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Trade-offs in Hospital Choices: Assessing the Impact of Distance and Quality on Healthcare Accessibility in Brazil

Dissertação de Mestrado

Thesis presented to the Programa de Pós–graduação em Economia, do Departamento de Economia da PUC-Rio in partial fulfillment of the requirements for the degree of Mestre em Economia.

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Co-advisor: Prof. Letícia Faria de Carvalho Nunes

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Abstract

Santos, Maria Mittelbach Leite; Dahis, Ricardo (Advisor); Nunes, Letícia Faria de Carvalho (Co-Advisor). **Trade-offs in Hospital Choices: Assessing the Impact of Distance and Quality on Healthcare Accessibility in Brazil**. Rio de Janeiro, 2023. 49p. Dissertação de Mestrado – Departamento de Economia, Pontifícia Universidade Católica do Rio de Janeiro.

This study investigates the Unified Health System (SUS) in Brazil, specifically examining individuals' hospital choices and disparities in health accessibility across different regions of the country. Through the analysis of hospital visit data from 2015 to 2019, a panel is constructed, and a demand model for hospitals is estimated. Various factors, including distance, quality, team composition, and mortality rates, are taken into account to understand the patterns of hospital visits. The findings indicate that travel time significantly influences hospital choices, with larger hospitals being less affected by distance. Moreover, the availability of healthcare professionals and lower mortality rates have a positive impact on hospital visits, underscoring their significance in patient decision-making. Additionally, this study introduces a preliminary counterfactual analysis, which explores the potential effects of establishing new small-sized hospitals in each Brazilian state. This exercise sheds light on the additional healthcare professionals required to attain comparable welfare improvements. By doing so, this study contributes to understanding the demand dynamics surrounding public hospitals in Brazil, aiming to address the regional disparities prevalent in the healthcare system.

Keywords

Healthcare accessibility; Demand Model; Hospital quality.

Resumo

Santos, Maria Mittelbach Leite; Dahis, Ricardo; Nunes, Letícia Faria de Carvalho. **Trade-offs nas Escolhas Hospitalares: Avaliando o Impacto da Distância e Qualidade na Acessibilidade aos Serviços de Saúde no Brasil**. Rio de Janeiro, 2023. 49p. Dissertação de Mestrado – Departamento de Economia, Pontifícia Universidade Católica do Rio de Janeiro.

Este estudo investiga o Sistema Único de Saúde (SUS) no Brasil, examinando especificamente as escolhas hospitalares das pessoas e as disparidades na acessibilidade à saúde em diferentes regiões do país. Através da análise dos dados de visitas hospitalares de 2015 a 2019, é construído um painel e é estimado um modelo de demanda para hospitais. Vários fatores, incluindo distância, qualidade, composição da equipe e taxas de mortalidade, são levados em consideração para entender os padrões de visitas hospitalares. Os resultados indicam que o tempo de viagem influencia significativamente as escolhas hospitalares, sendo que hospitais maiores são menos afetados pela distância. Além disso, a disponibilidade de profissionais de saúde e taxas de mortalidade mais baixas têm um impacto positivo nas visitas hospitalares, destacando sua importância nas decisões dos pacientes. Além disso, este estudo introduz uma análise contrafactual preliminar, que explora os efeitos potenciais de estabelecer novos hospitais de pequeno porte em cada estado brasileiro. Este exercício lança luz sobre os profissionais de saúde adicionais necessários para alcançar melhorias comparáveis no bem-estar. Ao fazer isso, este estudo contribui para uma compreensão da dinâmica de demanda em torno dos hospitais públicos no Brasil, com o objetivo de abordar as disparidades regionais prevalentes no sistema de saúde.

Palavras-chave

Acesso aos serviços de saúde; Modelo de demanda; Qualidade hospitalar.

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CNES —*Cadastro Nacional de Estabelecimentos de Saúde* (National Registry of Health Facilities)

COAP — *Contrato Organizativo da Ação Pública da Saúde* (Organizational Contract of Public Health Action)

CGR — *Colegiados de Gestão Regional* (Regional Management Boards)

NOAS — *Norma Operacional de Assistência à Saúde* (Operational Standard for Health Care)

NOBs — *Normas Operacionais Básicas* (Standards Basic Operating)

PDR — *Plano Diretor de Regionalização* (Regionalization Plan)

SIA — *Sistema de Informações Ambulatoriais* (Ambulatory Information System)

SIH — *Sistema de Informações Hospitalares* (System of Information on Hospitalizations)

SUS — *Sistema Único de Saúde* (Unified Health System)

1
Introduction

The Constitution of the World Health Organization affirms the universal right to health for all individuals, irrespective of any form of discrimination. However, the COVID-19 pandemic has unveiled significant global disparities in healthcare access (Lloyd-Sherlock et al., 2020; Díaz Ramírez et al., 2022; Rocha et al., 2021). While Latin America has made strides in expanding healthcare facilities, inequalities persist in terms of accessibility and quality across various regions (Dávila-Cervantes & Agudelo-Botero, 2019). Limited access forces patients to make difficult decisions regarding when and where to seek treatment. Therefore, it is crucial to understand the factors that patients consider when choosing healthcare facilities. This study focuses on non-specialized hospitals which provide comprehensive medical services across various specialties. Its objective is to develop a demand model for the Brazilian health market, aiming to enhance understanding and gain insights into the dynamics of healthcare demand. The key findings emphasize the importance of distance, number of doctors, and healthcare quality in patients' decision-making process when seeking care.

Brazil's healthcare system presents both unique challenges and opportunities due to its status as one of the largest and most populous countries in the world. This makes it an intriguing setting to investigate the determinants of hospital choices, given significant socioeconomic inequalities. The Unified Health System (*Sistema Único de Saúde*, SUS) strives to ensure that healthcare services are accessible to all citizens, regardless of their socioeconomic status. However, Brazil's regional diversity further highlights disparities in healthcare access and outcomes, with notable variations in life expectancy and mortality rates between regions, especially the Northern and Northeastern areas, when compared to the rest of the country (Rocha, 2021). Addressing these disparities necessitates targeted interventions and policy measures to enhance accessibility, resource allocation, and care quality, informed by an examination of the factors contributing to these disparities.

Brazil's vast geographical size and diverse population provide an opportunity to explore the impact of distance and geographic accessibility on healthcare choices. Smaller and isolated municipalities, particularly in regions like the

Amazon, face distinct challenges in providing healthcare services. These substantial distances and limited access to critical healthcare services exacerbate health inequalities and pose significant challenges for individuals residing in remote regions. For example, in the Amazon region, the average distance to the nearest facility with emergency services through the SUS remained at 15 km over a span of ten years, highlighting the stagnant progress in improving accessibility (Rocha, 2021). According to the National Health Survey (*Pesquisa Nacional de Saúde*, PNS), among individuals with diabetes and hypertension in this region, a relatively higher proportion cited distance or transportation difficulties as reasons for not seeking medical care. In contrast, residents of other regions more frequently mentioned disease control as a factor.

Moreover, the Family Budget Survey 2017-2018 (*Pesquisa de Orçamento Familiar*, POF) reveals that transportation is the second-largest expense for households, accounting for an average monthly expenditure of 18.1% of the total, following housing. This highlights the significant financial burden placed on families when it comes to accessing healthcare services.

The SUS is a decentralized healthcare system in Brazil that aims to provide universal and equitable healthcare services. While it has achieved some success, ongoing improvements are necessary to ensure high-quality healthcare for all Brazilians. The decentralization of Brazil's healthcare system brings about increased flexibility and local engagement, facilitating better responsiveness to regional needs.

However, this positive aspect is counterbalanced by persistent challenges arising from unequal management capacities, funding discrepancies, and varying infrastructure quality among states and municipalities, collectively leading to suboptimal outcomes (de Almeida Botega et al., 2020; Munga et al., 2009; Regmi et al., 2010). Notably, a significant proportion of municipalities, around 45% of the total, have populations of less than 10,000 residents, resulting in inefficiencies in managing numerous small-scale hospitals (de Almeida Botega et al., 2020; Collins et al., 2000). Consequently, the healthcare landscape in Brazil is dominated by these smaller facilities, with data from December 2017 revealing that 62.3% of healthcare establishments had fewer than 50 beds (Carpanez & Malik, 2021). This situation becomes notably concerning when taking into account existing literature that highlights the inefficiency challenges faced by hospitals with fewer than 200 beds (Aletras et al., 1997; Posnett, 1999, 2002).

Nonetheless, it's crucial to consider the accessibility of individuals in remote, densely populated areas. The discourse on the trade-off between efficiency and equity has been a longstanding fixture within healthcare economics literature. In this context, Gilson (1998) emphasizes the potential issues of an undue focus on efficiency, cautioning against its unintended consequences, such as erecting barriers and compromising care quality for marginalized groups, thereby exacerbating resource disparities. Echoing this sentiment, Cerovic et al. (2017) shed light on the challenges faced by publicly funded healthcare systems as they strive to harmonize streamlined service delivery with the need to ensure equitable access to care. Iyer et al. (2020) examine healthcare dynamics across African nations, unearthing the extended travel times to medical facilities in less densely populated regions, thereby underscoring the persistent trade-off where efficiency often takes precedence over achieving comprehensive healthcare access.

To investigate hospital choices in Brazil, I utilize comprehensive datasets on public hospital visits, including the System of Information on Hospitalizations (*Sistema de Informações Hospitalares*, SIH), the Ambulatory Information System (*Sistema de Informações Ambulatoriais*, SIA), and the National Registry of Health Facilities (*Cadastro Nacional de Estabelecimentos de Saúde*, CNES). These datasets enable a comprehensive understanding of the factors shaping hospital choices in the country. Additionally, I use the OpenStreetMap API to calculate travel times, considering the shortest car route available to the individual. This approach allows for a more accurate estimation of travel times compared to previous studies that rely on the linear distance between municipalities and healthcare facilities (Rocha, 2021).

I employ a demand model based on the spatial demand model for healthcare facilities developed by Hsiao (2022). The model examines the influence of distance and quality on individuals' welfare. Each sick individual residing in a specific municipality within a state during a particular year selects a non-specialized public hospital that maximizes its utility, considering factors such as distance, staffing levels, and mortality rate. To address unobserved facility variations, fixed effects are incorporated into the model. I calculate the market size used in the model based on one approximation of the number of sick individuals in each state during a particular year. Then I use the PNS to determine the proportion of sick individuals who actually seek healthcare in each State. The outside option corresponds to individuals not seeking any facility. Furthermore, I incorporate information about the complexity of each case to analyze how patients with different needs respond to the varying characteristics of the hospitals. This allows us to assess the impact of hospital features on different types of patients, taking into account their specific requirements.

The findings from these logit models highlight the significant influence of travel time on hospital visit patterns, indicating that longer distances decrease the likelihood of individuals visiting hospitals. However, larger facilities appear to be less sensitive to commuting time, suggesting potential compensatory advantages associated with their size, such as higher quality of care, a wider range of available procedures, and potentially shorter waiting times. Additionally, the availability of doctors and nurses positively influences hospital visits, highlighting the importance of staffing levels. Lower death rates are associated with higher visit numbers, indicating better patient outcomes and perceived quality of care.

When analyzing high-complexity diseases and primary care, large-sized hospitals show a positive interaction effect with commuting time, suggesting that specialized resources outweigh longer travel distances. The impact of the number of doctors and nurses varies depending on treatment complexity, with high-complexity patients being more sensitive to death rates.

Given the complexities inherent in achieving equitable healthcare access, a counterfactual analysis is undertaken in the paper's final section. This analysis aims to explore the potential welfare implications entailed by the introduction of 26 new small-sized hospitals in remote Brazilian municipalities. The primary objective is to discern how the establishment of healthcare facilities in geographically distant regions could influence welfare by improving equity access, although not necessarily efficiency. Employing both the estimated demand model and expected utility analysis, the study quantifies the additional healthcare professionals necessary to achieve comparable welfare gains as those projected from the new hospital implementations.

The outcomes of the analysis underscore the North and Northeast regions as beneficiaries of more substantial welfare enhancements, primarily due to their heightened demand for healthcare resources. Pertinent factors such as increased transportation costs and less developed medical infrastructure in these regions emphasize the importance of allocating medical resources to underserved areas. Specific states like Amapá and Amazonas emerge as strong contenders for notable improvements in expected utility through the introduction of new hospitals. However, it's crucial to acknowledge that this analysis remains theoretical, and real-world outcomes might not necessarily yield such pronounced welfare advancements.

Potential drawbacks must also be taken into account, including potential inefficiencies within the healthcare system and challenges associated with recruiting healthcare professionals for these remote areas. Thus, it becomes imperative to consider the need for further research to comprehensively understand the most effective allocation of resources while also considering the equity access of the population. This necessitates a thorough examination of expenses encompassing hospital construction and healthcare professionals' remuneration, all while addressing the varying disparities across distinct regions within Brazil. These disparities encompass a range of factors, such as differences in transportation infrastructure, population density, and income levels.

The remainder of this paper is organized as follows: Section 2 provides a comprehensive literature review on the topic. Section 3 presents the institutional background of the centralization of SUS. In Section 4, the data utilized in this study, along with descriptive statistics, are presented. Section 5 introduces the demand model employed for the analysis. The results are presented in Section 6, followed by the counterfactual analysis in Section 7. Finally, Section 8 concludes the paper, summarizing the key findings and their implications.

2
Literature Review

This paper makes significant contributions to three interconnected strands of literature: healthcare accessibility and industrial organization in healthcare settings. It contributes to the literature on healthcare accessibility by providing insights into factors influencing healthcare decision-making and assesses the benefits of opening new hospitals in remote areas, revealing differential effects on different regions of the country.

Lazar & Davenport (2018) shed light on the challenges faced by low-income families in accessing healthcare services in the United States. Multiple articles have also emphasized the significance of transportation costs and disparities in hospital quality across regions as major factors contributing to unequal healthcare access for lower-income families (Rocha, 2021; Manang & Yamauchi, 2020; Brekke et al., 2016; Guimarães et al., 2019). Brekke et al. (2016) shows that patients residing in lower-income regions in the European Union have lower rates of mobility and experience inferior healthcare quality compared to those in higher-income regions. Similarly, Manang & Yamauchi (2020) conducted a study in Uganda that revealed the positive impact of proximity to health facilities on maternal care utilization, leading to higher rates of institutional deliveries and reduced maternal morbidity and mortality. Chen et al. (2023) analyzes the relative contributions of population demand, healthcare resourcing, and transportation infrastructure to changes in spatial accessibility. Significant improvements in residents' access to healthcare were observed, with variations in the relative contributions of these factors among different villages.

In Brazil, studies conducted by Guimarães et al. (2019) and Rocha (2021) highlighted transportation as a major challenge in low-income neighborhoods, with long distances to healthcare facilities and limited access to public transportation options. Rocha (2021) also noted that decentralization in Brazil resulted in reduced distances between patients and healthcare facilities in certain municipalities.

This paper contributes to the existing literature on industrial organizations and healthcare markets, with a specific focus on the public healthcare sector. Existing research has focused on competition in the health insurance market (Ho & Lee, 2017; Post et al., 2018) and the determinants of hospital entry (Abraham et al., 2007). There is also a body of literature that utilizes discrete models to analyze patient healthcare choices. For instance, Eme Ichoku & Leibbrandt (2003) investigates the demand for Medicare in Nigeria, Kaija & Okwi (2011) explores healthcare demand determinants in rural Uganda, emphasizing the significance of individual characteristics such as age and gender. Another study conducted in China by LI et al. (2014) employs the logit model to examine the impact of distance to health facilities on healthcare utilization. More recently, Hsiao (2022) developed a discrete choice model to analyze individual decision-making and investigate the effects of democratization on the spatial allocation of public investment in healthcare infrastructure. The findings suggest that democratization leads to a reduction in misallocation overall. However, it is worth noting that these articles focus on healthcare services that involve a direct monetary cost for the patient, while this paper focuses on commuting costs in the public healthcare sector.

In conclusion, this paper contributes to advancing our understanding of healthcare accessibility and industrial organization. It uncovers insights into healthcare decision-making and the impact of establishing medical facilities in remote areas, highlighting regional disparities in Brazil. It also contributes by addressing transportation costs, healthcare quality disparities, and patient choices involving commuting expenses. Moreover, it extends industrial organization research within the public healthcare sector by focusing on non-monetary factors. Positioned within discrete choice models, this work offers a distinct perspective, enriching both scholarly and policy discussions.

3
Institutional Background

3.1
Brazilian Healthcare System

The Brazilian healthcare landscape underwent a significant transformation with the introduction of the 1988 Constitution, marking a pivotal shift towards universal and equitable healthcare access. This change set the stage for substantial reforms within the healthcare system, which uniquely combines elements from both the private and public sectors. A critical juncture emerged in 1990 with the establishment of SUS (Sistema Único de Saúde), aimed at providing comprehensive and unbiased care to all Brazilian citizens. Built on the principle of collective responsibility, SUS underscored society's commitment to the holistic well-being of each individual.

However, the Brazilian healthcare system faces distinct challenges that warrant careful investigation. The intricate interaction between the public and private sectors has given rise to a dual-subsystem model, influencing citizens' access to medical services. While the publicly funded and universally accessible SUS remains central, the private healthcare system offers alternatives like private health insurance and direct engagement with private service providers. Notably, the impact of the public health system is especially evident in the domain of hospitalization. In 2006, hospital beds affiliated with the Unified Health System (SUS) constituted a substantial 76.1% of the nation's total, gradually declining to 69.3% by 2017 (Castro et al., 2019).

Public hospitals assume a pivotal role in government healthcare expenditure, accounting for nearly 70% of the healthcare budget (La Forgia & Couttolenc, 2008). Government oversight extends over a significant portion of healthcare facilities, including 86% of outpatient care providers, 57% of inpatient services, and 61% of diagnostic and therapeutic support services as of January 2017. These statistics underscore the critical importance of public hospitals in the healthcare system, particularly given that only 20% of the total population is covered by private health plans (Andrade et al., 2018).

Between 2010 and 2019, Brazil witnessed a decrease in total hospital beds, dropping from 2.23 to 1.95 per 1,000 inhabitants, falling short of the unofficial global WHO average recommendation of 3.2. The number of hospitals decreased from 6,907 to 6,702 during this period. Notably, private hospitals saw a significant 11.6% reduction, while public hospitals increased by 17.1%. The count of private hospital beds decreased by 11.8%, in contrast to the 6.6% rise in public hospital beds (, 2019).

In conclusion, the Brazilian healthcare landscape has experienced a significant shift towards universal and equitable healthcare access through the establishment of SUS. The interplay between public and private sectors presents unique challenges, with public hospitals emerging as a cornerstone of the healthcare system despite their size limitations. Analyzing the trajectory of public hospitals within this framework is crucial for understanding the broader dynamics of healthcare provision in Brazil and underscores the significance of studying these institutions.

3.2 Decentralization versus Regionalization

The Brazilian Unified Health System (SUS) was established with a notable emphasis on decentralization, as underscored by the SUS Organic Law, Law n. 8.080/1990. This legislative framework not only introduced operational norms and federal funding mechanisms but also granted local governments the authority to tailor healthcare services in accordance with the unique needs of their communities (Gonçalves, 2018; Mendes & Gomes, 2018; de Almeida Botega et al., 2020; Rocha & Nunes, 2022).

In a complementary manner, the federal government introduced Standards Basic Operating (NOBs) between 1991 and 1996 to effectively regulate the decentralization process. The guidance provided by these NOBs enhanced local decision-making, leading to a substantial increase in resource allocation, improved health management practices, and the expansion of healthcare services. The synergy of these measures, combined with deliberate regionalization strategies, played a pivotal role in advancing healthcare management across Brazil (Souza, 2001; Rocha & Nunes, 2022).

However, municipalization encountered obstacles such as limited financial resources, inadequate infrastructure, and a shortage of healthcare professionals, which hindered the provision of comprehensive and equitable care. Consequently, there emerged disparities in federal funding allocation, with only 523 out of 5,570 municipalities effectively managing their health systems by December 2000, thereby restricting access to care and exacerbating existing inequalities (Viana et al., 2002).

To address these challenges and enhance coordination, the federal government instituted strategic interventions. The Operational Standard for Health Care (NOAS) of 2001 played a pivotal role by clearly delineating responsibilities: federal and state governments assumed oversight of complex care, while municipalities were tasked with primary care services (Teixeira, 2002; de Almeida Botega et al., 2020). In contrast, the National Policy for Small Hospitals (HPP), introduced in 2004, focused on bolstering healthcare facilities with 5 to 30 beds in low-density areas. This policy infusion amplified funding provisions, revamped administrative strategies, facilitated service expansion, and forged connections with primary care services.

As emphasized by Viana et al. (2010), while the decentralization of SUS brought forth a multitude of advantages, such as the broadening of healthcare services across the entire nation, it revealed limitations in effectively addressing pre-existing inequalities and fostering collaborative health entities within the system. In the pursuit of fortified healthcare regionalization, the Pact for Health emerged in 2006. This initiative established Regional Management Boards aimed at facilitating collaboration and equitable resource distribution. Subsequent developments like the 2008 Regionalization Plan aimed to optimize resource utilization among municipalities, while the 2011 Decree No. 7.508 mandated the provision of essential services within health regions. This decree also introduced the Organizational Contract of Public Health Action to foster enhanced cooperation and accountability. Collectively, these initiatives delineated a harmonized approach toward healthcare regionalization (Lima et al., 2012; Paschoalotto et al., 2022; de Almeida Botega et al., 2020; Rocha & Nunes, 2022; Pires et al., 2021).

By 2017, 437 health regions were established nationwide, improving regional healthcare coordination. These regions ensured comprehensive care access, integrating primary, secondary, and tertiary services. In 2018, Resolution No. 37 introduced health macro-regions, fostering collaboration among neighboring regions. These macro-regions aimed to optimize resources, integrate services, and enhance healthcare outcomes (Rocha & Nunes, 2022).

Despite advancements in regionalization, healthcare accessibility in Brazil remains disparate, especially within smaller municipalities where diminutive, under-equipped hospitals persist. Since the early 2000s, the Brazilian hospital landscape has encompassed around 6,500 to 7,000 facilities, primarily composed of small units with under 50 beds. Strikingly, studies from 2004 found that these small hospitals, constituting 62% of all, accounted for a mere 18% of total beds, operating with low occupancy rates (approximately 32%), catering to less complex cases, and lacking advanced technology, predominantly situated in rural areas. Subsequent research has consistently echoed these characteristics across regions, highlighting their focus on primary care (Corrêa, 2019).

Moreover, the fundamental concept of regionalization aims at creating a more efficient healthcare system by concentrating major hospitals in specific municipalities to serve as reference points. However, this approach often fails to ensure equal access for all citizens. In Amazonas, for instance, despite concentrating services in urban centers, challenges persist due to the scattered population and limited services in smaller towns and vast areas with bad transportation systems (El Kadri, 2019). This poses a dilemma for policymakers who must balance service concentration for efficiency with the inclusion of the wider population. Prioritizing equitable geographic access might mean sacrificing some efficiency. This balance between efficiency and equity highlights the complexity of healthcare regionalization decisions (Iyer et al., 2020).

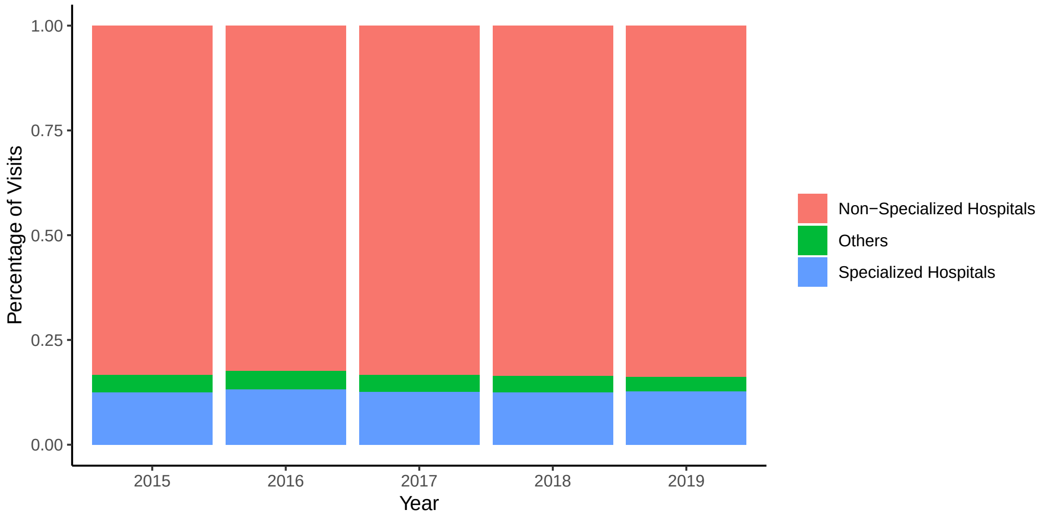
4
Data

I utilize two primary datasets, the SIH and SIA, both developed by the Ministry of Health, to calculate the number of visits to healthcare facilities. The SIH captures administrative information at the hospital admission level, while the SIA provides microdata on ambulatory care. To overcome the procedure-level nature of the SIA dataset, I employ observed characteristics like age, sex, procedure day, and race to identify data at the patient-visit level. This approach becomes necessary as a single patient might undergo multiple procedures during a single visit to a healthcare facility. By combining these two datasets, I obtain a comprehensive overview of all healthcare facility visits spanning from 2015 to 2019. The data includes details such as the patient's residence municipality, the facility's location municipality, and the complexity level of each case. This results in a final dataset structured around the year of establishment and municipality. In simple terms, each entry in my dataset represents the count of visits to a specific establishment in a given year by individuals residing in a particular municipality.

This article aims to explore the demand for non-specialized public hospitals in Brazil, which holds significance due to the limited availability of specialized medical facilities that often serve as key reference points in specific regions. According to the TabNet DataSUS statistics from December 2019, among a total of 6,051 hospitals, a considerable 84% (5,088 hospitals) were classified as general hospitals, while the remaining 16% (953 hospitals) were categorized as specialized establishments [source: `http://tabnet.datasus.gov.br/cgi/deftohtm.exe?cnes/cnv/estabbr.def`].

Analyzing the data on the number of visits presented in figure 4.1, we observe a consistent trend across the years in the sample. The proportion of visits to non-specialized hospitals falls within the range of 82% to 84% of all hospitalizations nationwide. This information offers valuable insights into the significant role these types of hospitals play in the broader context of the public healthcare system.

Figure 4.1: Percentage of Hospital Visits by Type of Establishment (2015-2019)



Notes: The information presented in this figure has been developed by the author using data from CNES and SIH from 2015 to 2019.

Table 4.1 provides a comparative overview of healthcare resource distribution across different regions in Brazil, highlighting three key indicators: the number of hospital beds from SUS, nurses, and doctors per 1000 inhabitants. The data reveals variations in resource allocation among regions. Specifically, the North region demonstrates relatively lower numbers of nurses and doctors per 1000 inhabitants compared to other regions. While the Northeast region shows slightly higher figures, the Midwest, South, and Southeast regions demonstrate a progressively higher concentration of healthcare resources. An interesting observation is the relatively higher density of doctors in the Southeast region (2.96), suggesting a potentially higher level of medical expertise available to the population. The nationwide average figures for Brazil are also provided for reference (1.47 beds, 1.31 nurses, and 2.29 doctors). This table underscores the discrepancies in healthcare infrastructure across Brazilian regions, which can have implications for healthcare accessibility and the quality of medical services.

To determine the shortest paths and travel time between the patient's municipality of residence and their chosen health facility, we rely on the OpenStreetMap API. This tool enables us to calculate real-time distances and travel times for the routes. It is important to note that these time and distance calculations remain the same across all years for a given pair of municipalities. Our analysis assumes that the paths between these locations have predominantly remained unchanged from 2015 to 2019.

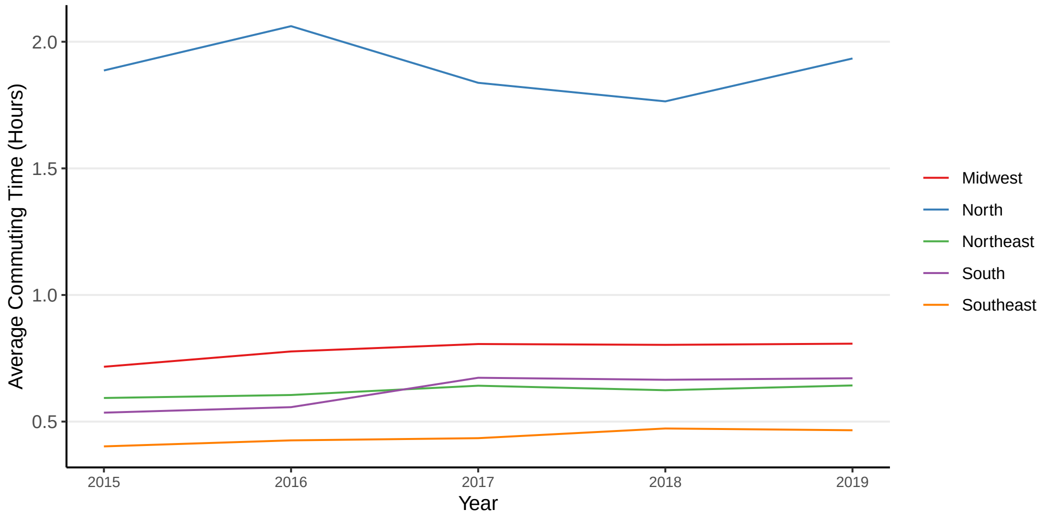
Table 4.1: Healthcare Resources Distribution by Region in Brazil (2019)

Region	Beds per 1000 habitants	Nurses per 1000 habitants	Doctors per 1000 habitants
North	1.44	1.02	1.17
Northeast	1.67	1.21	1.52
Midwest	1.50	1.32	2.25
South	1.68	1.34	2.53
Southeast	1.26	1.41	2.96
Brazil	1.47	1.31	2.29

Notes: This table presents statistics on health resources by region in Brazin in 2019. The data used in this table has been sourced from IEPS.

In Figure 4.2, we depict the average commuting time in hours for patients traveling from their municipalities to the public general hospitals of their choice over the years and across different regions. We can observe a significantly higher average commuting time in the North region compared to other regions. This disparity can be attributed to the inadequate transportation infrastructure and the relatively lower socioeconomic status of the population in the region (Rocha, 2021).

Figure 4.2: Average Commuting Time: Patient's Municipality to Hospitals' Municipality (2015-2019)

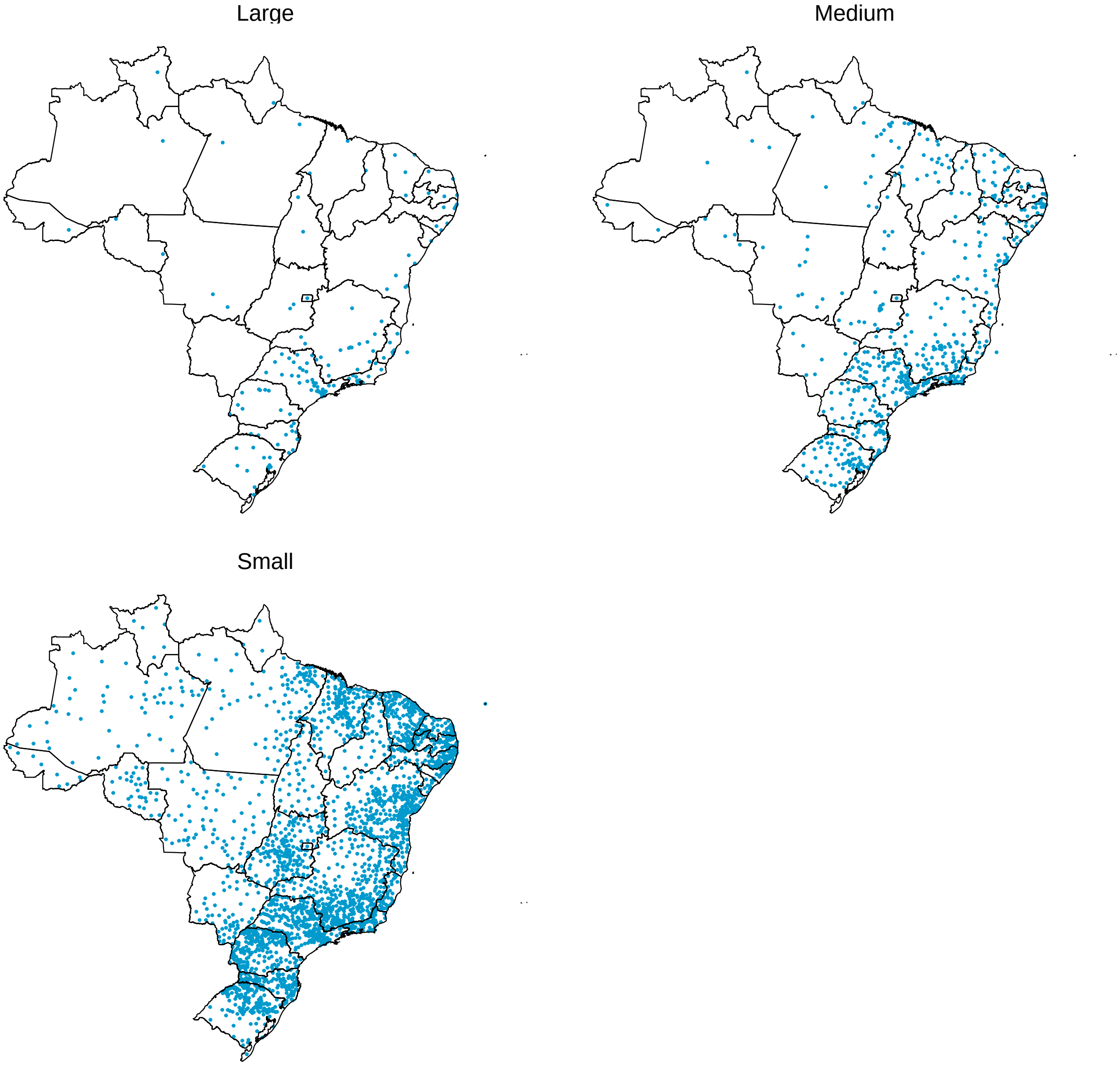


Notes: The information presented in this table has been developed by the authors using data from CNES, SIA, and SIH, along with the OpenStreetMap API from 2015 to 2019.

We utilize two primary data sources to analyze health facilities in this study. The first is the CNES, which is a publicly accessible document combined with the Ministry of Health's official information system. This extensive database provides essential information about healthcare establishments nationwide. By leveraging this dataset, we categorize hospitals into three groups based on their size: small, medium, and large. Specifically, we define small hospitals as having fewer than 50 beds, medium-sized hospitals as having 50 to 150 beds, and large hospitals as having 150 beds or more (Noronha et al., 2020).

Figure 4.3 presents the geographical distribution of different hospital types in Brazil in 2019. Notably, small-sized hospitals are more prevalent across the country. Additionally, all types of hospitals exhibit a higher concentration in the South and Southeast regions. Particularly striking is the scarcity of large and medium-sized hospitals in the North region. Out of a total of 5,570 municipalities in Brazil, 2,415 (43%) have at least one small-sized hospital, 552 (9.91%) have at least one medium-sized hospital, and only 150 municipalities (2.69%) have a large non-specialized public hospital. Furthermore, it is noteworthy that 48.6% of the municipalities in Brazil lack a non-specialized public hospital.

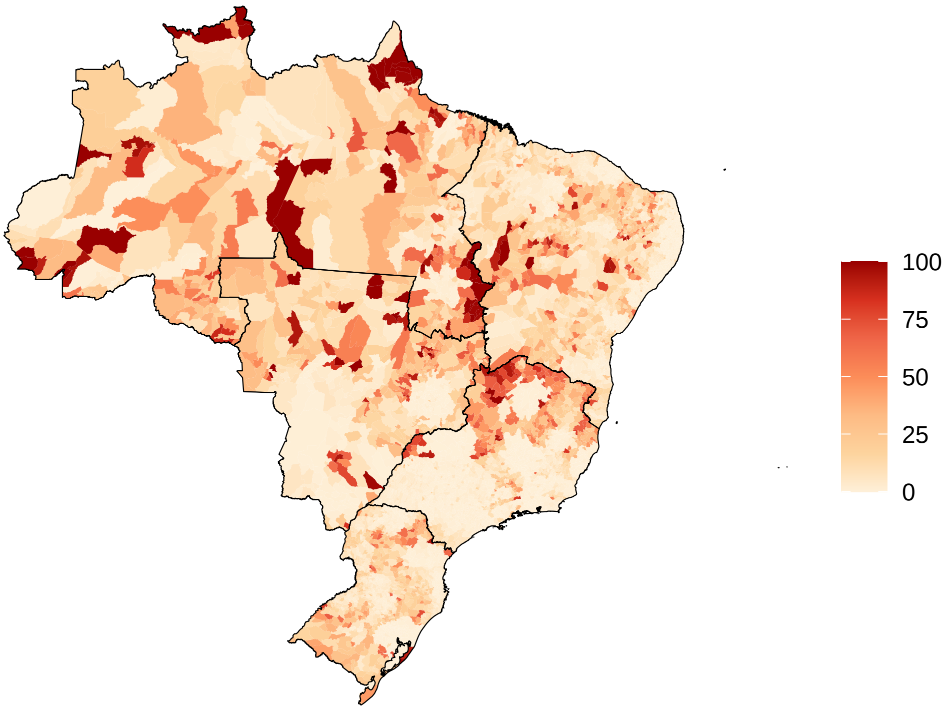
Figure 4.3: Presence of public non-specialized hospitals (2019)



Notes: The data is from CNES 2019. The lines in the table represent the borders of the states, and the shapefile used is from IPEA.

Figure 4.4 illustrates the percentage of patients who commute for more than two hours to reach their preferred healthcare facility. A clear pattern emerges, indicating that this phenomenon is considerably more prevalent in the North Region, while the South and Southeast Regions exhibit significantly lower percentages of patients facing long commutes.

Figure 4.4: Share of individuals that commute for more than two hours by residence location (2019)



Notes: The information presented in this table has been developed by the authors using data from CNES, SIA, and SIH, along with the OpenStreetMap API. The lines within the table depict the borders of the Brazilian regions, while the shapefile employed originates from Applied Economic Research Institute (*Instituto de Pesquisa Econômica Aplicada*, IPEA).

Furthermore, this dataset also provides valuable insights into the number of healthcare professionals associated with each facility. This metric serves as a proxy for assessing the quality of healthcare services provided. Additionally, we incorporate data from the PNS conducted in 2019 to determine the market size. Specifically, we utilize this survey to calculate the proportion of individuals who reported being sick during the reference period and sought medical care at the State level. By combining this proportion with the number of visits, we estimate the size of the market, taking into account individuals who did not seek any health assistance despite being ill.

Table 4.2: Descriptive statistics from sample of hospitals

	Midwest	North	Northeast	South	Southeast	Overall
	(N=2117)	(N=1722)	(N=5902)	(N=3879)	(N=5971)	(N=19591)
Death Rate						
Mean (SD)	1.05 (4.09)	0.777 (3.73)	1.13 (3.77)	1.17 (1.16)	2.03 (2.21)	1.37 (3.04)
Median [Min, Max]	0.321 [0, 66.9]	0.166 [0, 100]	0.370 [0, 100]	0.910 [0, 14.3]	1.39 [0, 25.0]	0.699 [0, 100]
Hospital beds						
Mean (SD)	34.2 (42.2)	45.5 (60.9)	43.1 (56.0)	58.0 (82.3)	74.5 (95.2)	54.9 (76.0)
Median [Min, Max]	20.0 [2.00, 370]	23.0 [1.00, 436]	25.0 [0, 555]	32.0 [0, 1020]	39.0 [0, 1170]	29.0 [0, 1170]
Number of doctors						
Mean (SD)	1.81 (16.2)	3.09 (17.0)	1.44 (12.0)	5.51 (35.1)	13.9 (86.9)	6.22 (51.6)
Median [Min, Max]	0 [0, 328]	0 [0, 231]	0 [0, 297]	0 [0, 606]	0 [0, 1800]	0 [0, 1800]
Number of nurses						
Mean (SD)	10.7 (25.0)	17.9 (37.9)	16.3 (32.9)	21.6 (55.5)	38.3 (81.6)	23.6 (57.1)
Median [Min, Max]	4.08 [0, 286]	5.83 [0, 372]	6.25 [0, 389]	5.00 [0, 719]	10.7 [0, 1480]	6.33 [0, 1480]

Notes: This table presents statistics regarding non-specialized public hospitals at the establishment-year level. The data used in this table has been sourced from CNES, covering the period from 2015 to 2019.

Table 4.2 presents descriptive statistics from my sample of hospitals, revealing significant variations in death rates, hospital bed counts, and the number of doctors and nurses across different regions of Brazil. The Southeast region stands out with the highest average death rate of 2.03, while the North region exhibits the lowest average death rate of 0.77. However, it is important to note that these death rates only reflect deaths occurring within non-specialized hospitals, introducing a potential bias in the data. This means that if patients requiring more complex care utilize hospitals outside their region, it may inflate the death rate of the receiving hospital. Moreover, regional differences in population composition, including age distribution and prevalent health conditions, can contribute to the observed disparities. Additionally, variations in reporting and data collection practices can impact the comparability of death rates.

Moving beyond mortality, disparities in hospital bed counts highlight differences in healthcare infrastructure and resources. The Southeast region boasts the highest average bed count of 74.5, indicating a relatively greater capacity for hospital care, while the Midwest region has the lowest average bed count of 34.2. These discrepancies can affect access to medical services and patient outcomes. Similarly, the number of doctors and nurses varies across regions, with the Southeast region having the highest average numbers (13.9 doctors and 38.3 nurses) and the Midwest region having the lowest average numbers (1.81 doctors and 10.7 nurses).

In conclusion, the descriptive statistics presented in this section offer valuable insights into regional disparities in death rates, hospital bed counts, and the number of doctors and nurses in Brazil. These findings shed light on potential discrepancies in healthcare resources and access to medical expertise across different regions. Understanding these variations is crucial for policymakers and healthcare professionals to address gaps in healthcare delivery and improve patient outcomes.

5
Structural Analysis

In this section, we present the model utilized in this study, building upon the spatial demand model for healthcare facilities developed by Hsiao (2022). Certain adaptations have been made to the model in order to investigate the influence of distance and quality on individuals' welfare.

For each sick individual i in municipality m, their choice set consists of general hospitals within the state where they reside, denoted as s, during a particular year y. The utility (U_{ifmsy}) derived from choosing hospital f is expressed as follows:

$$U_{ifmsy} = \alpha_1 \mathbf{time}_{mf} + \alpha_2 \mathbf{size}_f \times \mathbf{time}_{mf} + x_{fmsy}\beta + \delta_f + \xi_{fmsy} + \epsilon_{ifmsy}$$

Here, $\mathbf{time}_{mf}$ represents the travel time from the individual's municipality m to the selected hospital f. We also consider the interaction between hospital size (based on the number of beds) and travel time. x_{fmsy} represents various healthcare establishment characteristics, such as the average number of doctors and nurses employed each year and the associated mortality rate. The error term ϵ_{ifmsy} is i.i.d. and follows a type-I extreme-value distribution.

The variable ξ_{fmsy} represents a measure of hospital quality that is not observed by us but is known by the individuals and hospitals. To address some of the issues related to these unobserved characteristics that impact patient choices, we introduce fixed effects specific to each hospital facility (δ_f) within the existing model framework (Nevo, 2000). These fixed effects account for facility-specific factors that are invariant over time and play a role in determining individual preferences. By incorporating these fixed effects, we can control for these influential factors and ensure that the estimated effects of other variables remain unbiased and unaffected by facility-specific characteristics.

Unlike standard consumer choice models where unobservable quality ξ_{fmsy} is typically correlated with prices, we consider prices to be irrelevant in the context of public health. Therefore, we do not encounter the issue of needing instruments for estimation.

The market size is determined by the approximate number of people in each state who are sick each year. This is calculated by dividing the total number of visits by the proportion of individuals who were sick according to the PNS in 2019 and actively sought a healthcare establishment. It is important to note that the outside option in this model corresponds to individuals not seeking any healthcare facility despite being sick, and its utility has been normalized to zero.

To estimate the model, we perform the logit inversion, which implies the following equation:

$$\ln(s_{fmsy}) - \ln(s_{0msy}) = \alpha_1 \mathbf{time}_{mf} + \alpha_2 \mathbf{size}_f \times \mathbf{time}_{mf} + x_{fmsy}\beta + \delta_f + \xi_{fmsy}$$

In this equation, s_{fmsy} represents the market share coming from municipality m of a health establishment f in a given state s and year y. Additionally, we also estimate separate models for different types of complexities to account for how different medical needs respond to the characteristics of the hospitals.

6
Results

This section presents the initial findings from the logit models, which shed light on the factors influencing hospital visitation patterns across different sizes of hospitals.

Table 6.1 provides an overview of the results obtained from the logit model. The results indicate that commuting time has a significant negative effect on hospital visits, suggesting that individuals are less likely to visit small-sized hospitals as the commuting time increases. This finding is expected since longer commuting times reduce the convenience and utility of visiting a hospital. However, the impact of commuting time varies depending on the hospital's size. Medium-sized hospitals do not exhibit a significant interaction effect with commuting time, while large-sized hospitals demonstrate a substantial positive interaction effect. This suggests that the demand for large hospitals is relatively more insensitive to an increase in commuting time compared to small hospitals. The perception that larger hospitals offer a wider range of specialized services and resources may make them more attractive to patients willing to endure longer commutes, indicating a trade-off between travel time and perceived quality of care.

The availability of doctors and nurses, normalized by the number of beds, consistently shows a positive effect on hospital visits, respectively, 0.0510 and 0.0159. This finding aligns with the expectation that greater availability of healthcare professionals enhances the perception of quality and attracts more patients to seek care at the hospital.

Moreover, the death rate variable, serving as a proxy for hospital quality and patient outcomes, exhibits a negative coefficient that is statistically significant. This implies that higher death rates are associated with a lower number of visits to hospitals. Patients tend to prioritize hospitals with lower mortality rates, indicating better patient outcomes and perceived quality of care.

To delve deeper into the demand for hospitals based on the complexity of health issues, we conducted an analysis of the relationship between hospital visits and the categorized complexity levels of High, Medium, and Primary Care. The findings are presented in Table 6.2, which showcases the results

Table 6.1: Demand Model (Logit) - Hospitals

Dependent Variable:	$\ln(s_{fmsy}) - \ln(s_{0msy})$		
Model:	(1)	(2)	(3)
Variables			
Median commuting time	-0.0287***	-0.0230***	-0.0230***
	(0.0018)	(0.0017)	(0.0017)
Median commuting time × Medium	0.0059***	-0.0002	-0.0002
	(0.0012)	(0.0011)	(0.0011)
Median commuting time × Large	0.0126***	0.0035***	0.0034***
	(0.0008)	(0.0010)	(0.0010)
Number of doctors			0.0510***
			(0.0091)
Number of nurses			0.0159***
			(0.0033)
Death rate			-0.0020*
			(0.0011)
Fixed-effects			
Establishment		Yes	Yes
Fit statistics			
Observations	1,539,357	1,539,357	1,535,900
R^2	0.43550	0.48558	0.48554
Within R^2	0.06003	0.05804	0.05808

Clustered (Municipality) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

for each complexity level. The results consistently demonstrate a negative correlation between mean commuting time and hospital visits across all complexity levels. This implies that as the duration of commuting increases, individuals are less inclined to visit hospitals, irrespective of the complexity of their health issues.

The relationship between commuting time and hospital size reveals interesting patterns in patients' decision-making. The insignificant interaction effect observed for medium-sized hospitals suggests that patients visiting these facilities are equally affected by longer commuting times as those going to small hospitals, possibly indicating the importance of convenience and proximity. Medium-sized hospitals in Brazil are considered inefficient according to the literature (Giancotti et al., 2017), which may explain why they offer comparable services and quality to small hospitals, reducing the trade-off patients face when considering longer travel times. On the other hand, the significant and positive interaction effect found in large-sized hospitals for high-complexity diseases and primary care suggests that patients are less affected by longer commuting times when accessing care in these larger facilities. This could be due to factors like specialized departments, advanced medical equipment, and a larger pool of healthcare professionals, which outweigh the inconvenience of longer travel distances.

Table 6.2: Demand Model (Logit) - Heterogeneity by Complexity

Dependent Variable:	$\ln(s_{fmsy}) - \ln(s_{0msy})$		
complexity	High	Medium	Primary Care
Model:	(1)	(2)	(3)
Variables			
Median commuting time	-0.0223***	-0.0196***	-0.0231***
	(0.0015)	(0.0033)	(0.0019)
Median commuting time × Medium	0.0004	0.0008	-0.0021
	(0.0012)	(0.0048)	(0.0015)
Median commuting time × Large	0.0022*	-0.0011	0.0035***
	(0.0013)	(0.0044)	(0.0012)
Number of doctors	-0.0061	0.0698***	0.1401***
	(0.0117)	(0.0208)	(0.0138)
Number of nurses	0.0108	0.0361**	0.0170***
	(0.0068)	(0.0143)	(0.0037)
Death rate	-0.0403***	0.0060	9.87×10^{-5}
	(0.0032)	(0.0042)	(0.0011)
Fixed-effects			
Establishment	Yes	Yes	Yes
Fit statistics			
Observations	488,908	179,480	867,512
R^2	0.54317	0.48845	0.49101
Within R^2	0.07165	0.03489	0.05706

Clustered (Municipality) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

The impact of the number of doctors and nurses on visitation patterns varies depending on the complexity of treatment. For patients requiring high-complexity treatments, the number of doctors does not exert a significant influence on hospital visitation. Although the coefficient is negative, it lacks statistical significance, indicating that an increase in the number of doctors does not significantly affect the likelihood of patients seeking care for high-complexity treatments. However, for medium-complexity and primary care, the coefficients are positive and significant. This implies that a higher number of doctors is associated with an increased likelihood of patients seeking care for medium-complexity and primary care needs. Likewise, the number of nurses shows a positive and statistically significant coefficient in both the medium complexity and primary care models, indicating that an increased number of nurses is associated with a higher likelihood of patients seeking care for these treatment types.

However, when considering other quality measures, such as death rates, it becomes apparent that high-complexity patients are more sensitive to potential adverse outcomes. They may perceive hospitals with higher death rates as having lower quality and safety standards, leading them to avoid these facilities. On the other hand, medium complexity and primary care patients may not consider death rates as significant factors in their decision-making process, possibly due to the lower complexity of their treatments and the overall lower risk involved. Instead, patients seeking medium complexity or primary care treatments may place more importance on the availability and accessibility of healthcare providers, thus being influenced by the number of doctors and nurses.

In conclusion, the findings suggest that commuting time, availability of healthcare professionals, and hospital quality indicators play important roles in shaping hospital visitation patterns. The results highlight the trade-off between travel time and perceived quality of care, with larger hospitals being more attractive to patients willing to endure longer commutes. Additionally, the presence of a greater number of doctors and nurses positively influences visitation patterns, while lower death rates indicate better patient outcomes and perceived quality of care. Understanding these factors can aid healthcare policymakers and administrators in improving accessibility, resource allocation, and quality of care in hospitals of different sizes and complexities.

7
Counterfactual

In this section, I conduct a counterfactual exercise utilizing the estimated demand model to explore the potential welfare implications of introducing twenty-six new small-sized hospitals in remote municipalities. These hospitals are strategically located within each Brazilian state, except for the Distrito Federal, which consists of a single municipality. Specifically, they are situated in municipalities where the minimum commuting time to reach the healthcare facility is the longest. This approach aims to prioritize accessibility and ensure that healthcare services are available to individuals residing in areas facing significant transportation challenges. By carefully examining this scenario, we can derive valuable insights into how the establishment of healthcare facilities in geographically distant regions can impact overall welfare.

In Figure 7.1, we present the geographical distribution of these new hospitals. This map displays the locations across the Brazilian territory where the hospitals will be situated. Notably, these new healthcare facilities are designed to align with the average number of doctors, nurses, and mortality rates of the existing small hospitals within the same region.

Figure 7.1: Counterfactual Small-Sized Hospitals: Locations in Municipalities with Longest Minimal Commuting Time

Notes: This map illustrates the locations of small-sized hospitals in a counterfactual scenario. The selection process for these hospitals involved identifying municipalities with the longest minimal commuting time within each state.

To gain a deeper understanding of the effects of introducing small-sized hospitals in each state, we employ an expected utility analysis to assess the anticipated increase in welfare. Using the following equation for a given municipality m, state s, and year y, we compare the gains of introducing an additional hospital and changing the characteristics (V'_{fmsy}) of existing ones:

$$\ln \sum_{f=1}^{N+1} \exp V_{fmsy} = \ln \sum_{f=1}^{N} \exp V'_{fmsy} \tag{7-1}$$

where

$$V_{fmsy} = \alpha_1 \mathbf{time}_{mf} + \alpha_2 \mathbf{size}_f \times \mathbf{time}_{mf} + x_{fmsy}\beta + \delta_f + \xi_{fmsy}$$

This approach allows us to precisely calculate the supplementary healthcare workforce required to achieve equivalent welfare gains as those expected from the introduction of new hospitals. By considering the number of doctors and nurses as key variables, we gain valuable insights into the divergences in resource allocation across different regions in Brazil. This approach facilitates a concise and informative comparison of resource disparities among various Brazilian regions, utilizing the established variables of doctor and nurse availability.

Table 7.1 presents the necessary adjustments in the number of doctors and nurses to achieve comparable improvements in expected utility by region. The North region requires the most substantial percentage increase in healthcare professionals, with a 4.5% rise in doctors and a 2.58% increase in nurses. The Northeast region follows closely, with a smaller rise of 2.7% for doctors and an increase of 0.8% for nurses. In absolute figures, the North also needs a higher addition of doctors, approximately 48 more, along with nearly 159 new nurses.

On the other hand, the South and Southeast regions demonstrate a relatively modest increase in healthcare professionals. The South region necessitates an increase of roughly 11 doctors and almost 36 nurses, corresponding to a growth of 0.25% in doctors and 0.22% in nurses, to achieve the same expected utility. Similarly, the Southeast region would require an increase of more than 30 doctors and 101 nurses, representing a mere 0.18% increase in doctors and a 0.22% increase in nurses.

The necessity for increased numbers of doctors and nurses in certain regions, particularly the North and Northeast, compared to the South and Southeast, signifies the substantial disparities in accessibility and healthcare provision. These regions grapple with greater distances, limited accessibility, and a scarcity of medical professionals, accentuating the urgency for improved healthcare resources. This variance underscores the amplified importance of reinforcing healthcare support in the North and Northeast due to their potential for greater welfare gains, linked to factors such as elevated transportation costs and less developed medical infrastructure. The challenging geography and underdeveloped transportation systems in these regions hinder medical access, emphasizing the need to strategically allocate resources to remote areas to ensure comprehensive patient care.

Figure 7.2 provides the number of doctors needed in each state. Upon examining the North region, it becomes evident that the opening of new hospitals will have the most significant impact on Amapá and Roraima, considering the increase necessary in number of doctors and nurses. By expressing these outcomes in terms of percentages, a comparative analysis of the relative influences of opening hospitals across states becomes more straightforward, even though the actual impact of such openings might differ.

On the other hand, São Paulo and Minas Gerais exhibit the smallest increase in the percentage of doctors. The former is expected to experience a mere 0.04% rise, while the latter will see a marginal increase of 0.09%. In absolute numbers, this translates to the employment of approximately five doctors in São Paulo and less than two doctors for the entire state of Minas

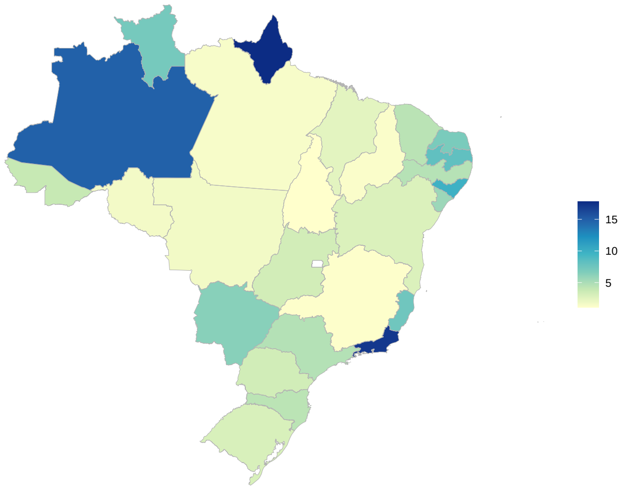
Gerais.

Table 7.1: Counterfactual Estimated Increase in Doctors and Nurses by Region (%)

Region	Increase Number of Doctors	Increase Number of Nurses	Increase Number of Doctors (%)	Increase Number of Nurses (%)
North	47.90	159.13	4.50	2.58
Northeast	46.29	153.79	2.73	0.80
Midwest	11.48	38.13	1.54	0.92
South	10.82	35.96	0.25	0.22
Southeast	30.40	101.00	0.18	0.22

Note: These calculations are based on the yearly mean number of doctors and nurses per bed between 2015 and 2019 for each respective Region.

Figure 7.2: Counterfactual Small-Sized Hospitals: Required Additional Doctors for Equivalent Expected Utility Gains

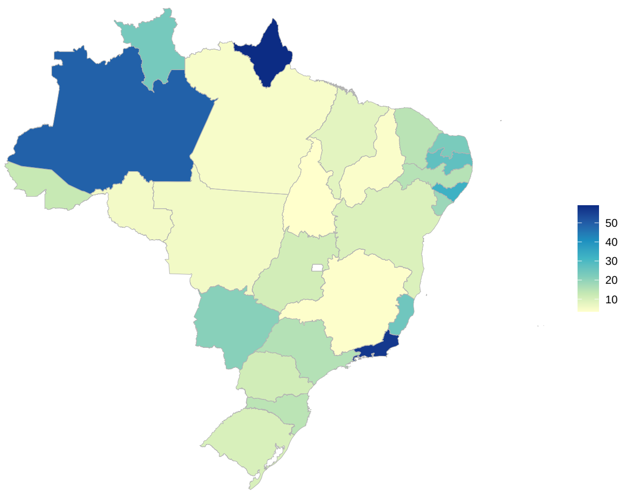


Note: The number of doctors per state is calculated using the expected utility function, which determines the required number of doctors per bed to achieve equivalent gains in utility as the opening of a new small hospital. This calculation is then multiplied by the total number of beds in 2019 by state, obtained from CNES data, to estimate the additional doctors needed.

Similarly, we conducted a corresponding analysis for nurses, which is an interesting exercise considering that the substitution of doctors with nurses is often regarded as a cost-effective change (Richardson et al., 1995). Figure 7.3 illustrates the findings of this exercise.

Once again, Amapá exhibits a substantial percentage increase in the number of nurses, with a rise of 23.00%, equivalent to 59 new nurses. Roraima and Amazonas also show significant gains, requiring an increase of around 24 and 49 nurses, respectively, ranking as the second and third highest increases in the percentage of nurses. In absolute terms, Rio de Janeiro has the second highest need for nurses, with almost 56 new nurses, but this is relatively small compared to the total number, representing only a 0.61% increase. Minas Gerais and São Paulo once again demonstrate the least need for nurses as a percentage of the total number, with increases of 0.05% and 0.06%, respectively. More information on these percentages by state can be found in the Appendix A.

Figure 7.3: Counterfactual Small-Sized Hospitals: Required Additional Nurses for Equivalent Expected Utility Gains



Note: The number of nurses per state is calculated using the expected utility function, which determines the required number of nurses per bed to achieve equivalent gains in utility as the opening of a new small hospital. This calculation is then multiplied by the total number of beds in 2019 by state, obtained from CNES data, to estimate the additional nurses needed.

In conclusion, employing a counterfactual approach enables us to quantitatively evaluate the additional healthcare workforce needed to achieve comparable enhancements in well-being, as projected with the introduction of new hospitals. This analysis provides invaluable insights into disparities in resource allocation across various regions in Brazil. While this hypothetical scenario deepens our comprehension of demand patterns and transportation costs related to healthcare facilities, thereby assisting policymakers in enhancing nationwide healthcare access and quality, uncertainties persist regarding the viability and efficiency of establishing hospitals in remote municipalities. To definitively address this concern, a broader array of studies becomes indispensable. Thus, the core aim of this approach is to facilitate the comparison of resource imbalances among distinct regions within Brazil.

8
Conclusion

This study offers valuable insights into the factors that shape individuals' choices when it comes to selecting hospitals. Through the analysis of Brazilian data from various sources, including the System SIH, the SIA, and the CNES, we employed a logit model of demand to estimate the determinants of hospital visitation patterns. Our findings shed light on the significant roles played by commuting time, healthcare professional availability, and hospital quality indicators.

One of the key findings is the trade-off between travel time and perceived quality of care. Our results indicate that individuals consider both factors when deciding which hospital to visit. Additionally, we found that a higher number of doctors and nurses positively influences visitation patterns, suggesting that the availability of healthcare professionals is an important consideration for patients. Moreover, lower death rates serve as an indicator of better patient outcomes and perceived quality of care, further emphasizing the importance of hospital quality.

Interestingly, the study reveals that preferences vary depending on the complexity of the disease. Patients seeking medium-complexity and primary care treatments are more likely to visit hospitals with a greater number of healthcare professionals. However, this influence is not significant for high-complexity treatments, indicating that other factors may play a more prominent role in the hospital selection process for such cases.

Furthermore, employing counterfactual analyses, I introduce 26 novel small-sized hospitals across each state in Brazil (excluding Brasilia) to comprehensively explore regional healthcare disparities. Employing an expected utility approach, I quantified the additional healthcare professionals needed in each state to align with the welfare gains from inaugurating these hospitals. The results validate predictions, notably underscoring the North's amplified demand for higher ratios of nurses and doctors compared to the Southeast, attributed to factors such as elevated transportation costs and underdeveloped medical infrastructure. This undertaking effectively reveals how establishing new, albeit less efficient, hospitals could amplify welfare across regions, serving as an invaluable comparative benchmark. Nevertheless, it remains essential to acknowledge the potential cost constraints associated with erecting new hospitals in exceedingly small municipalities. In this context, viable alternatives such as Emergency Care Centers (Unidades de Pronto Atendimento, UPA) and Basic Health Units (Unidades Básicas de Saúde, UBS) have demonstrated the potential to enhance accessibility without imposing substantial financial burdens.

Consequently, future research should delve into optimal resource allocation to simultaneously enhance system accessibility and efficiency, aligning with the requirement for a more comprehensive policy recommendation. This can be achieved by using estimated demand models to distribute hospitals effectively across the nation. It's also important to study how personal preferences influence political decisions, as in the work Hsiao (2022). This involves creating a preference model that considers various factors, collecting thorough data to understand complex relationships, analyzing decision-making to uncover preference integration, using computational modeling for prediction, and assessing policy outcomes for responsiveness. Addressing these gaps will provide a clearer understanding of how individual preferences impact healthcare policy choices.

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A
Counterfactual Results - Percentage Increase in Doctors and Nurses by State

Table A.1: Counterfactual Estimated Increase in Doctors by State (%)

State	Region	Total Number of Doctors	Increase Number of Doctors	Increase Number of Doctors (%)
Amapá	North	11.80	17.76	150.50
Roraima	North	24.75	7.14	28.84
Sergipe	Northeast	26.95	5.62	20.84
Mato Grosso Do Sul	Midwest	64.08	6.36	9.92
Alagoas	Northeast	100.82	9.81	9.73
Acre	North	54.72	3.88	7.09
Maranhão	Northeast	45.35	2.49	5.49
Amazonas	North	284.43	14.83	5.21
Rio Grande Do Norte	Northeast	133.72	6.94	5.19
Paraíba	Northeast	190.53	8.18	4.29
Espirito Santo	Southeast	369.23	7.45	2.02
Pernambuco	Northeast	244.72	4.58	1.87
Tocantins	North	74.70	1.10	1.47
Mato Grosso	Midwest	142.75	1.76	1.23
Rondônia	North	145.07	1.72	1.19
Ceará	Northeast	444.13	4.42	0.99
Bahia	Northeast	339.82	2.91	0.86
Piauí	Northeast	170.68	1.35	0.79
Rio De Janeiro	Southeast	2293.77	17.08	0.74
Santa Catarina	South	632.88	4.39	0.69
Goiás	Midwest	540.45	3.36	0.62
Pará	North	469.98	1.48	0.31
Paraná	South	1175.95	3.40	0.29
Rio Grande Do Sul	South	2465.52	3.04	0.12
Minas Gerais	Southeast	1385.82	1.21	0.09
São Paulo	Southeast	12530.75	4.67	0.04

Notes: These calculations are done using as reference the mean of total number of doctors between 2015 to 2019 for the specific State.

Table A.2: Counterfactual Estimated Increase in Nurses by State (%)

State	Region	Total Number of Nurses	Increase Number of Nurses	Increase Number of Nurses (%)
Amapá	North	256.50	59.00	23.00
Roraima	North	199.13	23.71	11.91
Amazonas	North	893.15	49.26	5.52
Alagoas	Northeast	991.00	32.58	3.29
Acre	North	422.05	12.88	3.05
Sergipe	Northeast	618.37	18.66	3.02
Mato Grosso Do Sul	Midwest	784.38	21.13	2.69
Rio Grande Do Norte	Northeast	1331.17	23.05	1.73
Paraíba	Northeast	2013.18	27.18	1.35
Espirito Santo	Southeast	1844.70	24.74	1.34
Rondônia	North	822.95	5.72	0.69
Rio De Janeiro	Southeast	9328.40	56.73	0.61
Goiás	Midwest	1988.38	11.16	0.56
Ceará	Northeast	2757.57	14.68	0.53
Pernambuco	Northeast	3532.28	15.23	0.43
Santa Catarina	South	3442.13	14.58	0.42
Mato Grosso	Midwest	1390.03	5.84	0.42
Piauí	Northeast	1076.98	4.47	0.42
Maranhão	Northeast	2364.27	8.26	0.35
Tocantins	North	1305.53	3.65	0.28
Paraná	South	4834.02	11.29	0.23
Pará	North	2269.77	4.91	0.22
Bahia	Northeast	4520.77	9.67	0.21
Rio Grande Do Sul	South	8447.03	10.09	0.12
São Paulo	Southeast	26062.42	15.52	0.06
Minas Gerais	Southeast	8461.58	4.01	0.05

Notes: These calculations are done using as reference the mean of total number of nurses between 2015 to 2019 for the specific State.