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Financing Needs, Spending Projection and the Future of Health in Brazil*

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Abstract

In this paper we adopt a growth accounting projection model to estimate and characterize health-financing needs in Brazil over the next four decades. We also estimate projections separately for the private and public sectors, isolate the burden of the demographic component, identify potential tensions between financing needs and spending constraints in the future, under different fiscal scenarios for the public sector, and discuss health system sustainability.

Key Words: health expenditures; projection models; fiscal constraints; health system sustainability.
JEL Codes: H51, I13, I18, J11.

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1 Introduction

The rapid growth in health spending around the world has led health systems to a situation of increasing tension between financing needs and constraints. The Institute for Health Metrics and Evaluation (IHME) estimates a current global health spending of approximately US$8 trillion per year, which is projected to double by 2050.[1] Growth in financing needs is expected to accelerate particularly in developing countries, where population is rapidly aging and health systems still face coverage and quality issues (SDG Collaborators, 2017). In light of the overall trends and challenges, it is therefore relevant to question whether and how developing countries will cope with increasing financing needs in healthcare over the path towards universal health coverage.

In this paper, we estimate and characterize health-financing needs in Brazil over the next four decades. We also identify potential tensions between financing needs and spending constraints in the future, in particular under different fiscal scenarios for the public sector, and discuss health system sustainability. Brazil is often considered a forerunner by the public health community and a potential model for other developing countries to follow (Harris, 2014; Atun et al., 2015). Brazil established universal and egalitarian access to health care as a constitutional right, and introduced a Unified Health System (Sistema Único de Saúde [SUS]) with the aim of achieving free universal health coverage and reducing disparities in access to healthcare services and health outcomes. SUS design therefore closely resembles social insurance models, in opposition to subsidized health insurance schemes and other models typically found in developing countries.

Despite the challenges typically faced by developing countries – such as limited state capacity to implement public policies, susceptibility to political cycles, adverse economic shocks and resource constraints – SUS has successfully expanded access to health services throughout the country, improved health outcomes, and reduced health inequalities (Castro et al., 2019; Bhalotra et al., 2019). No country in the world with more than 100 million inhabitants has designed and implemented such a universal coverage strategy. However, inequalities persist. Coverage and quality are still issues in the public sector and there exists great public-private segmentation both in the provision and financing of healthcare. About a quarter of the Brazilian population, generally formal workers and the wealthiest, are currently covered by private health insurance. In this context, the characterization of health financing needs in the country and the discussion about system long-term sustainability and equity are of fundamental importance. This should be true not only for Brazil itself, but also for informing the international community about the sustainability of an

[1] More specifically, expenditures for 2017 were approximately US$ 7.9 trillion in 2019 US$ values.

ambitious universal health coverage strategy, implemented by a developing country.

More specifically, in this paper we adopt a standard growth accounting projection model and generate a series of fiscal scenarios for the comparison of financing needs and constraints in Brazil up to 2060. Growth accounting projection models generally rely on the decomposition of the growth in health expenditure into three factors: income, demographic and residual factors. We adapt features of a standard approach to the Brazilian institutional context and make use of administrative microdata on mortality and hospitalization records to estimate medical cost curves by gender, age and survival status, which allow us to increase empirical adherence to the country's health system characteristics and investigate heterogeneities. In particular, we estimate projections separately for the private and public sectors, isolate the burden of the demographic component over the next decades, as well as generate simulations of spending constraints for the public sector.

According to the most recent data from the Brazilian Institute of Geography and Statistics (IBGE), in 2017 the final consumption of health goods and services in Brazil totaled R$608 billion (US$ 184 billion), or the equivalent to approximately 9.2% of GDP.[2] Of this total, 3.9 percentage points corresponded to public expenditure and the rest to private expenditure. According to the results of our benchmark projection, health financing needs in Brazil would reach 12.5% of GDP in 2060. This is equivalent to a growth of 3.29 percentage points, or approximately R$ 1.13 trillion (US$ 341 billion). Of this total increase, R$ 480 billion would correspond to the public sector needs, or approximately 1.44 percentage points of GDP in 2060. An important part of the increase will be due to the aging of the population. Keeping everything else constant, it is estimated that the change in population age structure will lead to an increase of R$ 303 billion in health financing needs in Brazil in 2060 compared to 2017, or 26.8% of the total expected increase. The lower is the economy's growth during the period, the higher is the effort, as a share of the GDP, to respond to health financing needs driven by demographic pressures. Under a projected growth of only 0.8% of GDP per year, it is estimated that financing needs will reach 13.2% of the GDP, a 3.96 percentage points increase by 2060. This pattern stems from a relatively larger contribution from the demographic component as GDP increases relatively less.

Those are estimations for the financial needs. What will happen with spending, however, will depend on the way the government and society will respond to financing needs. More specifically, we do not know to what extent income growth will be converted into more health spending, or to what extent the financing needs arising from an aging population

[2]We consider the exchange rate of 29 December, 2017 (1 US$ = R$ 3.31) to convert amounts in R$ to US$. Based on the exchange rate of 31 December, 2019 (1 US$ = R$ 4.03), Brazil's total health spending in the year of 2017 corresponds to US$ 151.

will be covered. These issues are particularly uncertain for the public sector, whose budget is typically subject to fluctuations over the political and economic cycles. Fiscal constraints have been particularly tight in Brazil since the mid-2010s. The institution of the Constitutional Amendment no. 95/2016 has frozen federal expenditure in real terms up to 2036 to the amount observed in 2017. Increases in health spending might be possible only in tandem with cuts in other sectors, what makes even small increases in federal health spending more difficult. In order to identify possible future tensions between needs and expenses, we compare the estimates of our base scenario to the results of simulations of spending under different fiscal scenarios for the public sector. As expected, the results indicate overall pressures for decreasing public spending as a proportion of total spending. In particular, in a scenario of a cap or freeze on federal spending, public expenditure as a share of total health spending would decrease by around 7 percentage points by 2060, while the share of public spending corresponding to state and municipal spending would increase from approximately 56% to 80%.

There are few economic models of national health spending focusing on accurately forecasting aggregate expenditure, and the existing evidence on developing countries is particularly scant. As mentioned by Getzen and Okunade (2017), most models are explanatory and few are amenable for making projections. While we adapt features of a standard growth accounting approach to the Brazilian context and make extensively use of administrative microdata to add fine-grained inputs to our model, the results of our benchmark projections are relatively close to the few existing estimates. Using a simpler variation of a top-down model, Jakovljevic et al. (2017) project the BRICS total health expenditure as a share of GDP for the year 2025. For Brazil, the authors find that these expenditures are expected to reach 10.5%, which is the highest among the countries analyzed. Meanwhile, our benchmark scenario projects 10.2% of GDP for 2025. For 2040, we estimate that the financing needs would reach 11.7% of GDP, somewhat similar to the 11.8% found by SDG Collaborators (2017), who follow a cross-country stochastic frontier methodology. Similarly, we estimate that the share of financing needs due to the public sector reaches 42.1% in 2040, slightly below the 45.9% found by the same authors. Specifically with regard to the public sector, we estimate a variation from 3.9% of GDP in 2017 to 5,3% in 2060. This figure is lower than the 6.8% projected by De la Maisonneuve and Martins (2015) under the authors' cost containment scenario. This difference is possibly due to the fact that the authors project a larger residual and use a per capita cost curve for OECD countries, therefore higher than those estimated for Brazil.

The fact that we are aligned with the main existing results in the literature reinforces our benchmark predictions on financing needs and allows us to move forward with our methodology in novel ways in search of relevant heterogeneities and a more complete characterization of the projections. In particular, the estimation of medical cost curves by age and separately for the public and the private sectors allows us to isolate and discuss future patterns of spending due to the age structure and shed light on public-private segmentation. Also importantly, and to the best of our knowledge, this is the first paper to contrast financing needs and spending constraints in the future, thus exposing potential tensions between sectors and within government entities.

Overall, our approach enables us to shed light on concerns and challenges for health system sustainability. In Brazil, meeting future needs will require society to mobilize funds towards healthcare. However, even without efficiency gains, our base scenario suggests that future financing needs are not intrinsically unbearable. The public sector, in particular, would require an increase in spending of around 1.44 GDP points by 2060. Considering population projections, this would correspond to a 2.7 times higher level of spending per capita than that currently observed. On the other hand, fiscal constraints have been particularly tight in the country, and even small increases in public spending have become relatively more difficult. It is therefore possible that restrictions on public spending may imply an increase in public-private segmentation in health financing and provision, leading to potential losses of equity in the system. In sum, while the ambitious universal health coverage strategy implemented in Brazil is not inherently unsustainable, constraints that are typical of developing countries, although eventually exogenous to the health sector, might pose challenges to the funding of equitable and quality healthcare services in the future.

The remainder of this paper is organized as follows. Section 2 describes our empirical model and the data. Further details on the estimation of cost curves are presented in Appendix Section A. Section 3 presents our main results, and in Section 4 we discuss simulations for alternative fiscal scenarios. Section 5 provides an overall assessment of policy implications, which is further extended to cover conjectures about the eventual impacts of COVID-19 on long-run health system financing. Section 6 concludes with final comments.

2 Projection Model and Data

2.1 Brief Overview of Projection Models

Projections of health expenditures often rely on bottom-up or top-down approaches, which differ mainly by the level of disaggregation of information used in estimations. Top-down projection models are typically standard growth accounting models which rely upon the decomposition of a spending growth equation into three factors separately: income, demographic and residual factors. Bottom-up models, on the other hand, estimate health expenditures based on detailed accounting of the costs of goods and services, as well as the estimation and projection of demographic pressures on health demand and the factors that make up the health care supply. The demographic pressures that determine the demand for health services include characteristics of the population, such as the age profile, gender, fertility rates, mortality and morbidity profile. Supply pressures include changes in wage in the health care sector, productivity gains and drug price variations. Compared to the top-down model, the bottom-up model has the main advantage of being able to identify the determinants of demand pressures and health costs at a higher level of disaggregation. However, projecting expenditures using the bottom-up approach requires detailed and reliable data, not only on the age and epidemiological profile of the population, but also on health costs and expenses.

The data available for Brazil are not detailed enough to allow estimates of health expenditure projections using the bottom-up approach, especially for the private sector. Furthermore, as mentioned in Charlesworth et al. (2018), both approaches lead to similar aggregate results. Not surprisingly, top-down models have been widely used by international organizations and governments for long-term health spending projections (De la Maisonneuve and Martins, 2015). In view of the data limitations to perform a bottom-up estimate for Brazil, and the convergence of the models when considering aggregate expenditure, in this paper we use a top-down approach.[3]

2.2 Top-Down Methodology and Data

We follow a top-down approach to project the health financing needs in Brazil until 2060. The projection is made for three factors separately: income factor, demographic factor and a residual. The income factor is calculated from projections for GDP growth and income elasticity assumptions. The demographic factor is estimated based on a combination of the age structure of the population, which varies over time, and a curve of medical costs per capita, by gender, age and survival status. The residual refers to the share of expenses not explained by the two previous factors. The variation in health financing needs between two periods of time t_0 and t, $\Delta S_t / S_{t_0}$, can be expressed from the following breakdown:

[3]Despite the differences in the relative importance of each factor to explain future health expenditure, the estimates of total expenditures made by Charlesworth et al. (2018) for the United Kingdom in the bottom-up model are very similar to those obtained by De la Maisonneuve and Martins (2015) in the top-down model. For reference to top-down projections for the United Kingdom and the European Union, see also European Commission (2015) and Licchetta and Stelmach (2016).

$$\frac{\Delta S_t}{S_{t_0}} = \varepsilon[\frac{\Delta Y_t}{Y_{t_0}}] + \frac{\Delta D_t}{S_{t_0}} + \frac{\Delta R_t}{S_{t_0}} \quad (1)$$

Where ε is the income elasticity of demand for health, which refers to the proportion with which health spending increases in relation to the increase in income $\frac{\Delta Y_t}{Y_{t_0}}$, with Y_t equal to GDP in period t. The term $\frac{\Delta D_t}{S_{t_0}}$ corresponds to the variation due to the demographic factor and $\frac{\Delta R_t}{S_{t_0}}$ refers to the share of the variation in health expenditure not explained by the previous factors.

As explicit in Equation 1, the projection of financing needs requires a starting point t_0. The total health expenditure S_{t_0} is computed for 2017 and obtained from IBGE (2019), which discloses the latest available expenditures separately for the public and private sectors and follows methodological standards of the System of National Accounts (SNA), 2008 Revision (UN, 2009). We use data from client payments released by the National Regulatory Agency for Private Health Insurance and Plans (ANS) to estimate spending on private health insurance. The difference between the private expenditures of the SNA and spending on private insurance allows us to estimate total out-of-pocket payments.

Total public expenditure in 2017 corresponded to R$ 254 billion, while private expenditure corresponded to R$ 355 billion, of which R$ 181 billion were spent on health insurance and R$ 174 billion on out-of-pocket payments. These figures form the baseline for health spending S_{t_0} in the projections, both for total spending and separately for the public and private sectors. Next, we detail the methodology for calculating the other components of Equation 1.

Income Factor

The income factor corresponds to the expected variation in health spending in response to variations in income. The income elasticity of demand for health is the parameter that measures the extent to which health expenditure varies with income. There is no consensus in the literature on the magnitude of this parameter, whether health would be a luxury good (elasticity greater than 1) or a necessity good (elasticity less than 1). Considering health expenditures at the individual level, the income elasticity estimated empirically is, in general, less than 1 (Acemoglu et al., 2013). The income elasticity tends to be close to or slightly higher than 1 when aggregate health expenditures are considered (Chernew and Newhouse, 2011; Hall and Jones, 2007). More recently, based on data for 167 countries, Baltagi et al. (2017) find that income elasticity rises to around unity when moving from wealthier to poorer countries.

Top-down projections generally consider income elasticity close to or equal to 1. De la Maisonneuve and Martins (2015) use income elasticity of 0.8 to estimate health spending in OECD member and non-member countries and unit elasticity in sensitivity analyzes. For the United Kingdom, Office for Budget Responsibility (2011) considers unit elasticity in its main specifications.[4] In light of the findings from Baltagi et al. (2017) and given that Brazil is a developing country, in our projections we consider the income elasticity equal to 1. Implicitly, assuming a unitary income elasticity implies the fact that health spending would increase with economic growth, but would remain constant as a proportion of GDP.

We also need estimates for GDP over time to compute the income factor. We obtain the GDP data for Brazil up to 2019 from the National Accounts of IBGE. For the years between 2020 and 2023, we consider the median of GDP growth projections released by the Focus Report of the Brazilian Central Bank.[5] For the period 2024 to 2060, we use the GDP growth projection released by OECD Economic Outlook No. 103. In all cases, GDP is calculated at 2017 prices to match in nominal terms the latest available SNA data on health expenditures, released from IBGE (2019).

Demographic Factor

It is expected that the increase in life expectancy and changes in the population's demographic profile translate into increased health spending via two main channels. The first is the simple increase in the number of people demanding health services (extensive margin). The second, more complex, is related to the fact that health expenditure increases according to age (intensive margin). To better understand this second channel, two factors must be taken into account, the mortality rate and costs related to death, as well as the population's morbidity profile. Several studies have shown that it is not age itself, but the proximity of death that is related to high health costs. This is due to a demand for much more expensive care (Felder et al., 2010; Steinmann et al., 2007; Felder et al., 2000; Zweifel et al., 1999). As the population ages, the increase in the mortality rate combined with the costs of death imply an increase in health expenditure. With regard to the population's morbidity profile, we must assess the extent to which life expectancy gains are reversed in years lived in good health. There are three main hypotheses that relate the aging population and the

[4]According to De la Maisonneuve and Martins (2015), the income effect would explain 25% of the growth in health spending in Brazil for the period 1999-2009, and less than 40% for OECD countries. Although relevant, however, the income factor is not able to explain the growth in spending alone. As highlighted by SDG Collaborators (2017), the level of per capita income is associated with more health expenditure, but it is not a deterministic factor. In fact, there is a lot of variation between countries with the same level of per capita income. The age structure and institutional and technological factors are also relevant.

[5]GDP projections by the BCB were extracted as of February 26, 2020, previous to downward revisions due to COVID-19 impacts.

morbidity profile. The first one considers a compression of morbidity (Fries, 1980). According to this hypothesis, the increase in life expectancy is accompanied by an increase in years in good health.[6] Alternatively, the theory of the expansion of morbidity proposes that medical technology will reduce mortality from fatal diseases, in addition to allowing the survival of people in worse health conditions (Olshansky et al., 1991). Because of this, the increase in life expectancy will be accompanied by more years in a worse health state, putting pressure on health expenditures. Finally, the dynamic balance theory (Manton, 1982) establishes that improvements in living conditions arising from medical treatments will reduce the severity of chronic conditions and, thus, reduce health costs. However, with the extension of life, the occurrence of diseases will increase, increasing health costs. The final effect of population aging on health spending would then depend on the weight of these two components.

There is no consolidated and available methodology for estimating cost curves for Brazil. In light of the hypotheses above, we estimate the demographic factor based on a combination of the population age structure, which varies over time, and a curve of medical costs per capita, by gender and age, fixed over time. To take into account the difference in health spending between people who survive and die each year, we estimate health cost per capita curves for survivors and non-survivors separately. Regarding the evolution of the morbidity profile, ideally the per capita curves should be shifted over time to reflect the effect of technological changes on the population's morbidity profile regardless of variations in age structure and medical prices. As there is no clear consensus in the literature on how this response occurs, the health cost curves used in this study to project health expenditures will be fixed over time.

IBGE provides projections for the age structure of the population and releases the number of people by age and gender over the years. Appendix Figure A.1 shows that the Brazilian population is expected to rapidly age until 2060. In 2000 about 5% of the population were between 65-79 years old, and 1% was over 80 years old. This together accounted for just over 10 million people. It is estimated that in 2060, 17% of the population, or 39 million people, will be between 65-79 years old, while the proportion of people over 80 will reach 8.4%, or more than 19 million of people. In order to compute cost curves and health expenditures for the public and private sectors separately, we also collect the average coverage of private health insurance for the last 5 years (ANS, 2015-2019) and, specifically for the non-survivors curve, the average mortality rate in the last 5 years with available information (2014-2018). Total demographic expenditure reported to the private sector considers

[6]Technological advances in the medical field and the expansion of preventive care, for example, would allow the improvement of health status, resulting in a reduction in spending throughout life.

expenditure on both private insurance and out-of-pocket expenses. We further detail the methodology used to estimate cost curves in Appendix Section A, which informs additional sources of data and specific modelling decisions.

Residual

The residual is the share of the growth in expenditure that is not explained by the demographic effect or by the income effect. Other factors that pressure healthcare costs, such as technological as well as institutional innovations, are included in the residual.[7] de la Maisonneuve et al. (2017), for instance, find that while a large share of differences in public health expenditures across OECD countries over the 2000-2010 period can be explained by demographic and economic factors, cross-country variations in policies and institutions have a significant influence, explaining most of the remaining difference in public health spending and the bulk of the residual variation.

Estimating the residual from past data is simple while future records rely on ad hoc scenarios. For each previous year, firstly, the variation in health expenditure that can be attributed to the demographic factor and the income effect is considered. The residual then is the difference in relation to the total variation of the expenditure. For example, we observe that between 2000 and 2017 total health expenditure grew by an average of 3.13% in Brazil. Of these, 2.62 percentage points are explained by the demographic factor and 2.41 by the income effect. The estimated residual is therefore -1.9 percentage points. A negative residual suggests a context of cost containment. For projection purposes, we rely on varied scenarios. In our main projections, neutral in this sense, we consider the residual to be zero. In other words, the demographic factor and the income effect fully explain the growth in health spending. In sensitivity analyzes, we will consider a residual of -0.75 and +0.75 percentage points, that is, respectively, associated with cost containment and expansion scenarios.

3 Health Financing Needs in Brazil: Baseline Scenario

In this section, we present and discuss our main projections for health financing needs in Brazil until 2060. The results are presented for the health system as a whole and separately for the public and private sectors. In our base scenario, we assume income elasticity equal to 1 and GDP projections that average an annual growth of 1.8%. GDP growth rates come from the Brazilian Central Bank (BCB) from 2020 until 2023 and from the OECD be-

[7] A relative drop in productivity in the health sector can also be interpreted as part of the residual.

tween 2024 and 2060.[8] In alternative simulations, we vary the growth scenario for more or less conservative rates. Table 1 summarizes all combinations of parameters used in the projections discussed in this section. In the next section we complement the analysis by evaluating these projections in light of alternative fiscal scenarios for the public sector.

Table 1: Parameters Considered in Projections of Health Financing Needs

Scenario	Medical cost curve: Public Sector	Medical cost curve: Private Sector	Elasticity	GDP growth	Residual
Base	Public	Private	1	BCB+OECD (average 1.8%)	-
Positive residual	Public	Private	1	BCB+OECD (average 1.8%)	+0.75
Negative residual	Public	Private	1	BCB+OECD (average 1.8%)	-0.75
Public cost	Public	Public	1	BCB+OECD (average 1.8%)	-
Private cost	Private	Private	1	BCB+OECD (average 1.8%)	-
GDP Growth:					
Pessimist	Public	Private	1	0.8%	-
Optimist	Public	Private	1	2.8%	-

Notes: Medical cost curves, for both public and private sectors, were constructed with data, mainly, for the year of 2017. They were used to estimate the growth in health expenditure driven by the demographic factor (for details, see Appendix Section A). Income elasticity was used to estimate variation in health expenditure driven by variation in GDP. GDP growth projections came from the Brazilian Central Bank for 2020-2023 and from the OECD for 2024-2060. The average annual growth is 1.8% for the whole period. For the pessimist and optimistic scenarios we considered a fixed estimate of -/+ 1pp from this average, respectively. Residual refers to the portion of the growth in health expenditure that is not explained by neither the demographic factor nor the income effect.

It is important to highlight that, strictly speaking, the projections should not be interpreted as projections of expenses, but rather as financing needs. In other words, we can consider expenses as what has already been done, and financing needs as something latent and that could be realized as expenses in the future. It is expected that the growth of the economy and the aging population will pull the demand for health goods and services for greater coverage, higher quality and more technological incorporation, which would then lead to an eventual increase in spending. In this regard, we associate the results of the projections in this section with financing needs. What will happen with spending, however, will depend on the ability of the government and society to actually respond to these needs with more resources. This will be discussed in more detail in Section 4, when comparing the results of the projections, presented below, to alternative fiscal scenarios.

Table 2 presents the results of our projections for health financing needs in Brazil until 2060.

[8] Estimated on February 26, 2020.

In the first two columns, we report the observed health spending as a proportion of GDP, respectively for 2000 and 2017. These expenses corresponded to 8.2% in 2000 and 9.2% in 2017. According to the base scenario, we then estimate an increase in total health financing needs to 10.8% of GDP in 2030, 12.0% in 2045, finally reaching to 12.5% in 2060. This would represent an increase of 3.29 points of GDP, driven in part by an increase in public sector financing needs of 1.44 points in GDP, and in part by an increase of 1.85 points in the private sector. This difference is due to the fact that the private sector has a higher medical cost curve by age and gender. When we project demographic changes, given higher costs, naturally the financing needs of the private sector will be greater.

Table 2: Health Financing Needs: Main Projections

Parameters	Observed Spending (% of GDP)		Projected Needs (% of GDP)			Δ 2017-2045 (in p.p.)	Δ 2017-2060 (in p.p.)
	2000	2017	2030	2045	2060		
Base scenario:							
Total	8.2%	9.2%	10.8%	12.0%	12.5%	2.78	3.29
Public	3.5%	3.9%	4.5%	5.1%	5.3%	1.21	1.44
Private	4.7%	5.4%	6.3%	7.0%	7.2%	1.57	1.85
Residual:							
Total -0.75	-	-	9.9%	10.0%	9.4%	0.76	0.19
Total +0.75	-	-	11.8%	14.5%	16.7%	5.22	7.45
Cost curve							
All public	-	-	10.6%	11.7%	12.2%	2.47	2.95
All private	-	-	11.2%	12.7%	13.3%	3.48	4.06
GDP Growth:							
0.8% annual	-	-	10.9%	12.5%	13.2%	3.23	3.96
2.8% annual	-	-	10.7%	11.8%	12.2%	2.61	2.99

Notes: Data on past health expenditure is available for 2000-2017. Projections are estimated annually for the period 2018-2060. Health care expenditure is expressed relative to GDP. The last two columns show, in percentage points, the difference between the projected health spending in 2045 and 2060, respectively, and the observed health spending in 2017 for each one of the scenarios detailed in Table 1.

A growth of about 3.29 percentage points of GDP in 2060 would correspond to an increase of approximately R$ 1.13 trillion compared to the expenditure observed in 2017. Of this total, the demographic factor would contribute 26.8%. More specifically, if we use the fixed cost curves in the base year, by age and gender, and simply project the change in the demographic structure expected by 2060, we find that health financing needs increase by approximately R$ 303 billion, with R$ 133 billion in the sector public and R$ 170 billion in the private sector. The aging population will therefore significantly pressure health financing needs. These figures do not take into account any changes in the cost structure or in the quality of the health goods and services offered, nor the income factor or the residual factor.

The first set of alternative scenarios considers residual factors other than zero. Assuming a negative residual, for example of -0.75 percentage points, the projections indicate relative stability of the financing needs until 2060, with an increase of only 0.19 GDP percentage points. A negative residual can be interpreted in several ways. On the one hand, it can reflect efficiency gains and technological innovations, which would eventually allow for increases in quality and coverage with fewer resources. There is no evidence, however, that this is happening in the country. On the other hand, and particularly in relation to the public sector, it may reflect fiscal restrictions and the government's low capacity to expand SUS coverage and quality. We will discuss this in detail in the next section. In the scenario under positive residual, for example +0.75 percentage points, total health expenditure would reach 16.7% of GDP in 2060. A positive residual, similarly, may reflect a continuous expansion of quality and coverage of goods and services, or an upwards shift in medical cost curves, in addition to income gains or needs due to population aging. Alternatively, it may also reflect an increase in inefficiencies related to institutional restrictions and the inefficient overuse of the system.

In view of the difference in the per capita cost curves of the public and private sector, the second set of scenarios investigates what would happen to health financing needs if the entire population were served under the cost structure of the public versus the private sector. It is important to mention that this exercise is simple and suggestive. It reflects only a change in the considered cost curve. Under the public cost curve, we observe that total spending would increase by 2.95 GDP percentage points by 2060, which is 1.12 percentage points lower if we consider the private sector cost curve.

Finally, we analyze scenarios under different rates of economic growth. Under a projected growth of only 0.8% of GDP per year, it is estimated that financing needs as a proportion of GDP would increase by 3.96 percentage points by 2060. Considering higher growth rates, at 2.8%, we found smaller variations of 2.99 percentage points. This pattern stems from a relatively smaller contribution from the demographic component as GDP increases relatively more. The message of these results is very relevant. The lower the growth, the less the country's ability to respond to the financing needs of an aging population.

The results from our base scenario are relatively close to those found in the literature. Using a simpler variation of the top-down model, Jakovljevic et al. (2017) project the BRICS total health expenditure as a proportion of GDP for the year 2025. For Brazil, the authors find that these expenditures are expected to reach 10.5%, which is the highest proportion among the countries analyzed. Meanwhile, our baseline scenario projects 10.2% of GDP for 2025.[9] For 2040, we estimate that the financing needs would reach 11.7% of GDP, somewhat similar to the 11.8% found by SDG Collaborators (2017), who follow alternative methodology.[10] Similarly, we estimate that the share of financing needs due to the public sector reaches 42.1% in 2040, slightly below the 45.9% found by the same authors. Specifically with regard to the public sector, we estimate a variation from 3.9% of GDP in 2017 to 5.3% in 2060. This figure is lower than the 6.8% projected by De la Maisonneuve and Martins (2015) under the authors' cost containment scenario. This difference is possibly due to the fact that the authors project a larger residual and use a per capita cost curve for OECD countries, therefore higher than those estimated for Brazil.

In general, the results indicate that health financing needs are expected to increase by around 3.29 GDP percentage points in Brazil over the next four decades. The fact that we are aligned with the main existing results in the literature reinforces this prediction and allows us to move forward with our methodology in search of a more complete characterization of the projections. In the next section we compare our baseline scenario for health financing needs with alternative fiscal scenarios, mostly for the public sector, which allows us to assess the difference between future financing needs and constraints.

4 Financing Needs vs Health Spending: Fiscal Scenarios

As previously mentioned, the results of Section 3 should be interpreted as projections for health *financing needs*. What will happen with spending, however, will depend on the way the government and society will respond to these needs. More specifically, we do not know to what extent income growth will be reversed in more health spending, or to what extent the financing needs arising from an aging population will be covered. These issues are particularly uncertain for the public sector, whose budget is typically subject to fluctuations over the political and economic cycles.

In this section, we start from our base scenario (Scenario 1) and perform simulations under

[9] The authors use a macroeconomic model of excessive budget growth, which considers how much health spending increases above GDP growth, controlling only for the effects of the population's age composition. Mortality rates, per capita cost curves and survivors and non-survivors are not considered in this type of projection.

[10] The stochastic frontier methodology used by the authors is based on relative projections between countries, in addition to requiring data with a temporal dimension, for more than one observation unit (countries in the sectional dimension).

alternative fiscal scenarios for the public sector. In the first alternative scenario (Scenario 2), we consider that the income elasticity of the federal public sector is equal to zero. In this case, economic growth is not converted into more federal spending on health. The federal government, however, continues to cover the demographic factor, while state and municipal governments continue to respond both to economic growth and to the demographic factor (as in the base scenario). In Brazil, decentralization of healthcare funding and delivery within SUS has leveraged the responsibility of states and municipalities over time. By the mid-2010s, the federal government covered 44% of total public spending, states covered 26%, and municipalities 30%. Following (Scenario 3), we add a cap for federal health expenditure in order to mimic the effects of Constitutional Amendment no. 95/2016. In this case, federal expenditures are frozen in real terms at 2017 figures, and expenditures do not respond to income growth or financing needs due to the aging population in the following years.[11,12] State and municipal public spending continues to respond to income and demographic factors as in the base scenario. In Scenario 4, we set the income elasticity of the public sector as a whole to zero. In this case, economic growth is not converted into more public spending, but the public sector continues to cover financing needs arising from the demographic factor, i.e., population aging. Finally, in Scenario 5, we apply the spending cap again, but now for the entire public sector. All public spending is frozen in 2017 in real terms and is unrelated to both economic growth and demographic factor financing needs.

Table 3 and Figure 1a show simulations for public health expenditure as a share of GDP for the different scenarios compared to the base scenario. As expected, we see that in Scenarios 2 to 5 the public health expenditure (as % of in GDP) increases relatively less or decreases. In Scenario 2, we see a modest increase of just 0.34 percentage points in the long run. In Scenario 3, with a cap for federal spending, we observe that the proportion of public spending relative to GDP would remain stable (-0.08 percentage points relative to 2017). Although in this case federal spending decreases in relation to GDP, the growth in state and municipal spending would be sufficiently enough to cover a great part of the difference. In the last two scenarios, however, public spending on health as a proportion of GDP would decrease to 2.8% (Scenario 4) and 1.8% (Scenario 5) in 2060. In the latter case, under a freeze on spending for the public sector as a whole, Brazil would approach the share of public expenditures observed, on average, for Sub-Saharan countries in the year

[11] More precisely, according to Constitutional Amendment no. 95/2016, increases in health spending might be possible only in tandem with cuts in other sectors so that total federal expenditure is kept constant in real terms until 2036. In this case, even small increases in federal spending become relatively more difficult.

[12] For scenarios 2 and 3, where fiscal restrictions are applied solely to the federal spending, we consider that local governments (states and municipalities) do not cover the portion of the expenses forgone by the federal government.

Table 3: Health Financing Needs vs. Spending: Simulations for Alternative Fiscal Scenarios for the Public Sector

Parameters	Observed Spending (% of GDP)		Projected Needs (% of GDP)			Δ 2017-2045 (in p.p.)	Δ 2017-2060 (in p.p.)
	2000	2017	2030	2045	2060		
Public expenditure							
Scenario 1 (base)	3.5%	3.9%	4.5%	5.1%	5.3%	1.21	1.44
Alternative scenarios							
Scenario 2 ($\varepsilon_{fed} = 0$)	3.5%	3.9%	4.1%	4.2%	4.2%	0.38	0.34
Scenario 3 (Federal cap)	3.5%	3.9%	3.8%	3.8%	3.8%	-0.03	-0.08
Scenario 4 ($\varepsilon_{pub} = 0$)	3.5%	3.9%	3.5%	3.2%	2.8%	-0.69	-1.07
Scenario 5 (Public cap)	3.5%	3.9%	2.9%	2.2%	1.8%	-1.61	-2.02

Notes: Data on past health expenditure is available for 2000-2017. Projections are estimated annually for the period 2018-2060. Health care expenditure is expressed relative to GDP. The last two columns show, in percentage points, the difference between the projected health spending in 2045 and 2060, respectively, and the observed health spending in 2017 for each one of the fiscal scenarios. Scenario 1 refers to the base scenario described in Table 1. Figures for this scenario are identical of those in the second row of Table 2. Scenario 2 changes income elasticity of the federal government to be equal to zero. Scenario 3 freezes federal health expenditure in 2018-2060 to be equal to that observed in 2017. Scenario 4 sets income elasticity of the public sector as a whole in zero. Scenario 5 introduces a cap to the public health expenditure to be equal to the observed government expenditure in 2017.

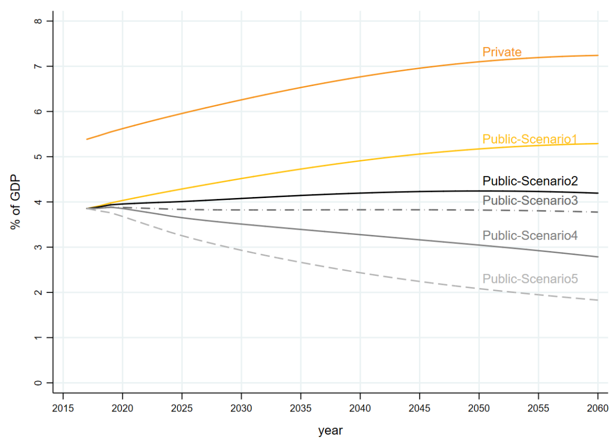
of 2017.[13]

Next, we investigate what would happen with per capita health spending, which suggests an indicator of quality and coverage of health goods and services. Figure 1b shows the results for per capita spending in the public and private sectors.[14] We observe significant growth in both sectors, but it is stronger in the private sector. While public spending per capita approaches about R$ 4,400 in 2060, private spending reaches R$ 10,600 for the same period. In Figure 1b, we see a large dispersion for the trajectory of public spending per capita between the different fiscal scenarios. In particular, public spending per capita amounts to just over R$ 2,300 in Scenario 4 with zero elasticity for the public sector as a whole. According to the assumptions of our projections, this amount would be just enough to cover the increase in financing needs due to the change in the age structure and the aging population. In Scenario 5, with a cap for the public sector as a whole, spending per capita would actually decrease in real terms. In particular, this trend would stem from the contrast between the freeze on public spending and population growth which could occur until the mid-2040s.

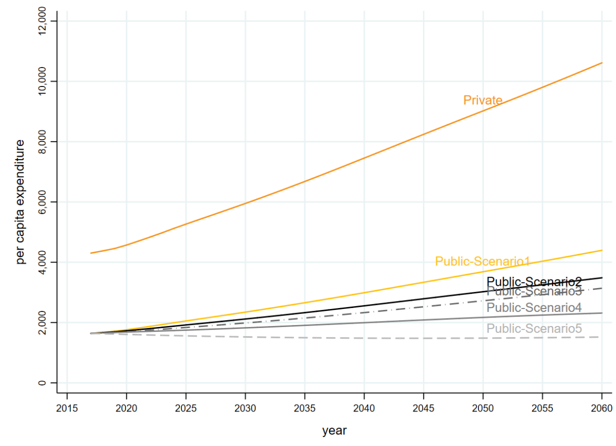
[13] According to The Institute for Health Metrics and Evaluation (IHME), Sub-Saharan countries presented, on average, a public health expenditure of 1.86% of GDP in 2017

[14] For the per capita calculation, we use different population denominators for the sectors, according to our assumptions about the respective coverage rates.

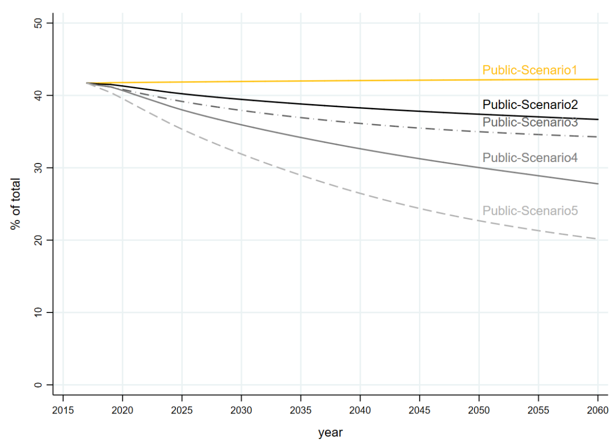
Figure 1: Indicators of Health Expenditure in Different Fiscal Scenarios



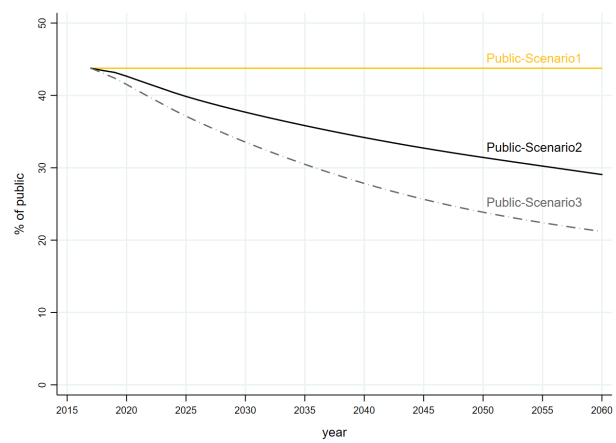
(a) Health Expenditures as % of GDP



(b) Per Capita Health Spending



(c) Public vs. Private Composition



(d) Share of Federal Health Spending

Notes: Figures (a) and (b) show health expenditure, respectively as a share of GDP and in per capita terms (in R$), for the private sector (base scenario) as well as for the public sector for each one of the fiscal scenarios described in Table 3 (Notes). Figure (c) presents the public share of the national health expenditure for each one of the fiscal scenarios for the public sector described in Table 3 (Notes), while keeping the base scenario for the private sector. Figure (d) shows the proportion of the public expenditure that is funded by the federal government in the base scenario (Scenario 1) as well as in scenarios where we apply fiscal constraints solely to this level of the federation (Scenarios 2 and 3), detailed in Table 3 notes.

We should expect variations in the composition of health expenditures between the public versus private sectors across the scenarios, as well as variations in the composition of public expenditures between different entities of the federation. Figure 1c shows that the share of public expenditure in total health expenditure would tend to fall in all scenarios compared to the base scenario. In particular, in the federal spending cap scenario with zero federal elasticity (Scenario 3), the share of public spending would decrease to 34%, while in the scenario where these constraints are applied to the public sector as a whole (Scenario 5), this proportion would drop to 20%. The results suggest pressures to decrease public spending as a share of the total in all scenarios involving some constraint on public spending.

Finally, Figure 1d shows simulations for the composition of public spending between different entities of the federation. Once there are restrictions on federal spending, it is expected an increase in the share of states and municipalities in the composition of public spending. This occurs, in particular, when comparing Scenarios 2 and 3 to the base scenario.[15] As soon as federal spending no longer responds to the income factor (Scenario 2), or are completely frozen (Scenario 3), state and municipal spending becomes more relevant. In particular, under the federal cap scenario with zero federal elasticity (Scenario 3), the share of federal spending on public health spending would decrease to just over 20% in 2060. This would represent a substantial increase in the importance of the role of states and municipalities in sustaining SUS and for the conduction of public health policies in the country.

5 Discussion

Health financing needs are expected to increase over time in Brazil, not only in absolute terms, but as a share of GDP. Meeting future needs will require society to mobilize additional funds towards healthcare. However, even without efficiency gains, our base scenario suggests that future financing needs are not intrinsically unbearable. The public sector, in particular, would require an increase in spending of around 1.44 GDP points by 2060. Considering population projections, this would correspond to a 2.7 times higher level of spending per capita than that currently observed. In this sense, we find no evidence that the trajectory of SUS financing needs is inherently unsustainable – despite its commitment to provide free and universal health care to more than 200 million citizens. Due to its scale, the ability to coordinate prevention and health promotion through primary care programs,

[15] There are no changes in the composition of public spending across different entities of the federation in Scenarios 4 and 5 with respect to the base scenario given that in such scenarios the constraints are applied uniformly to the public sector as a whole.

and the potential in terms of productivity gains, SUS could contribute to system sustainability even under a restricted fiscal space.

Fiscal constraints, however, have been particularly tight in Brazil since the mid-2010s. The institution of the Constitutional Amendment no. 95/2016 has frozen federal expenditure in real terms up to 2036 to the amount observed in 2017. Increases in health spending might be possible only in tandem with cuts in other sectors. In this case, even small increases in federal spending become relatively more difficult. It is therefore possible that restrictions on public spending may imply an increase in public-private segmentation in health financing and provision. This can lead to potential losses of equity in the system. In this case, it would be up to Brazilian society to consider to what extent it would be willing to give even more in terms of equity in health at the expense of spending in other policy fronts. It would also be important to identify to what extent and for how long the public sector's fiscal constraint will last, and so to reflect on its long-term health implications. Countries that finance public systems with taxes and that have recently experienced transitory economic crises have in fact tended to contain healthcare spending. However, some past evidence suggests that the difficult but transitory situation has led to pressure, some possibly opportunistic, for an increase in the system's inequity, with potentially permanent consequences (Evans, 2002).

Finally, Brazil has experienced a rapid and continued rise in the number of COVID-19 deaths since the first case was recorded on February 2020. By late July 2020, there were nearly 88,000 reported deaths, one of the greatest death tolls in the world. COVID-19 has impacted economies and health systems around the world, but little is known about whether and how the pandemic shock will translate into permanent changes. In light of our projections for Brazil, we discuss at least two relevant channels through which COVID-19 might affect the financing needs and health spending in the long-run. First, the pandemic has affected GDP growth, potentially reducing mid- to long-run growth trajectory by increasing government debt to GDP and leveraging fiscal constraints. As mentioned in Section 3, the lower the growth, the less the country's ability to respond to financing needs. Second, there have been investments in public hospital capacity, while society's overall perception towards the relevance of the healthcare sector has changed as the pandemic revealed resource scarcities and inequalities in access to healthcare and outcomes (Rache et al., 2020; Baqui et al., 2020). In that sense, COVID-19 might eventually lead to a change in priority setting and greater public support toward higher spending in healthcare. In particular, the trajectory of public spending might ascend relatively more, specially in the federal government, despite the effects implied by Constitutional Amendment no. 95/2016.

6 Final Comments

In this paper we projected and characterized the health financing needs in Brazil over the next four decades. To this end, we adopted a top-down approach adapted to the Brazilian context. According to base scenario results, health financing needs in Brazil should reach, in 2060, 12.5% of GDP, or the equivalent to a growth of 3.29 percentage points. This is approximately equivalent to an increase of R$ 1.13 trillion. An important part of this increase will be due to the aging of the population, regardless of income growth. Precisely for this reason, the effort required to respond to health financing needs as a share of the GDP will be higher the lower is the economy's growth during the period.

The results also indicate pressures to decrease the share of public spending in all scenarios involving fiscal restrictions for the public sector. In particular, in a scenario of a cap or freeze on federal spending in real terms, public spending as a share of total health spending would decrease by about 7 percentage points by 2060, while the share of public expenditure corresponding to state and municipal spending would increase from approximately 56% to 80%. This would represent a substantial increase in the importance of the role of states and municipalities in sustaining SUS.

Efficiency gains might become increasingly relevant to mitigate the growing pressure for more spending given fiscal constraints. This is a possible interpretation of the scenario under cost containment. Assuming a residual of -0.75 percentage points, total health expenditure is kept below 10% of GDP in 2060. In fact, efficiency gains could then be reflected in increased quality and coverage under resource constraints. However, there is no evidence that this has been the case in the country. In particular with regard to the public sector, the restraint observed reflects fiscal restrictions and the government's limited capacity to expand SUS coverage and quality. In this sense, the delay in responding to health demands may come with detrimental consequences for society, for example, by decreasing quality, increasing segmentation and inequality.

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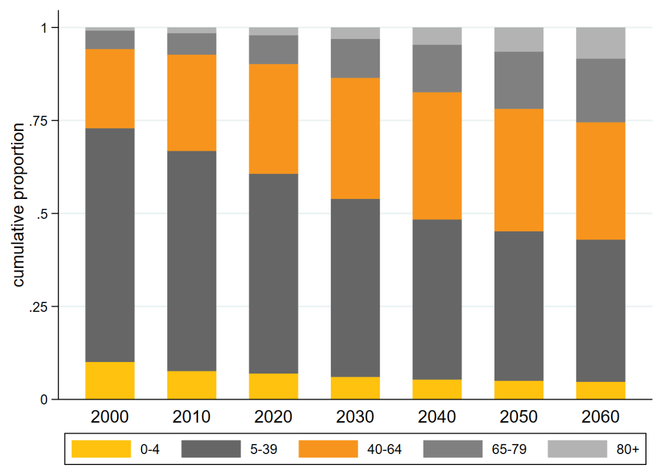
A Appendix: Estimating Cost Curves

We construct cost curves following three steps: (i) we first estimate the total demographic spending based on observable data for previous years and distribute it among cells by age, gender and survival status (i.e. for survivors and non-survivors); (ii) by dividing the spending by the size of the population in each respective cell, we calculate the cost per capita in each cell. These calculations are performed separately for the public and private sectors; (iii) finally, we use projections on age structure and mortality to sum up costs per year and project future needs. Figure A.1 shows the recent and the projected age structure of the Brazilian population.

Figure A.1: Proportion of Population by Age Group



Notes: Age structure of the Brazilian population from IBGE estimates. Brazilian population is expected to rapidly age until 2060. In 2000 about 5% of the population were between 65-79 years old, less than 1% was over 80 years old. It is estimated that in 2060, 17% of the population will be between 65-79 years old and the proportion of people over 80 will reach 8.4%.

The demographic cost used in the cost curves is based on the year 2017, the last year with information on health spending by the SNA. Although expenditures are reported separately for the public and private sectors, the Satellite Accounts do not detail private expenditures between private insurance and direct disbursement by families. For this reason, we also make use of data made available by the ANS. In addition, the SNA does not provide the necessary details to infer the share of demographic expenses. In this regard, we make use of the ANS expenditure breakdown as well as the public accounts by health function (disclosed by the Ministry of Health) for the private and public sector, respectively.

We begin with the description of the calculation of demographic expenditure by sector. We use public accounts according to the health function disclosed by the Ministério da Saúde (2018) to obtain a proxy for the public expenditure attributed to the demographic component. More specifically, we define this proxy as the sum of all public health functions except those related to health system management and governance (HC.7) and other health activities and not classified in another group (HC.9). For the period of data release (2010-2014), we find that the demographic expenditure represented 84% of total public expenditure, on average. In 2017, the value corresponded to R$ 214 billion.[16] The same report from the Ministry of Health also provides an estimate for the proportion of public expenditure covered by each entity of the federation (federal, state and municipality governments). On average, for the period between 2010 and 2014, the federal government covered 44% of spending, states covered 26% and municipalities 30%. These proportions are important for the simulation under different fiscal scenarios in Section 4.

For the private sector, we consider spending on private insurance and out of pocket spending separately. For the definition of the demographic spending on private insurance, we consider the health care costs actually covered by health insurers as reported by ANS in 2017 (R$ 151 billion). This corresponds to 83% of the total expenditures on private insurance, which is estimated based on revenues from client payments. This is similar to the proportion found for the public sector (84%). We use this same proportion to calculate the demographic share of the direct disbursement, reaching to R$ 145 billion for 2017. In 2017, demographic spending on private insurance and direct disbursements totaled R$ 295 billion altogether.[17]

To estimate the curves, by sector, these values must then be distributed by age, gender and survival status.[18] For this distribution, we use weights computed from the microdata of the Hospital Information System (SIH DataSUS). SIH contains all hospitalizations in Brazil financed by SUS. Although the SIH reports costs associated with each hospitalization record, the cost reflects only an approximate amount of the federal transfer, and not the total cost spent on patient health care (Ministério da Saúde, 2018). Therefore, we use only the way in which these costs are distributed across age and gender, for both hospitalizations that resulted in death and those that did not, to calculate the weights applied to demographic expenditure. For example, on the average of the period 2015 to 2019, 0.8% of the total expenditure reported in the SIH is associated with hospitalizations of 60-year-old men who survive the end of the hospitalization while 0.1% are associated with hospitalizations of men from same age whose outcome was death. Applying these weights, at the end of this stage, we have an estimate of the total amount of demographic expenditure for each group of survivors and non-survivors, by age and gender. The same weights are used for the public and private sectors.[19]

Finally, to arrive at the per capita cost curves by age and gender we divide the aggregate expenditure in each cell by the respective number of people in the cell, for the respective reference year of the curve.[20] We assume that the mortality rate by age and gender is

[16] More specifically, we used the average proportion of health care functions in relation to the total health expenditure reported by the Ministry of Health for the period of data disclosure (2010-2014), which was then multiplied by the public expenditure of the 2017 Satellite Account: 84% of R$ 254 billion.

[17] All figures are in 2017 prices.

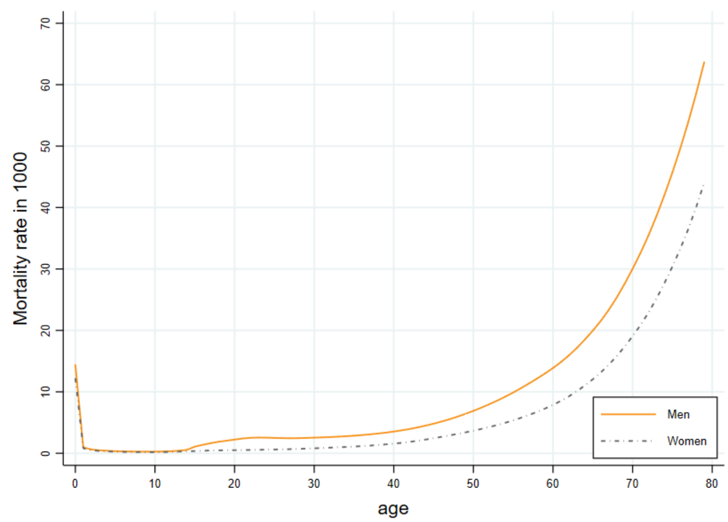
[18] Since there are no databases that directly provide the per capita cost of health by age.

[19] We consider that all expenditure on direct disbursement is spent on survivors. The reason for this will be explained later in this section.

[20] The reference year is 2017 for all sectors. For the survivors' curve, the total number of people by exact age and gender is obtained from population estimates by IBGE. As we only have information for the mortality rate up to 2018, we estimate the number of deaths for the year of 2019 onwards from the average mortality rate for the last 5 years available (2014-2018) in order to avoid specific fluctuations in a given year.

the same for the population covered by the public and private sectors.[21] As we observe in Figure A.2, the mortality rate is relatively higher in the first year of life, dropping to close to zero between 1 and 14 years. From the age of 15, the mortality rate increases continuously, being higher for men of all ages.

Figure A.2: Mortality Rate (in 1,000) by Gender and Age, Average for the Period 2014-2018



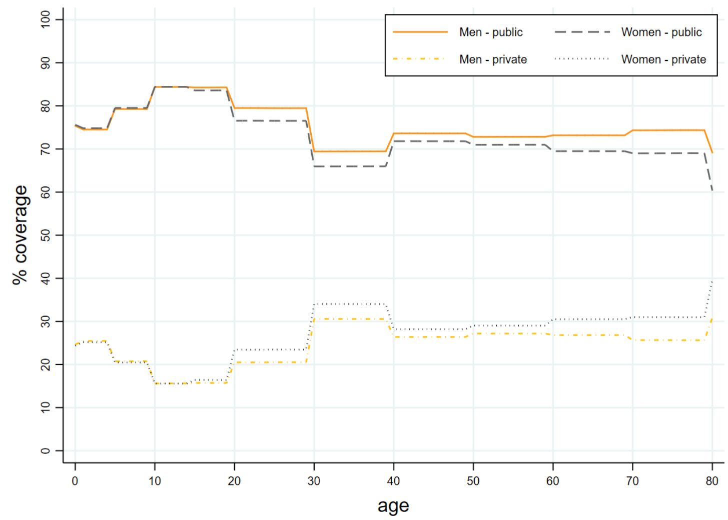
Notes: Solid (orange) line represents men average mortality rate for the period 2014-2018 per 1,000 inhabitants by age. Dashed (gray) line reports the same for women. Mortality rate is lower for women at all ages. We used mortality rate for the year of 2017 to get the number of non-survivors needed for the construction of the cost curves. The average mortality rate for the period of 2014-2018 was then used in the projection of the number of non-survivors for the period of 2018-2060.

For the distribution of people by cells between the public and private sectors, we consider the proportion of the population covered by health insurance by age and gender obtained from ANS data (available by year until 2019). In our projections, we consider that this proportion remained constant and equal to the average coverage, by age, between 2015 and 2019. In other words, we assume a constant segmentation over time.[22] The proportion of the population that was not insured by private plans gives us an approximation of the share of the population covered by the public sector. During the period considered, on average 25% of the population had private insurance. We note, however, that coverage varies significantly by age. Figure A.3 shows that children and young people between 10 and 19 years old are among those with less coverage, possibly because they have less risk and because most of the private plans are businesses, benefiting people of economically active age.

[21] Due to the different characteristics in the health profile and life expectancy of the population covered by private health plans and the SUS, the mortality rates of these groups are expected to be different. However, we consider the same rate for both groups as it is not possible to calculate specific mortality rates for each group with the existing data.

[22] In order to get an estimate of the number of people covered by health insurance by year, we multiply the projected number of people in each cell for a particular year by the average coverage rate for the 2015-2019 period. We consider, however, that the entire population incurs direct disbursement.

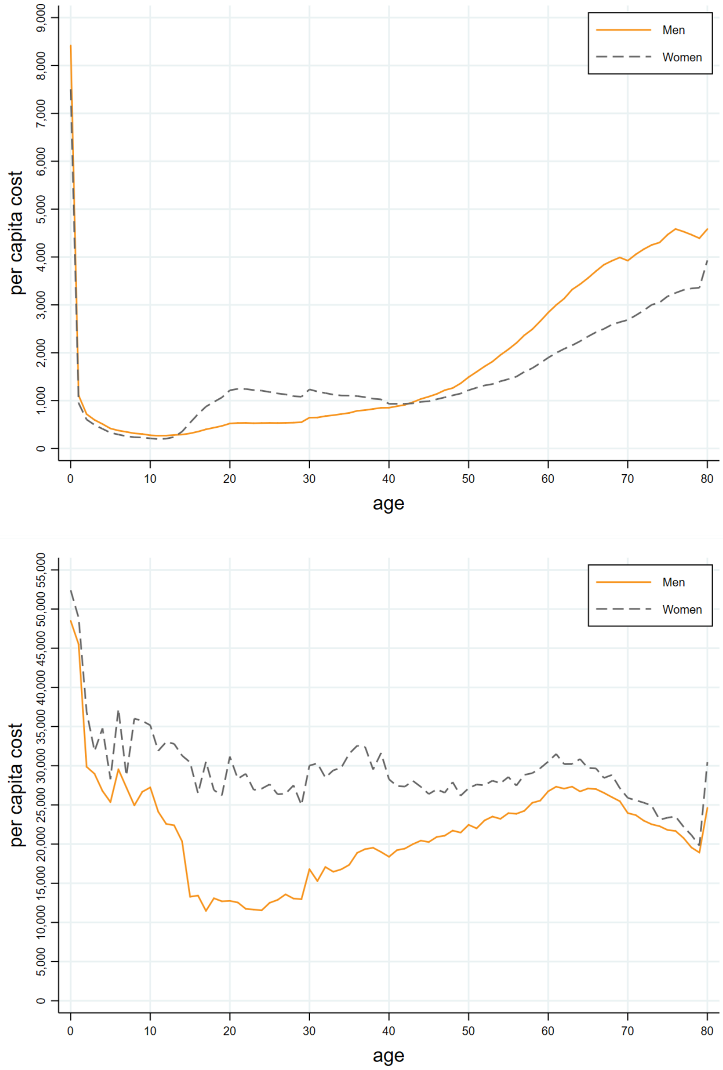
Figure A.3: Average Rate of Private Insurance Coverage by Gender-Age for the Period 2015-2019



Notes: The graph shows the average share of private insurance coverage by gender and age for the period 2015-2019. Dash-dotted line (yellow) represents the average share of men covered by private health insurance, by age. The solid line (orange) is the complement of this share, representing the percentage of men covered by the public health system. Dotted line (light gray) represents the average share of women covered by private health insurance, by age. The dashed line (gray) is the complement of this share, representing the percentage of women covered by the public health system. The average coverage for the period of 2015-2019 was used both in the construction of the cost curves as well as in the estimation of the number of people covered by private health insurances for the projected period. The difference between total population and the latter gives us an estimation of number of people covered by SUS.

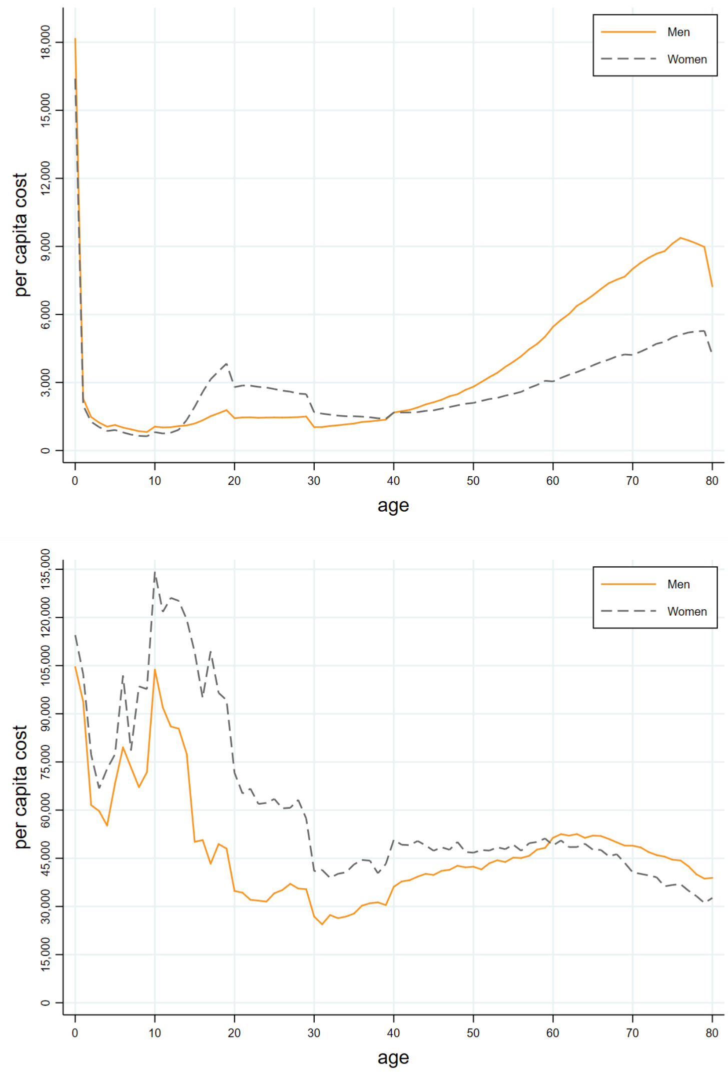
From this point on, we were able to compute the cost curves for the public sector and for private insurance sector. Figure A.4 shows the per capita cost curves by age and gender, for survivors and non-survivors, for the public sector. The same is illustrated for the private insurance sector in Figure A.5. As expected, the per capita cost of people who are close to death is greater than the per capita cost of health care for people who survive the end of a period of illness, regardless of age. As also expected, it can be observed that the cost per capita in the private insurance sector is higher than the cost per capita in the public health system, on average, by 2.17 and 2.18 times for survivors and non-survivors, respectively. In the survivor curves of both the public and private sectors, the per capita expenditure on women is higher only around 14 to 40 years old, coinciding with the female reproductive age. On the other hand, non-survivor curves show higher per capita costs for women, with exception of those aged 60 or more in the private sector.

Figure A.4: Public Sector Cost Per Capita Curves. Upper Panel: Survivors, Lower Panel: Non-survivors



Notes: Data from Ministério da Saúde (2018), IBGE and Sistema de Informações Hospitalares (SIH/Datasus). Per capita cost curves are obtained by, first, multiplying SUS's demographic expenditure by the weights from the distribution of SUS's hospitalizations by survival status, age and gender and, second, dividing it by the population in the respective cell. Upper graph represents the per capita cost curve for survivors and lower graph the cost curve for non-survivors. Solid (orange) and dashed (gray) lines are the per capita cost by age for men and women, respectively. Reference year for all curves is 2017.

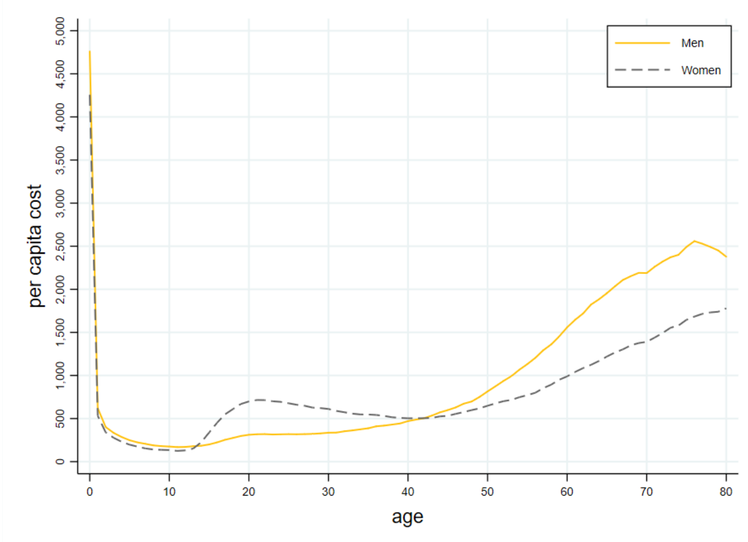
Figure A.5: Private Sector Cost Per Capita Curves, Supplementary Health. Upper Panel: Survivors, Lower Panel: Non-survivors



Notes: Data from ANS, IBGE and Sistema de Informações Hospitalares (SIH/Datasus). Per capita cost curves are obtained by, first, multiplying ANS's demographic expenditure (supplementary health) by the weights from the distribution of SUS's hospitalizations by survival status, age and gender and, second, dividing it by the population in the respective cell. Upper graph represents the per capita cost curve for survivors and lower graph the cost curve for non-survivors. Solid (orange) and dashed (gray) lines are the per capita cost by age for men and women, respectively. Reference year for all curves is 2017.

For direct disbursement expenditures, we consider that the entire population incurs this type of expenditure and that all disbursement expenditure comes from survivors. It is reasonable to consider that all individuals incur direct health expenditures, regardless of accessing private coverage or using the public network. Individuals tend to use health plans or SUS for hospitalizations, and direct disbursement for other expenses, as it is the case with medications. As death usually involves hospitalizations, and that hospitalizations tend to occur through the public or private network, we assume that the expenses with direct disbursement are not related to death. Therefore, for direct disbursement, we consider only the per capita cost curve for survivors, which is shown in Figure A.6.

Figure A.6: Per Capita Cost Curve for Direct Disbursements



Notes: Data from Ministério da Saúde (2018), ANS, IBGE and Sistema de Informações Hospitalares (SIH/Datasus). Out of pocket expenditure refers to the difference between total private expenditure reported by the Ministry of Health and spending from supplementary health reported by ANS. We considered the demographic share of out of pocket expenditure to be the same of that reported by ANS. Per capita cost curves are obtained by, first, multiplying out of pocket demographic expenditure by the weights from the distribution of SUS's hospitalizations by age and gender (solely for survivors) and, second, dividing it by the population in the respective cell. The graph represents the per capita cost curve for survivors. Solid (orange) and dashed (gray) lines are the per capita cost by age for men and women, respectively. Reference year for all curves is 2017.