60+	0.6525	0.4945	0.7026	0.8626	0.5276	0.3043	0.5301	0.7280
Dialysis treatment								
[0,19]	0.6700	0.0007	0.9898	0.9999	0.6662	0.0203	0.9814	0.9984
[20,29]	0.3147	0.0008	0.0778	0.6734	0.4023	0.0027	0.1312	0.9308
[30,39]	0.3355	0.0091	0.1287	0.6115	0.3218	0.0124	0.1468	0.5760
[40,49]	0.4351	0.0130	0.2708	0.9741	0.3208	0.0035	0.1065	0.6090
[50,59]	0.3358	0.0361	0.2163	0.5880	0.3315	0.0178	0.1987	0.6409
60+	0.2857	0.0349	0.1877	0.4429	0.2929	0.0332	0.1817	0.4444
Transplant								
[0,19]	0.3055	0.0177	0.0897	0.8215	0.2934	0.0260	0.0868	0.7638
[20,29]	0.1920	0.0139	0.0704	0.1903	0.2735	0.0477	0.1448	0.5874
[30,39]	0.1302	0.0041	0.0143	0.0580	0.1499	0.0053	0.0154	0.0663
[40,49]	0.0343	0.0041	0.0097	0.0176	0.1221	0.0000	0.0028	0.0242
[50,59]	0.0606	0.0000	0.0016	0.0064	0.0873	0.0215	0.0431	0.0509
60+	0.2408	0.0178	0.0677	0.4215	0.3124	0.0557	0.1807	0.5943

Notes: This table shows the probability of enrollees utilizing in-network private facilities by sex and age groups. The rows present the age groups. The columns provide different points along the private utilization probability distribution, separated by male and female.

Table A7: Insurance choice parameters - OLS

	Premium				Network			
	Coefficient		Elasticity		Coefficient		Elasticity	
	Male	Female	Male	Female	Male	Female	Male	Female
[0,18]	0.0009 (0.00015)	0.0009 (0.00015)	2.0210	2.0097	0.4367 (0.02932)	0.4313 (0.02939)	0.6310	0.6402
[19,23]	0.0008 (0.00015)	0.0008 (0.00014)	2.2645	2.1590	0.4923 (0.03517)	0.2647 (0.01920)	0.6298	0.5596
[24,28]	0.0006 (0.00011)	0.0006 (0.00011)	1.9668	1.8416	0.5051 (0.03530)	0.2742 (0.01930)	0.6344	0.5766
[29,33]	0.0005 (0.00010)	0.0005 (0.00010)	1.8977	1.8323	0.4575 (0.03146)	0.2789 (0.01939)	0.6320	0.6284
[34,38]	0.0005 (0.00009)	0.0005 (0.00009)	1.9831	2.0312	0.4592 (0.03135)	0.2791 (0.01932)	0.6258	0.6287
[39,43]	0.0005 (0.00009)	0.0005 (0.00009)	2.1627	2.1164	0.3594 (0.02490)	0.2454 (0.01724)	0.5963	0.6196
[44,48]	0.0004 (0.00007)	0.0004 (0.00007)	2.2758	2.2748	0.3483 (0.02476)	0.2374 (0.01713)	0.5744	0.5935
[49,53]	0.0003 (0.00006)	0.0003 (0.00006)	2.1156	2.0151	0.2865 (0.02050)	0.1985 (0.01442)	0.5669	0.5570
[54,58]	0.0002 (0.00004)	0.0002 (0.00004)	1.9233	1.8076	0.2804 (0.02059)	0.1943 (0.01447)	0.5260	0.5214
60+	0.0002 (0.00003)	0.0002 (0.00003)	2.1808	2.2300	0.2119 (0.01591)	0.1741 (0.01322)	0.4681	0.4393
Observations	929,120	929,120			929,120	929,120		

Notes: This table presents the results for the premium and inclusive value of care coefficients from the insurance choice model without instrumenting premiums. All coefficients are derived from the same regression, which also includes plan, municipality, and sex-age fixed effects. Standard errors are clustered at the plan level. Implied elasticities are computed using the weighted average premium and market share, with the enrolled population serving as the weight.

Table A8: Counterfactual results - weighted average

	Baseline (1)	No public option for enrollees (2)-(1)	R^{pub} = avg R^{priv} (3)-(1)	$R^{pub} = 0$ for all treatments (4)-(1)	R^{pub} only for basic, surgery, and obstetrics (5)-(1)	R^{pub} only for basic, and surgery (6)-(1)
Avg # of facilities	41.17	5.61	1.84	1.10	2.87	2.89
Premium/enrollee	5772.72	74.04	157.76	−160.62	−8.19	−10.82
CS/enrollee	401.17	−2.83	−18.83	26.78	28.10	26.74
Insurers profit/enrollee	2635.76	−96.48	−132.13	63.41	44.24	42.70
AC^{priv}/enrollee	2990.49	316.99	175.60	−77.55	35.77	35.07
Reimbursement to govt/enrollee	146.48	−146.48	114.28	−146.48	−88.20	−88.59
Surplus						
Enrollment (M)	6.91	−0.29	−0.51	0.53	0.28	0.28
CS of enrollees (R$M)	2765.60	−131.58	−319.37	415.66	321.43	308.68
Insurers profit (R$M)	11637.43	−1672.19	−2132.46	1546.43	635.50	648.44
Govt net revenue (R$M)	337.23	−493.74	599.36	−927.23	−476.46	−484.24
Total surplus (R$M)	14740.26	−2297.51	−1852.47	1034.86	480.47	472.88
Govt finances						
Govt revenue (R$M)	1011.70	−1011.70	656.65	−1011.70	−592.63	−595.82
Govt savings (R$M)	0.00	−156.50	−247.72	281.51	159.63	155.79
Govt costs (R$M)	674.46	−674.46	−190.43	197.05	43.46	44.21
Govt net revenue (R$M)	337.23	−493.74	599.36	−927.23	−476.46	−484.24

Notes: This table presents the results for five counterfactual policies and compares them with the baseline. The first column displays the baseline results. The second column shows the outcomes when enrollees are not allowed to utilize the public system unless a treatment is unavailable at any facility. The third column considers reimbursing the government at the average rate observed for private facilities in the data. The last three columns set reimbursements (partially) to zero: the fourth column sets it to zero for all treatments, the fifth column sets it to zero for transplant, cancer, and dialysis treatments, and the sixth column includes obstetrics in the non-reimbursable treatments. All variables per enrollee are weighted by the enrolled population.

Table A9: Consumer surplus decomposition (in million R$)

	No public option for enrollees	R^{pub} = avg R^{priv}	$R^{pub} = 0$ for all treatments	R^{pub} only for basic, surgery, and obstetrics	R^{pub} only for basic, and surgery
Baseline	2765.60	2765.60	2765.60	2765.60	2765.60
New P, new H	2634.01	2446.22	3181.25	3087.03	3074.27
Baseline P, new H	2821.75	2748.15	2835.30	2872.12	2887.10
New P, baseline H	2566.19	2443.77	3086.03	2939.94	2942.85

Notes: This table presents a decomposition of consumer surplus for five counterfactual policies compared to the baseline. The first row shows the total consumer surplus under the baseline. The second row displays the consumer surplus after the policy is implemented. The third row isolates the impact of premium changes by holding network breadth constant at the baseline level while allowing insurers to set premiums post-policy. The fourth row holds premiums constant at the baseline, considering the network breadth chosen after the policy implementation.

Table A10: Different Reimbursement Valuation Index

	RVI = 0 (1)-(3)	RVI = 0.5 (2)-(3)	RVI = 1.0 (3)	Baseline (4)-(3)	RVI = 2.0 (5)-(3)	RVI = 2.5 (6)-(3)	RVI = 3.0 (7)-(3)	RVI = 3.5 (8)-(3)	RVI = 4.0 (9)-(3)	RVI = 4.5 (10)-(3)	RVI = 5.0 (11)-(3)
Avg # of facilities	2.02	1.38	0.76	24.83	−0.54	−1.13	−1.69	−2.27	−2.87	−3.33	−4.00
Premium/enrollee	−183.70	−122.54	−61.08	5779.97	61.87	123.46	185.11	246.78	308.58	370.28	432.05
CS/enrollee	10.37	6.71	3.33	128.01	−2.77	−5.52	−8.12	−10.56	−12.85	−15.10	−17.21
Insurers profit/enrollee	−5.57	−5.96	−6.39	2706.79	−7.09	−7.41	−7.72	−8.01	−8.26	−8.53	−8.79
AC^{priv}/enrollee	2.05	1.30	0.86	2893.00	−0.21	−0.68	−1.14	−1.62	−2.00	−2.52	−2.99
Reimbursement to govt/enrollee	−180.17	−120.15	−60.10	180.17	89.32	186.36	286.07	387.10	484.10	597.02	712.61
Surplus											
Enrollment (M)	0.53	0.32	0.15	6.91	−0.13	−0.26	−0.38	−0.50	−0.62	−0.73	−0.84
CS of enrollees (R$M)	415.66	265.73	130.47	2765.60	−105.24	−212.19	−311.99	−405.43	−492.93	−578.00	−659.89
Insurers profit (R$M)	1546.43	956.29	420.80	11637.43	−429.10	−837.51	−122018	−157171	−190689	−222792	−253187
Govt net revenue (R$M)	−927.23	−559.91	−256.79	337.23	259.56	509.22	755.24	1013.82	1258.53	1495.00	1760.59
Total surplus (R$M)	1034.86	662.11	294.47	14740.26	−274.78	−540.48	−776.93	−963.33	−114129	−131092	−143118
Govt finances											
Govt revenue (R$M)	−101170	−616.15	−285.19	1011.70	315.59	627.25	931.95	1251.73	1550.46	1838.58	2162.94
Govt savings (R$M)	281.51	172.88	80.44	0.00	−66.85	−136.92	−203.29	−265.69	−325.86	−384.65	−441.89
Govt costs (R$M)	197.05	116.64	52.05	674.46	−10.82	−18.89	−26.58	−27.77	−33.92	−41.07	−39.54
Govt net revenue (R$M)	−927.23	−559.91	−256.79	337.23	259.56	509.22	755.24	1013.82	1258.53	1495.00	1760.59

Notes: This table presents the counterfactual results for different Reimbursement Valuation Index (RVI) levels, with 1.5 as the baseline. The results are shown as differences from the baseline, while the baseline columns display actual values. "Government revenue" refers to the revenue from reimbursements, and "Government savings" reflects the reduction in healthcare expenses due to enrollment changes. "Government cost" represents the expense of providing care to enrollees based on the SUS Table. "Government net revenue" is calculated by adding government revenue and savings, then subtracting government costs. M denotes million R$.

A. Macro health region definition

The ministry of health groups municipalities into health regions, and health regions into macro health regions to help the management of the public health system. There are 119 macro health regions and 450 health regions in Brazil. This grouping was defined based on cultural, economic, and social factors. The municipalities within a health region share border and usually have a shared transportation system.

I group some macro health regions together to make sure all units have a considerable number of utilization among enrollees. This grouping is based on geographic proximity and done within state. Therefore, I consider 75 macro health regions (or health regions for simplicity), which are illustrated in the Appendix Figure A.A1. I exclude the health regions where Brasilia, Rio de Janeiro, and Sao Paulo are located. The first because I do not have some demographic data for the region. The last two I exclude due to their significantly larger population compared to other regions, which could skew the results. I also exclude two states in the northern part of the country due to insufficient utilization data to conduct the analysis.

Figure A.A1: Adjusted macro health regions

Notes: The shaded areas are the excluded macro regions.

B. SIGTAP/SUS description

The SUS Procedures, Medications, and Orthotics, Prostheses and Auxiliary Means of Locomotion Table Management System (SIGTAP/SUS), or the SUS Table, lists all procedures performed by the public system. The SUS Table includes not only procedures performed on patients in healthcare facilities, but also management, surveillance, and educational procedures. Each procedure is identified by a 10-digit identifier. The first two digits correspond to the primary group to which the procedure belongs among eight possible groups.[28] The third and fourth digits correspond to the subgroup, and the fifth and sixth digits to the form of organization. The subsequent digits help precisely identify the procedure.

The SUS Table brings detailed information about each procedure, such as its description, the international code of diseases - 10 associated with, which type of beds is required to perform such procedure, minimum and maximum age of the patient potentially eligible to undergone the procedure, how complex it is, whether/which license it requires the health establishment to have to perform it, whether/which category of specialized care it belongs, among others. Since this table is used by the public system for reimbursements occurred within the system, it also contains the outpatient costs and inpatient costs associated with the procedure. The inpatient costs are split into professional and hospital. The public system regularly publishes revised version of this table including and/or excluding procedures, and revising the costs; however, it is common knowledge that the costs are not revised as often as the market prices change, and that they are considerably below the market prices.

Appendix Table A.B1 brings how the codes listed in the SUS Table were assigned to the different six treatments. The SIGTAP description column identifies the name of the primary (first two digits) or secondary group (third and fourth digits) of procedures included in the groups of treatment used for the analysis.

The claims data do not use the same procedure definition as in the SUS Table. DATASUS regularly publishes a non 1-to-1 mapping between the procedures code used by SUS and the

[28]These groups are: 01 - Health promotion and prevention actions, 02 - Procedures for diagnostic purposes, 03 - Clinical procedures, 04 - Surgical procedures, 05 - Organ, tissue and cell transplantation, 06 - Medicines, 07 - Orthosis, prostheses and auxiliary means of locomotion, and 08 - Complementary health care actions.)

supplementary health market.[29] For those procedures mapped with more than one procedure in SIGTAP/SUS, I assign the proportion of cases observed in the overall public system as the weight.[30] Naturally, for procedures with only one correspondence in the SUS Table, the weight is 1. About 25% of the inpatient visits could not me matched to a SIGTAP/SUS code, and 15% of the outpatient visits. These visits are excluded from the analysis.

Table A.B1: SIGTAP codes included in each group of treatment

Group	SIGTAP description	Codes included
Basic treatment	Procedures for diagnostic purposes	starting with 02, excluding 0213 and 0214
	Clinical procedures	starting with 03, excluding 0304, 0305, 0307, 0308, and 0310
	Minor surgeries and surgeries of the skin, subcutaneous tissue and mucous membranes	0401
Oncology treatment	Treatment in oncology	0304
	Surgery in oncology	0416
Dialysis treatment	Treatment in nephrology	0305
	Surgery in nephrology	0305 0418
Transplant	Organ, tissue and cell transplantation	starting with 05
Obstetrics	Labor and birth	0310
	Obstetric surgery	0411
Surgery	Surgical procedures	starting with 04, excluding 0401, 0416, and 0418

Notes: This categorization uses the SIGTAP/SUS table published in September 2022.

[29] I use the mapping from April 2017.

[30] For example, if procedure A is mapped with procedures 1 and 2 in the SUS table, and I observe procedure 1 being done 150 times and procedure 2 being done 50 times between 2015 and 2019, then procedure A with procedure 1 receives a weight of 0.75, and procedure A with procedure 2 a weight of 0.25.

C. Reimbursement to the public system

I compute the reimbursement to the public system for each group of medical treatment using four pieces of information: (1) the cost of a single procedure when it is performed in an inpatient and/or outpatient setting, (2) the average cost of an hospitalization in the public system by procedure, (3) within a procedure, the share performed in an inpatient and outpatient setting using public occurrences from 2015 to 2019, and (4) the number of occurrences of each procedure in the public system as a whole in 2015 by procedure, age, sex and health region.

Cost per procedure in the public system: the reimbursement to the public system follows closely the prices of the procedures released by the SUS Table. The reimbursement is currently stipulated as 1.5 times the cost of the treatment published in the public utilization datasets, which is based on the SUS Table.[31] Therefore, I use the SUS Table prices at the procedure level multiplied by 1.5 as the cost per procedure. This cost is different depending if a procedure is performed in an inpatient our outpatient setting.

Average cost of an hospitalization in the public system: the average cost of an admission comes from SIHSUS/DATASUS. In this dataset, each admission is related to the main procedure performed. I replace the inpatient cost from the SUS Table by the average cost of an hospitalization in the public system to account for some procedures involving further care and longer hospital stay, which the SUS Table does not account for.

Occurrences in the public system: an occurrence can be either an admission or a visit to any public facility. I use all occurrences by procedure from 2015 to 2019 to combine the inpatient and outpatient prices of a procedure. Once I have a final price per procedure, I use the occurrence data based on sex, age, and health region in 2015 to compute the average reimbursement to the government per procedure. Particularly for transplant, the average reimbursement varies only at the sex and age level given the reduced number of occurrences within a year. Hence, variations in reimbursement to the public system arise from distinct utilization patterns across different demographics.

[31] *Resolucao Normativa nº 251/2011.*