TesouroNacional

REVISTA

CADERNOS DE FINANÇAS PÚBLICAS

2022

EDIÇÃO ESPECIAL

Local Fiscal Status and the Response to the Pandemic of COVID-19: Evidence for Brazilian Municipalities

Rafael Barros Barbosa
Universidade Federal do Ceará
Gerrio dos Santos Barbosa
Fundação Oswaldo Cruz
Glauber Marques Nojosa
Universidade Federal do Ceará
Daniel Tomaz de Sousa
Universidade Federal do Ceará

Summary

This monograph investigates the effect of local fiscal conditions on mortality during the COVID-19 pandemic. Through a difference-in-differences model, it is shown that municipalities with better fiscal conditions have lower mortality during the pandemic. To understand these results, a theoretical model is presented that suggests that the existence of local fiscal space allows mayors to expand the capacity of hospital care, thus reducing mortality during the pandemic. Subsequently, it is analyzed that municipalities in a better fiscal situation can expand the number of beds, the number of doctors and nurses in relation to municipalities in worse fiscal conditions. The favorable local fiscal situation also allows for a better-quality supply of services for the treatment of COVID-19. These results indicate that the fiscal capacity contributed to mitigate the effects of the pandemic of COVID-19, mainly by expanding the capacity of hospital care.

Key-words: Local Tax Situation, COVID-19 Pandemic, Public Goods

JEL: H75, I10, H41

SUMÁRIO

1. Introduction

On March 11, 2020, the World Health Organization (WHO) upgraded the hitherto unresolved epidemic of COVID-19 to a global pandemic. The COVID-19 pandemic has strongly affected the world's economies, whether through reduced economic activity, the high number of fatalities, or the congestion of hospital care capacity. In all cases, the pandemic of COVID-19 presents itself as the greatest challenge experienced by humanity in this century.

From a public finance perspective, the pandemic of COVID-19 generated a high public deficit by reducing tax revenues, strongly dependent on economic activity, and at the same time increasing the need for public spending for certain purposes. This effect became known in the literature as the scissor effect. Thus, the existence of fiscal space to cope with the fiscal shock caused by the pandemic may have been critical to the success of public policies and to maintaining the supply of public services. Countries with greater capacity to raise and modify the composition of their expenditures were less affected than countries more limited in terms of fiscal space.

At the subnational level, the challenge required to face the pandemic was more critical, given that Brazilian states and municipalities cannot increase their fiscal space immediately. The two main mechanisms for increasing fiscal capacity are public indebtedness and the expansion of tax revenues. In the case of debt, states and municipalities are prohibited from doing so, and only the Federal Government is the only federative entity with the capacity to finance its expenditures directly through public debt. In the case of tax revenues, the approval of changes in tax laws requires constitutional deadlines that do not fit the immediate needs of the response to the pandemic.

In this scenario, states and municipalities depend only on the previous fiscal space created until 2019 and on intergovernmental transfers, mainly those passed on by the federal government. The federal government implemented two main measures to transfer resources to states and municipalities[1], however, such resources were only approved in April 2020, two months after the WHO declared the pandemic. In other words, the previous fiscal capacity may have been determinant for the best response of subnational entities to face the pandemic of COVID-19.

This monograph aims to investigate whether the existence of prior fiscal capacity in Brazilian municipalities contributed to a better response to the pandemic of COVID-19. The municipal response to crises is an issue still under discussion because of the low capacity to expand the municipal fiscal space, the sharing with other entities of the supply of public goods and services, especially health services, and the difficulty of political accountability in responding to crises. In all cases, there is strong incentive for municipalities to adopt the behavior of "hitchhiking", leaving to the other sub-national entities the responsibility for facing the pandemic.

Thus, this monograph will analyze whether municipalities with better fiscal situation in 2019 were able to reduce mortality, whether caused by COVID-19 or arising from other causes during the pandemic. In case municipalities in better fiscal situation were able to reduce mortality, it will be in-

1 The Complementary Law 173/2020 distributes resources to the states and municipalities in order to mitigate the loss of tax revenues. An important aspect of this Supplementary Law is that the resources were made available to the municipalities according to population size. The other action was the Provisional Measure 938/2020 that recomposed the losses of the Participation Funds of the Municipalities (FPM) and the States (FPE). In other words, both measures did not take into consideration the previous fiscal situation, nor the degree of exposure to the pandemic of the municipalities.

vestigated which local policies were adopted, that is, which mechanisms explain the systematic decrease in mortality in better-off municipalities compared to other municipalities during the COVID-19 pandemic.

To classify the local fiscal situation in 2019, the Capacity to Pay (CAPAG) indicator prepared annually by the National Treasury Secretariat (STN) will be used. The CAPAG is formed from three sub-indicators that enable a broad characterization of the municipal fiscal situation. The sub-indicators refer to municipal debt, current surplus (called current savings) and municipal liquidity. Each municipality is classified with a score in the CAPAG ranging from A to D, being the municipalities with grade A those that present better fiscal conditions. Municipalities with a score of B, C or D have at least one fiscal constraint in at least one of the sub-indicators.

The CAPAG indicator has two other important characteristics. First, it is an indicator of interest to municipalities, since municipalities classified as CAPAG C or D cannot obtain loans with the Federal Government guarantee. Second, and more importantly for the purposes of this monograph, in 2019 the CAPAG classification took into account only fiscal information from before the onset of the pandemic[2]. Thus, this indicator is relevant to the fiscal situation of municipalities and was not influenced by the emergence of SARS-COV-2 infections.

The municipalities in the best fiscal situation, CAPAG A, will be compared against the other municipalities (CAPAG's B, C and D) before and after the start of lockdown in Brazil. Although to date there has been no official lockdown declaration for the entire country, April 2020 will be used as the starting point for lockdown because this month recorded the lowest social mobility in Brazil during the entire pandemic period, and because it was the month with the highest adoption of state regulations to control social[3] mobility.

By means of a difference-in-differences (DiD) strategy, the results point out that municipalities that were in a better fiscal situation during the onset of the COVID-19 pandemic had significantly fewer fatalities than those municipalities in worse fiscal conditions. This result is valid whether one considers the total municipal mortality, as measured by the excess mortality indicator, or whether one considers only COVID-19 mortality or those recorded as Severe Acute Respiratory Syndromes (SARS). That is, in fact, the previous fiscal situation was responsible for a better response in facing the pandemic by the municipalities.

It is worth noting that the mortality difference between the two groups of municipalities is mitigated with the implementation of Complementary Law 173/2020 that distributed resources for municipalities to cope with their fiscal constraints during the year 2020. However, these resources could only be used as of June 2020, allowing three months of strong fiscal restriction for those municipalities classified as CAPAG's B, C or D. Based on a back-to-the-envelope exercise, and considering only the mortality caused by SARS-COV-2 infection, the number of deaths that could have been avoided is approximately 11 thousand people, just in these three months (April, May and June).

2 The first reports of an influenza outbreak in the city of Wuhan in China's Hubei province officially reached the WHO only on December 31, 2019.

3 More details in section 4.

Subsequently, a theoretical model is adapted, which attempts to rationalize the main mechanisms explaining the existence of local fiscal capacity on the reduction of deaths during the pandemic. The model is based on Hausmann and Schetter (2020), but adapted to incorporate local public spending as one of the determinants of COVID-19 mortality. In the model, the public manager faces the dilemma of adopting the lockdown policy, which contains mortality caused by COVID-19 but raises subsistence mortality, derived from reduced economic activity in places with the presence of a large proportion of poor individuals. Local public spending contributes to reducing mortality from both sources. By expanding the capacity for hospital care, public spending can reduce mortality directly caused by COVID-19 and that caused by other factors that usually require hospital care. In turn, the existence of municipal spending capacity can allow municipalities to adopt more effective social distancing policies, reducing the economic burden of lockdown adoption.

In the subsequent section, it is empirically investigated which of these potential channels explain the smaller impact on mortality in the better-off municipalities. First, it is analyzed whether CAPAG A municipalities manage to expand their hospital care capacity. The results show that these municipalities managed to significantly increase both the number of beds per 100,000 inhabitants and the hospital care team (doctors, nurses and other health professionals). Additionally, it is verified that these municipalities were also able to hire health professionals more adapted to the treatment of COVID-19, such as anesthesiologists. In this way, municipalities in a better fiscal situation have expanded more the capacity of hospital care in comparison to municipalities with fiscal restrictions and have also done so by increasing the quality of care focused on the treatment of COVID-19.

It was also verified whether municipalities with better prior fiscal capacity were able to adopt more social isolation policies and thereby reduce social mobility. The results indicated that such measures were not affected by prior fiscal capacity. Thus, the main channel explaining the lower mortality during the pandemic in municipalities with better fiscal conditions occurs by the expansion of the quantity and quality of hospital care capacity, and not by the adoption of local social isolation measures.

Finally, different potential heterogeneous effects on the expansion of hospital capacity in municipalities with better fiscal conditions were investigated. A higher proportion of elderly people was found to contribute to an increase in local hospital capacity, but the same effect was not found with a higher proportion of poor people. Both measures are related to the demand for health services during the pandemic. Local income inequality showed contradictory results for the number of beds and doctors per 100,000 inhabitants. Finally, it was identified that municipalities with greater political polarization had more difficulty in expanding their hospital capacity even in the presence of fiscal pre-conditions.

This monograph, therefore, contributes to the understanding of the importance of the local fiscal situation as a crisis mitigation measure in general, and the COVID-19 pandemic. Guaranteeing municipalities the ability to perform their local public spending is an important tool for coping with situations that often have characteristics particular to these municipalities.

This monograph is organized into seven additional sections in addition to this introduction. The next section discusses the relationship of this monograph to the literature on the topic. Section three presents the databases that were used in the subsequent empirical exercises. Section four presents the results of the local fiscal situation on the different mortality measures. In turn, section five presents the theoretical model developed to understand how local fiscal conditions contribute to reducing mortality during the pandemic. Section six presents analysis of the mechanisms and section seven presents the results of heterogeneous effects. Finally, section eight discusses the main conclusions of this monograph.

2. Relationship with literature

This monograph aims to understand how subnational municipal entities responded to the pandemic of COVID-19 by expanding hospital capacity, either by creating beds or hiring medical staff with certain characteristics. Therefore, this work relates to the recent and extensive literature that investigates the macroeconomic effects of the pandemic on and its ways of mitigation. Examples include: Eichenbaum, Rebelo, and Trabandt (2020a, 2020b), Hausmann and Schetter (2020), Krueger, Uhlig, and Xie (2020), Acemoglu et al. (2020), Aum, Lee, and Shi (2021), Alvares et al (2020). These papers seek, directly or indirectly, to adapt SIR epidemiological models (Kermack and McKendrick 1927) to investigate the consequences of the pandemic and the optimal lockdown policies to be implemented by governments.

Most of these works focus their analysis on developed countries. However, developing countries have specific characteristics that cause both the adoption of optimal lockdown policies and the economic effects of the pandemic to produce effects different from those found in developed countries. Alon et al. (2020) list some of these specific characteristics of developing countries that contribute to the heterogeneity of the impact of the pandemic.

First, the population of developing countries is younger on average than that of developed countries. The first variants of COVID-19 affected older populations much more acutely, raising the number of victims of COVID-19 in places with a high concentration of elderly people. The demographic characteristics of developing countries, in this case, represented an advantage in facing the pandemic, since younger populations are less susceptible to the worsening of SARS-COV-2 contamination.

Second, developing countries have a large informal sector. The presence of the informal sector strongly hinders the adoption of social distancing measures for at least three reasons. On the one hand, the absence of regulation makes it difficult to control and punish non-compliance with measures that restrict the mobility of individuals. On the other hand, individuals working in informal sectors do not have social safety nets that make it possible to mitigate the effects of the pandemic (Bassier et al. 2021; Schotte et al. 2021). Finally, the very existence of a large informal sector suggests that a significant portion of the population is poor. Evidence for Brazil suggests that the informal sector accounts for approximately 40% of total jobs in the economy (Ulyssea 2018, 2020).

Third, developing countries have limited capacity to provide public health care goods. The main ways of coping with the pandemic in the field, such as intubation procedures and isolation of infected patients require large capacity. In fact, the main reason that the pandemic of COVID-19 worsens is the rapid increase in the number of cases and, consequently, the collapse of the health system due to the lack of care conditions. Developing countries generally have poor hospital structures, which compromise the response to the pandemic. Brazil has experienced some moments of hospital collapse, the most striking being the event that occurred in early 2021 in Manaus, Amazonas, where the health system was exhausted due to the lack of beds and oxygen for patients.

Fourth, developing countries, and especially Brazil, have little fiscal space to meet the expenditures required by the pandemic. The pandemic of COVID-19 generated enormous challenges for fiscal policy in all countries. On the one hand, there was strong pressure to increase and change the composition of public spending. On the other hand, the main measures to face the pandemic, such as the reduction of mobility, negatively affect the tax revenue of all national entities. In Brazil, the increase in public spending is quite restricted due to the already high public[4] debt. Added to this is the fact that the rapid change in the composition of spending is limited due to the little discretionary nature of public spending.

Fifth, developing countries have a higher number of cohabitations between older and younger individuals, raising personal contact between individuals who must be in isolation and those who need to go to work. A relevant part of this higher cohabitation between different ages is explained by poverty in these countries and the lack of opportunities for younger individuals (Cabanas et al. 2014). This context is aggravated by the housing conditions in these countries. According to a United Nations survey, approximately 1 billion people live in favelas in large cities in developing countries (UN 2020). Favelas are marked by the absence of housing and sanitation infrastructure, such as water supply, sewerage, urban cleaning, urban drainage, solid waste and stormwater management (Ashraf, Glaeser, and Ponzetto 2016; Brotherhood et al. 2020; Henderson and Turner 2020).

Because of all these specific characteristics it is expected that the pandemic will produce different impacts in developed countries compared to what is predicted by macroeconomic models developed for advanced countries. This paper therefore relates more closely to the recent literature investigating the impact of the COVID-19 pandemic on developing countries, such as: Hausmann and Schetter (2020), Alon et al. (2020), Brotherhood et al. (2020), Rocha et al. (2021), Maia et al. (2021) among others.

One of the central objectives of this monograph is to understand the role of municipalities in mitigating the effects of the pandemic. Since this subnational entity does not have mechanisms to soften economic shocks through debt, then the response to the pandemic will depend on the existence of the state capacity to expand the supply of public services. Three are the sources of public resources available to municipalities: intergovernmental transfers from the state or the Federal Government, increased current fiscal revenue, and the existence of past fiscal space, acquired before the pandemic. Of these three forms, it is believed that only the last one played a unique role in determining the state capacity of municipalities during the shock caused by the pandemic in 2020.

In general, state capacity can be defined as its ability to resolve conflicts, ensure that its citizens comply with established laws (enforcement), regulate the economy, and provide supply of public goods

4 Brazil's public debt showed significant recent growth as a result of excessive public spending in the period from 2012 to 2016. Contributing to this increase were the political instability resulting from the impeachment of President Dilma Roussef (BARBOSA (2018)) and the subsequent recession experienced by the country between 2014 and 2016. To maintain the sustainability of the public debt, the fiscal rule of the "Spending Ceiling" was adopted, which was successful in changing the growth trajectory of the public debt, but at a very high level (Instituto Fiscal Independente, 2021).

and services (Acemoglu and Robinson 2019). All these characteristics are important in addressing the pandemic. For example, the adoption of non-pharmaceutical (NPI) social distancing measures, such as lockdowns or wearing masks, require governments to be able to ensure minimal compromise for their effectiveness (Haug et al. 2020; Goldstein, Yeyati, and Sartorio 2021).

In turn, to be able to increase the capacity of hospital care, municipalities need to be endowed with fiscal capacity. Here fiscal capacity is understood as both the fiscal situation prior to the pandemic and the ability to increase tax revenue or change the composition of public spending. A large literature studies the characteristics of state capacity and its relationship to the supply of public goods, with emphasis on Besley and Persson (2009, 2011), Besley, Ilzetzki and Persson (2013), Besley (2019), Acemoglu (2005).

An important characterization of this literature is the concept of Weak States, which can be understood as states that are not able to enforce their laws or provide public services adequately to their citizens (Acemoglu (2005), Besley, Ilzetzki and Persson (2013). This paper, therefore, will use the event caused by the pandemic to understand to what extent Brazilian municipalities can be considered weak states, that is, to what extent municipalities lack the necessary state capacity to increase the supply of public goods and enforce the legal determinations arising from the pandemic.

To understand in detail this relationship, it will be examined whether the response to face the pandemic depends on specific characteristics of the municipalities, whether arising from increased demand for public services or issues related to the balance of local power. A large literature suggests which are the determinants of public spending at different levels. This monograph will focus on three main aspects. First, it will analyze whether the demand for public services contributes to increase municipal public spending during the pandemic. Municipalities with a higher demand for public services will be those that have a high proportion of elderly and poor individuals. Both aspects require greater investment by the public[5] sector during a pandemic.

Second, public spending is also determined by the income inequality of the population. More unequal municipalities can be captured by local elites who allocate public resources for purposes other than expanding hospital capacity (Gächter et al. 2017; Bergstrom, Blume, and Varian 1986; Ostrom et al. 1994).

Third, political polarization at the local level may contribute to the fact that public spending is not allocated to the expansion of health care during a pandemic. The relationship between polarization and the provision of public goods is a specific case in a broader literature that seeks to understand how different social groups converge to achieve a common goal, in this case, the provision of public goods and services. Substantial parts of this literature find evidence that the difficulty of coalition among social groups has a negative effect on the supply of public goods (Alesina, Baqir and Easterly (1999); Alesina and La Ferrara (2000); Ashraf and Galor (2013); among others). Here it will be studied whether the expansion of hospital capacity, whether by the provision of beds or doctors, depends on

5 Note that in the case of the proportion of the poor, the dual role of the government in contributing to both the number of spending on the provision of public goods and the enforcement of lockdown measures is more prominent. Poor individuals have little access to quality health services and great difficulty in transferring the shock caused by the pandemic to future periods, which increases the chance of non-compliance with NPIs.

the level of political polarization of each municipality. The expected result is that in places with greater political consensus there will be a greater local reaction to the supply of public goods when resources are available for such expansion[6].

Finally, a last aspect related to this monograph refers to how the relationship between the different subnational entities influence the provision of public goods and services. This work focuses on the provision of public health goods at the municipal level. However, according to the 1988 Federal Constitution, the provision of these goods is shared among the different federative entities (Souza 2018). Arguments in favor of sharing, highlight the importance of decentralization of government actions enabling greater effectiveness and efficiency in the realization of public policies, especially because of greater accountability[7] (Oates 1972).

However, the adoption of the shared form of providing public goods can generate inefficiency for several reasons. First, when there is no clear and objective definition of which entity should provide the public good (Kresch 2020; Joanis 2014). In this case, inefficiency in the provision of the public good can occur due to the absence of a clear process of accountability. Second, the decentralization of public policy may be affected by the type of public good being offered. Due to the absence of state capacity, some public goods may not be provided by municipalities, for example. This category includes public goods that require greater gains in scale for their efficient execution. Examples are: highly complex medical treatment and inter-municipal or inter-state infrastructure works. In other words, the supply of these public goods by municipalities is inefficient due to lack of state capacity.

Third, there are inter-municipal externalities that can reduce the supply of public goods. Again, in the case of health, a small municipality near a large urban center, such as a state capital, may reduce the supply of health services to “hitch a ride” on the state capacity of this large urban center (Acemoglu, Garcia-Jimeno, and Robinson 2015). Finally, certain public goods and services do not have a clear definition of responsibility because there is no legislation defining it. This is the case with the COVID-19 pandemic, and other influenza outbreaks such as the Zika-virus. Although the municipality is directly responsible for providing public health care services and the states must provide public health care goods and services of high and medium complexity, there is still no clear and objective definition of whether the pandemic of COVID-19 is configured in one or the other case.

The COVID-19 pandemic is related to some of these potential sources of inefficiencies. First, it is a new phenomenon and has not yet been adequately discussed to create the accountability necessary for decentralization to work efficiently. It is possible that there are strong externalities generated by moving closer to large urban centers. Municipalities may not have enough state capacity to offer health services to face the expansion and deepening of the pandemic. Finally, electoral accountability

6 Political consensus will be measured by the proportion of votes for President Jair Bolsonaro in the 2018 runoff elections. We will define the existence of local political consensus when the proportion of votes is greater than 75% (pro-government-elect consensus) or less than 25% (anti-government-elect consensus). Thus, the definition of political consensus used in this monograph does not refer to a consensus around a single type of party, but rather, the local consensus in being for or against President Jair Bolsonaro.

7 The concept of accountability here refers to the identification of which public managers are actually responsible for the provision of public goods and the possibility that the inefficient provision of these goods may affect citizens’ voting decisions.

is not clear, that is, if the pandemic is not adequately controlled, which government entity will be held responsible?

This monograph will examine an important aspect of the provision of public health goods and services by municipalities: fiscal capacity. The objective is to understand whether municipalities with greater fiscal capacity perform better in dealing with the pandemic of COVID-19. In addition, it will be investigated whether fiscal capacity contributed to the reduction in mortality from COVID-19.

3. Database

3.1. Fiscal Data

The Municipal Payment Capacity Indicator (CAPAG) will be used to classify the municipalities' fiscal situation. The CAPAG scores determine the fiscal situation of subnational entities and indicate whether a new debt represents a credit risk for the National Treasury. The form of the CAPAG calculation, given by MF Ordinance No. 501/2017, is performed from three fiscal indicators:

i) Indebtedness (DC):

$$DC = \frac{Gross\ Consolidated\ Debt}{Actual\ Net\ Income}$$

ii) Current Savings (CP)

$$PC = \sum_{t=1}^{n} \frac{Current\ Expenditure_t}{Adjusted\ Current\ Revenue_t} * P$$

Where: P represents the weights arranged as follows: exercise (t-1), weight 0.50; exercise (t-2), weight 0.30; exercise (t-3), weight 0.20.

iii) Liquidity (LI)

$$IL = \frac{Financial\ Liabilities}{Availability\ of\ Gross\ Cash}$$

The indebtedness (DC) and liquidity (IL) indicators use information relative to the 3rd quarter of the last fiscal year available in the Fiscal Management Report (RGF). The current savings indicator (CP), on the other hand, is obtained by the weighted average of the ratio of current expenditure and current revenue adjusted for the last three fiscal years[8].

For each indicator, a letter (A, B, C, or D) is assigned to represent the partial classification in that item, where A is the best category and D the worst category. The final CAPAG score is obtained from the combination of the partial scores of the three indicators, as shown in Table 1.

The CAPAG scores have important characteristics for their use as an indicator of the fiscal situation prior to the COVID-19 pandemic. First, it has great availability of information for most Bra-

8 All the data for the CAPAG calculation are available in the Brazilian Public Sector Accounting and Fiscal Information System (Siconfi). The Transparent Treasury website also reports the partial and final CAPAG ratings.

zilian municipalities. Of the total of 5,560 municipalities, 1,595 (28%) have no classification available in 2019. A total of 716 (12.8%) fall into the A classification. Most municipalities fall into the C classification, 2,402 (43.2%). Only 11 (0.19%) municipalities are in the D situation and 845 (15%) classified with a B grade.

Table 1 – CAPAG Indicators

Partial ranking of the indicators			
Indicator	**Acronym**	**Value Range**	**Partial Classification**
Indebtedness	DC	DC < 60%	A
		60 ≤ DC ≤ 150%	B
		DC ≥ 150%	C
Current Savings	PC	PC < 90%	A
		90% ≤ PC <95%	B
		PC ≥ 95%	C
Liquidity	IL	IL > 1	A
			C

Source: Adapted from MF Ordinance 501/2017.

Table 2 - CAPAG Classification

Partial indicator ranking			**Final payment capacity rating**	**Number of municipalities (2019)**
Indebtedness	**Current Savings**	**Liquidity**		
A	A	A	A	716
B	A	A	B	845
C	A	A		
A	B	A		
B	B	A		
C	B	A		
C	C	C	D	11
Other combinations of partial ratings			C	2,402

Source: Adapted from MF Ordinance 501/2017.

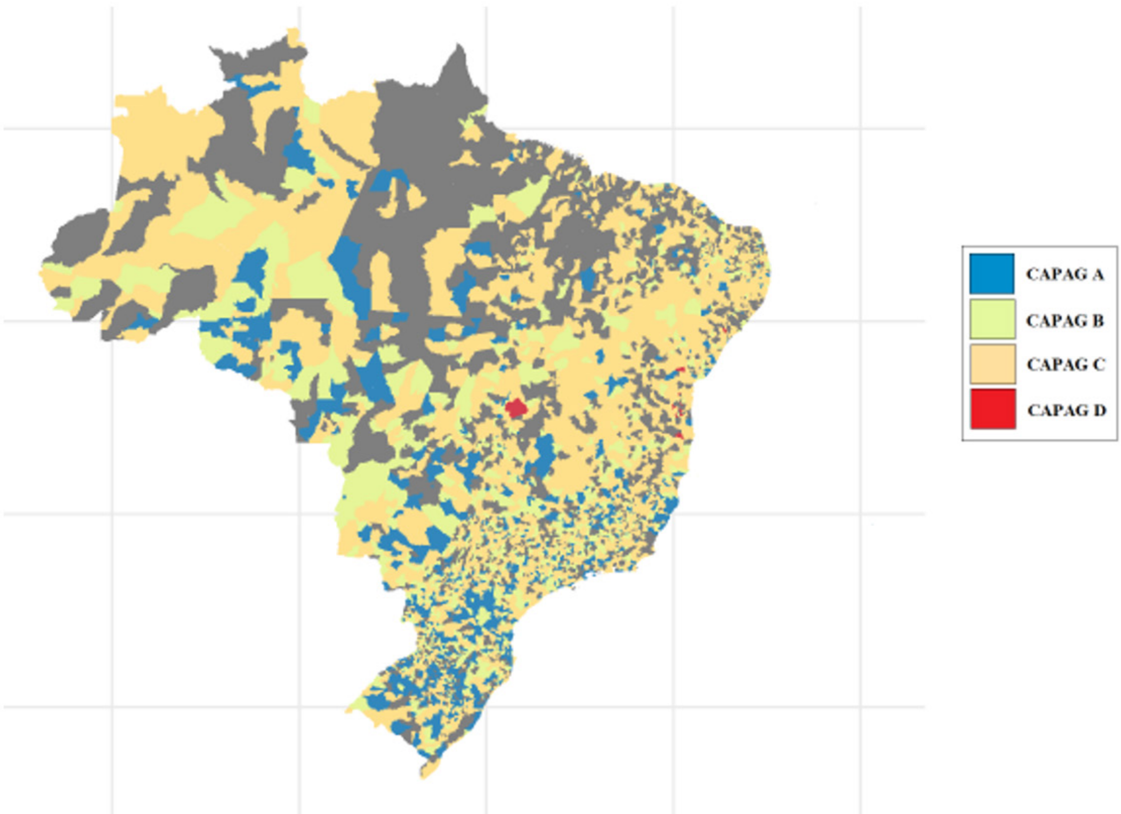
The CAPAG scores have important characteristics for their use as an indicator of the fiscal situation prior to the COVID-19 pandemic. First, it has great availability of information for most Brazilian municipalities. Of the total of 5,560 municipalities, 1,595 (28%) have no classification available in 2019. A total of 716 (12.8%) fall into the A classification. Most municipalities fall into the C classification, 2,402 (43.2%). Only 11 (0.19%) municipalities are in the D situation and 845 (15%) classified with a B grade.

Second, the calculation of the CAPAG is relevant for municipalities, since such a ranking enables the municipality to take out loans guaranteed by the Federal Government. Unlike the other fiscal indicators, there is an interest of the municipality in being well ranked in the CAPAG and in providing the correct information so that the indicator is computed without errors.

Finally, the CAPAG consists of three indicators that allow for a more complete classification of the municipal fiscal situation. This last point is important because different types of fiscal constraints can generate different effects on the municipal response to the COVID-19 pandemic. In a specific section, the existence of heterogeneous effects due to the nature of the municipal fiscal condition will be analyzed.

Figure 1 presents the geographic distribution of municipalities according to CAPAG rating in 2019. No specific geographic pattern associated with the CAPAG rating is observed on the map, suggesting that the distribution of CAPAG scores is almost random. The absence of a specific geographic pattern allows CAPAG to be used for detecting the causal effect of the municipal response to the COVID-19 pandemic mediated by the local fiscal situation.

FIGURE 1: Geographic distribution of Brazil's municipalities according to CAPAG classification in 2019



Source: National Treasury Secretariat (STN)

Note: Figure 1 shows the geographic distribution of CAPAG scores in Brazilian municipalities. No geographical pattern is observed on the frequency of CAPAG scores A, B, and C, with all states in Brazil having at least one municipality classified in each of the situations. The CAPAG D score is infrequent. Municipalities in gray had no CAPAG classification.

3.2 Mortality Data

Different databases were used to measure mortality. First, the mortality for COVID-19 at the municipal level was taken from the Brasil.IO[9] website. This site compiles epidemiological bulletins from the 27 State Health Secretariats, making available the historical series of confirmed cases and deaths in each municipality. These data have a daily frequency, but were aggregated monthly, seeking to reduce classification errors or delays in the assignment of the cause of death to COVID-19. Here an official base was not used due to technical difficulties that the Ministry of Health had in releasing the information.

A limitation in using the number of fatalities from COVID-19 stems from the presence of underreporting that occurred in the early months of the pandemic, due to the absence and poor quality of disease identification tests. Besides suffering from shortages, these tests had high false-positive rates. To overcome this limitation, the number of fatalities from Severe Acute Respiratory Syndrome (SARS) was used. Time series of SARS show seasonal patterns and low incidence over months. Thus, a rapid growth in the number of SARS during the pandemic may be an indication of underreporting of cases of COVID-19. The figure 2 presents the absolute value of fatalities whose death was recorded as caused by SARS and the number of fatalities identified as COVID-19. In the months of March to December, there is a large difference between the mortality due to COVID-19 (in gray) and that due to SARS (in black), suggesting the presence of underreported cases.

Information on SARS was obtained from the DATASUS Severe[10] Acute Respiratory Syndrome database. The data are extracted in monthly frequency and with municipal geographic coverage.

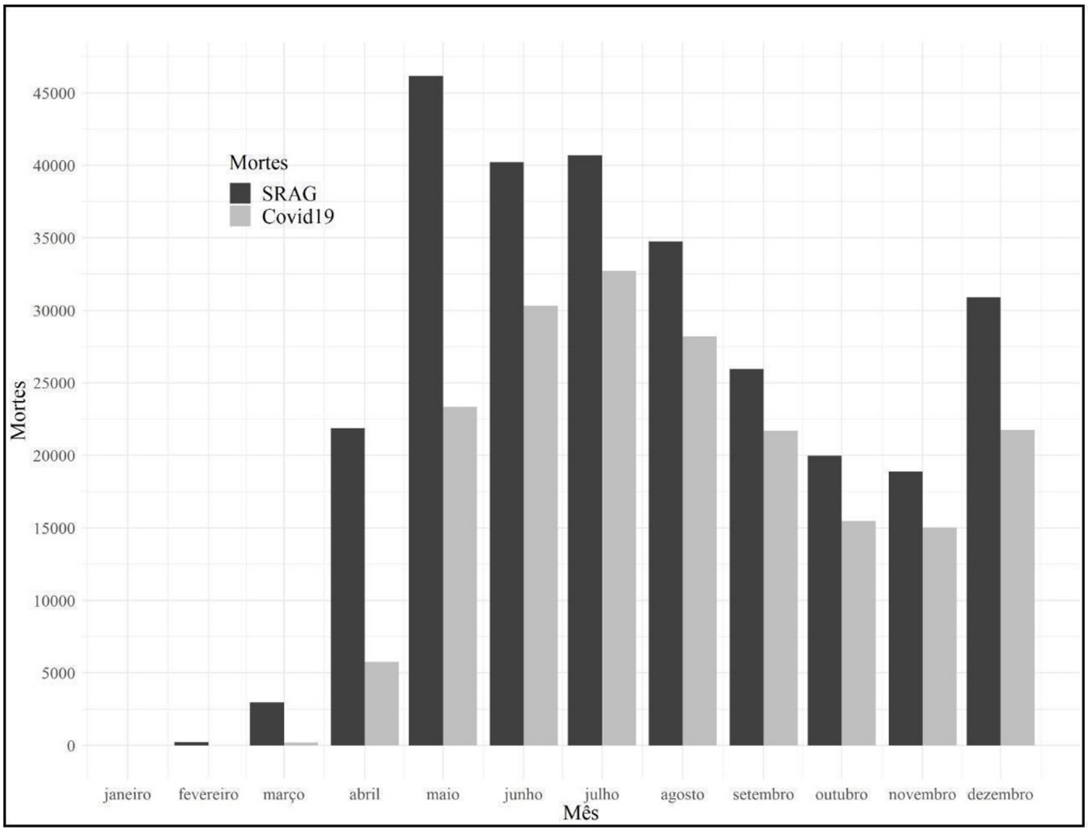
Finally, the pandemic of COVID-19 did not cause fatalities only because of respiratory syndromes. There is ample evidence that people were fatally affected by other diseases, indirectly associated with the pandemic of COVID-19 (Jain and Dupas 2021). Thus, to capture the overall effect of the pandemic on mortality, whether COVID-19 cases or not, information on total mortality at the county level during the year 2020 will be used. Total mortality will be calculated using the excess mortality indicator, obtained from microdata from the Mortality Information System (SIM) at the municipal level with monthly frequency between the years 2015 through 2020[11].

FIGURE 2 - Comparison of SARS and COVID-19 Mortality in 2020

9 Website: https://brasil.io/home/.

10 Link: https://opendatasus.saude.gov.br/dataset/bd-srag-2021

11 The information for the year 2020 is preliminary, so that it can still be updated according to the screening policy established by the MS/SVS Ordinance No. 116/2009, which seeks to give quality to the data. These data were extracted from the Department of Health Analysis and Surveillance of Noncommunicable Diseases (DASNT) in April 2021.



Months: January, February, March, April, May, June, July, August, September, October, November, December

Source: Own elaboration.

Note: Figure 2 presents the data of deaths recorded monthly for SARS and COVID-19 throughout 2020. In all months, the number of SARS deaths was higher than that of COVID-19, which may indicate underreporting of COVID-19 cases.

3.3 Hospital capacity data

Hospital care capacity is measured using the DATASUS[12] Network of Care database. Human capital and physical resources data were extracted to characterize hospital capacity. As for human capital, the number of doctors, nurses and other health professionals at the municipal level were computed. From this base, it was possible to construct the quantity of total physicians, general practitioners and anesthesiologists per 100 thousand inhabitants. Medical anesthesiologists are important for the specific care of COVID-19 because of the intubation procedure, recurrently used in the treatment of patients in advanced stages of infection. Thus, this variable can be interpreted as a measure of the quality of medical care provided to the municipality. That is, municipalities that increased the number of anesthesiologists per 100 thousand inhabitants during the pandemic of COVID-19 were able to offer care more appropriate to the demands of the pandemic.

As for physical resources, the number of total beds per 100 thousand inhabitants in each municipality is used. The total number of beds was chosen because many municipalities, especially the smaller ones, do not have the capacity to create more specialized beds, such as Intensive Care

12 Site: http://www2.datasus.gov.br/DATASUS/index.php?area=0204

Unit (ICU) beds.

3.4 Data on the adoption of restriction measures at the municipal level

To detect the measures adopted to restrict municipal mobility, we will use a survey promoted by the National Confederation of Municipalities (CNM) applied at the end of 2020 and answered by 4,076 (72.3%) Brazilian municipalities. This survey provides information about which non-pharmaceutical measures have been adopted by the municipalities. The data can be obtained in Sousa Santos et al. (2021).

The variables used refer to the adoption of non-pharmaceutical measures such as: adoption of barriers to the movement of people, limitation to the use of public transportation, and mandatory use of masks.

3.5 Other databases

Other important variables were obtained from the Brazilian Institute of Geography and Statistics (IBGE), the Institute for Applied Economic Research (IPEA) and the Superior Electoral Court (TSE) and correspond to municipal GDP, proportion of votes in the 2018 presidential elections, inequality measured by the GINI index, distance of municipalities to the capitals of their states, municipal poverty level among others.

These variables are used to control for heterogeneity among municipalities as predetermined variables or to perform subgroup analyses.

4. Fiscal situation and mortality

This section examines whether the local fiscal situation contributed to mediating the impact of the COVID-19 pandemic on mortality. Four measures of mortality will be analyzed: mortality from COVID-19, mortality from Severe Acute Respiratory Syndrome (SARS) infection, and two measures of excess mortality.

COVID-19 mortality refers to the number of deaths per 100,000 population of individuals who had the test and were confirmed to have been caused by SARS-COV-2 virus infection. This variable is potentially affected by measurement errors due to the difficulty of testing, either because of low reliability and quality in existing tests or because of the limited supply of these tests during 2020. For both cases, there is a great risk of underreporting fatalities related specifically to COVID-19. In addition, tests to detect the presence of COVID-19 in 2020 would take approximately one month to issue conclusive opinions[13]. This may alter the date of mortality registration in specific months.

To circumvent these potential measurement errors, we chose to also estimate the impact of the pandemic of COVID-19 on the number of deaths per hundred thousand inhabitants caused by Severe Acute Respiratory Syndrome (SARS). SARS is a respiratory syndrome, caused by several factors, which can lead patients to death. This type of syndrome has more general symptoms that are easier for

13 See news about this theme and its repercussions in the Folha de São Paulo newspaper (https://mural.blogfolha.uol.com.br/2021/04/08/a-demora-do-teste-de-covid-19-diante-das-milhares-de-mortes-diarias/)

doctors[14] to detect. One of the causes of SARS deaths is SARS-COV-2 infection (COVID-19). Thus, many cases of fatalities from COVID-19 may have been classified as SARS victims. In regions with greater difficulties in testing for COVID-19, an exogenous variation in the time series of SARS deaths during the pandemic is attributed to COVID-19 victims. Therefore, using the number of deaths identified as SARS allows us to mitigate some of the errors in detecting COVID-19 fatalities. However, SARS-COV-2 infection is one of the causes of SARS, and this is a limitation of using such a measure for mortality; that is, victims of SARS may not necessarily be victims of COVID-19.

Although SARS fatality data partly solve the problem of measurement error, analyzing the impact of the pandemic only on the fatalities associated with COVID-19 has some limitations, as the pandemic may also have generated indirect casualties caused by other factors that became more salient during the pandemic. The COVID-19 pandemic forced local and national governments to adopt strong restrictive social mobility measures with the aim of restricting the circulation of the SARS-COV-2 virus, thereby reducing the number of patients in hospital care networks. However, restricting social mobility has other social effects, such as reduced economic activity, increased unemployment rates, and difficulty in obtaining medical care for other recurrent illnesses, among others. Therefore, it is expected that the adoption of measures to restrict the movement of people will result in an increase in mortality caused by other factors (hunger and other diseases) not directly associated with SARS-COV-2[15] infection (JAIN and DUPAS 2021; HAUSMAN and SCHETTER 2020).

To detect the global effect of the pandemic of COVID-19 on mortality, the concept of excess mortality will be used, which refers to an exogenous increase in the number of total deaths in a municipality in a period in relation to the historical average of deaths in this locality (Average of 5 previous years). This measure allows capturing the overall effect of the COVID-19 pandemic, that is, the mortality caused by SARS-COV-2 infections added to those indirectly caused by the adoption of measures to restrict social mobility.

The excess mortality variable indicates how much the municipality i in the month t registered mortality per 100,000 inhabitants above the recent historical series, measured from 2015 to 2019. In other words,

$$Exc_{ist} = (mort100_{ist} - \overline{mort100_{ist}})$$

Where: $mort100_{ist}$ represents the total mortality in the municipality iin the month t and in the state s. The advantage of using the excess mortality measure stems from the possibility of measuring deviations from the historical average associated with specific periods, as is the case of the COVID-19 pandemic. In addition, it allows controlling for seasonal variations in mortality.

Such a measure of excess mortality is limited when making comparisons between geographic

14 The most common symptoms of SARS are difficulty breathing, heaviness in the chest, decreased oxygenation in the blood, blue or purple face and lips (https://portalarquivos.saude.gov.br/images/af_gvs_coronavirus_6ago20_ajustes-finais-2.pdf).

15 Hausman and Schetter (2020) discuss the trade-off faced by governments in developing countries, most of whose population is already exposed to social vulnerability. As the adoption of restriction measures affects the income of the poorest population, governments are faced with the choice between reducing mortality from COVID-19 and increasing mortality from other factors. Such an impasse has been called by Hausman and Schetter (2020) a cursed trade-off.

units with very different population sizes. In other words, excess mortality is very sensitive to population size. To get around this problem, we use the percentage change in excess mortality, known as p-score, is defined by:

$$p - score_{ist} = \frac{(mort100_{ist} - \overline{mort100_{ist}})}{\overline{mort100_{ist}}} \times 100$$

This measure computes the percentage change in excess mortality in the county iin the month t and in the state s.

The main objective of this section is to understand if municipalities with better previous fiscal conditions were less affected by the pandemic of COVID-19 in terms of mortality. Thus, to access the causal effect of municipal fiscal situation on the mortality indicators described above a difference-in--differences (DiD) model will be used, with the equation of interest defined by:

$$y_{it} = \beta_0 + \gamma\ Trat_i \times Lockdown_t + \mu_i + \tau_t + \varepsilon_{it} \qquad (1)$$

Where: y_{it} refers to the variable of interest in municipality i in period t. The variable $Trat_i$ represents the fiscal situation of municipality i in 2019. This variable assigns value 1 for municipalities with CAPAG A and zero for the other CAPAG's (B, C and D). Although the CAPAG B classification does not represent a restriction on obtaining federally guaranteed loans from the STN, this category means that the municipality has some fiscal restriction. The only municipalities without fiscal restrictions are those classified with the CAPAG A score.

The variable $Lockdown_t$ is assigned a value of 1 for months after April 2020 and zero for months before that month. April 2020 represents the beginning of the period of mobility restrictions in Brazil. The figure 3 presents two measures of the impact of adopting the $Lockdown_t$. Figure 3A shows the social mobility for going to work measured by Google through the movement of users of the Android[16] system. In turn, Figure 3B shows the rigidity index measured by the University of São Paulo in partnership with the University of Oxford, England. This index indicates the intensity and type of legal measures adopted by Brazilian states seeking to restrict social mobility. Both figures show the average monthly aggregation by state (gray); in black is the national monthly average. The red line highlights the month of April, used as the effective start date of the COVID-19 pandemic in Brazil. In Figure 3A we notice a strong decrease in the mobility at the beginning of April in relation to the reference period that starts in the second half of February. This reduction in mobility may be a result of the adoption of legal restriction measures by the states as presented in Figure 3B. Lockdown represents the main non--pharmaceutical measure (NPI) adopted to address the pandemic and was predominantly responsible for the effects of the pandemic on economic activity.

The parameter of interest is γ which measures the impact of lockdown adoption in municipalities with good prior fiscal conditions compared to municipalities with restricted fiscal situation on different mortality indicators. The sign of the estimated parameter is expected to be negative, indica-

16 Mobility to work was used because it has information for most Brazilian municipalities. Other mobility measures computed by Google are only present in large urban centers.

ting that municipalities with better fiscal conditions in 2019 were able to be less impacted in terms of mortality than municipalities with some fiscal constraint.

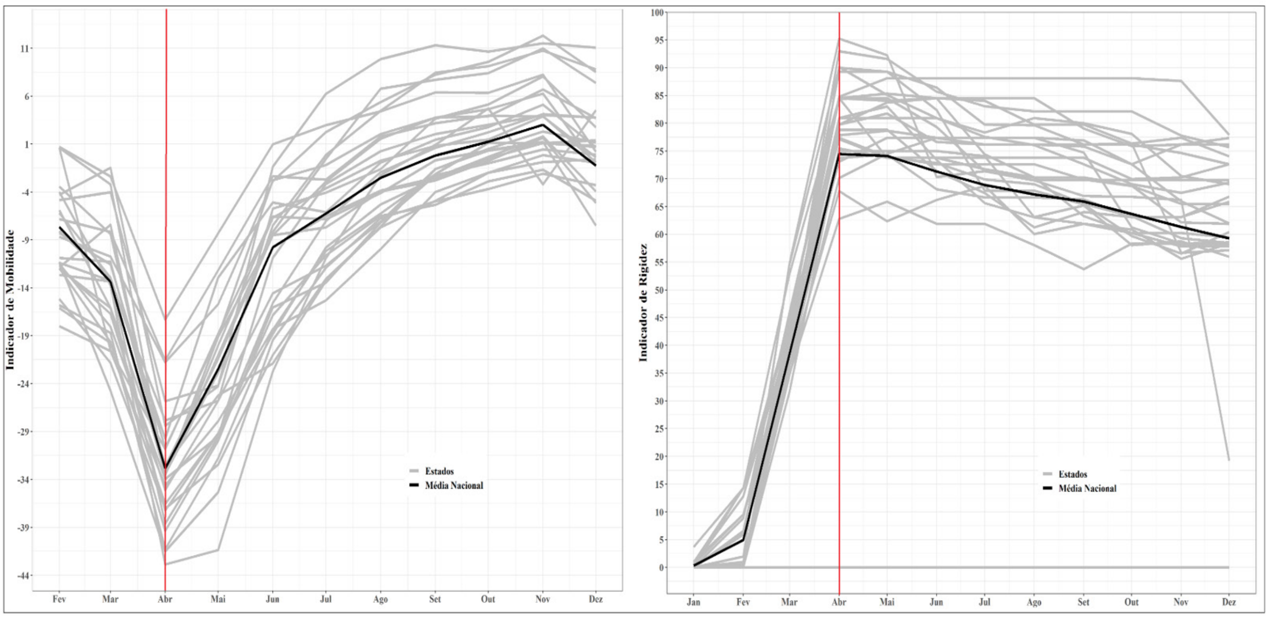
There are several reasons to believe that municipalities with greater fiscal capacity can ameliorate the impact of the COVID-19 pandemic during lockdown. First, municipalities without fiscal constraint can expand hospital capacity to care for both COVID-19 cases and cases related to other diseases, thus avoiding increased mortality. Second, to adopt restriction measures that directly affect the transmission of the SARS-COV-2 virus requires allocating fiscal resources to unusual areas, such as public safety and purchasing specific equipment. It is easier to make such additional expenditures when there are no fiscal constraints. Finally, the adoption of measures restricting the movement of people can worsen the local social situation because of reduced economic activity. Municipalities with fiscal capacity can propose local policies that mitigate such effects, such as the purchase and distribution of basic food baskets in schools, local income transfer policies, and the purchase and distribution of sanitary protection equipment such as masks and alcohol gels. For all these reasons, it is believed that municipalities without fiscal restraint tend to reduce the number of fatalities during the pandemic of COVID-19.

The variables μ_i e τ_t represent the municipal and monthly fixed effects used to absorb idiosyncratic differences across municipalities or national shocks in specific months that may affect the outcome variables. In the most demanding specifications, state fixed effects are added, multiplied by monthly fixed effects seeking to capture specific time-varying actions that may have affected the mortality variables.

FIGURE 3 - Urban mobility measures and rigidity index

Figure 3A — Mobility Indicator x States/National Average

Figure 3B — Stifness



Source: Own elaboration.

Notes: Figure 3A shows the behavior of the mobility index for work, measured by Google. Figure 3B, presents the rigidity index, measured by USP in partnership with Oxford University. In both panels, gray lines represent the state averages, black line the national average, and red line delimits the month of April, when strict lockdown measures were adopted. We observe a drop in mobility at the beginning of April (Figure 2A) in relation to the reference period starting in the second half of February, a fact probably associated with more rigid measures (Figure 3B).

Most of the results in this section will be obtained from this specification in (1). However, the variables related to the excess mortality indicator can be presented in a dynamic version of the equation in (1). This dynamic version has the advantage of relating the average treatment effect more directly to the temporal occurrence of the pandemic, measured by the variable $Lockdown_t$. Moreover, it makes it possible to partially check the validity of the parallel trends hypothesis, necessary for the identification of the causal effect in difference-in-differences (DiD) models. The dynamic specification can be defined by:

$$y_{ist} = \beta_0 + \sum_{t=-3}^{-1} \beta_t Trat_i + \sum_{t=+1}^{8} \beta_t Trat_i \times Lockdown_t + \mu_i + \tau_t + u_{it} \qquad (2)$$

In (2), periods prior to the start of the lockdown (January 2020 through March 2020) and eight periods thereafter (May through December 2020) are considered, with April as the reference month.

The main causal identification hypothesis of the difference-in-differences (DiD) method is the parallel-trends hypothesis, in which the behavior of municipalities should follow the same trend in the absence of the shock caused by the pandemic. Although it is not possible to test such a hypothesis in practice, one way to approximate its validity is to observe whether differences in trends exist prior to the occurrence of the lockdown. Thus, it is expected that the parameters estimated before April 2020 do not show different trends. That is, it is expected that prior to the imposition of the lockdown, the differences between the mortality variables will not vary because of the prior fiscal situation in 2019.

The causal identification of the parameters can be inferred by assuming that the fiscal situation of municipalities in 2019 was not anticipated due to the shock caused by the COVID-19 pandemic in 2020. The pandemic became public worldwide in late 2019, but despite the severity and the need for tougher measures to address it, actions were implemented in other countries only in 2020. In other words, it does not seem plausible that mayors were able to change their fiscal situation in 2019 because of the pandemic.

A factor that may confound the results refers to the federal government's transfer for fiscal recovery of states and municipalities, made through Complementary Law 173/2020. These resources contributed to improve the fiscal situation of the municipalities during the pandemic and may have reduced the effect of previous fiscal conditions on the results of mortality and other indicators. All resources allocated to municipalities were distributed according to population size, and were not related to the previous fiscal situation of municipalities nor to the incidence of the COVID-19 pandemic. In other words, municipalities more affected by COVID-19 or that were in a worse fiscal situation at the beginning of 2020 did not receive more resources than municipalities with the same population. Finally, Supplementary Law No. 173/2020 was enacted only on May 27, 2020, almost two months after the start of the social distancing measures, which occurred at the end of March.

Another measure taken by the federal government was the re-composition of the municipalities' (FPM) and states' (FPE) participation funds by means of Provisory Measure 938/2020, which was later transformed into Ordinary Law 14,041/2020.

4.1 Results for COVID-19 and SARS Mortality

The Table 1 presents the estimation of equation in (1) that measures the effect of lockdown adoption in Brazil and its effect mediated by municipal fiscal status on COVID-19 and SARS mortality per 100,000 inhabitants in Brazilian municipalities. Columns (1) include in equation (1) only temporal and municipal fixed effects. These absorb idiosyncratic differences between municipalities or between different months of the year as national measures affecting mortality. In turn, in columns (2) time-varying state fixed effects are added, whose purpose is to capture variations in state policies for coping with the pandemic.

All estimates show negative sign of the parameter of interest, suggesting that municipalities with better prior fiscal conditions have lower mortality caused by COVID-19 or SARS after the introduction of lockdown. The standard errors in conjunction with the point estimates indicate that the magnitude of the impact is relevant in differentiating mortality across municipalities. That is, all estimates were statistically significant. Finally, the introduction of time-varying state fixed effects reduced the magnitude of the estimates, but did not change their direction or significance, suggesting that different state policies were relevant to the impact of the pandemic on mortality, but not sufficient to eliminate the effect of differences in prior fiscal conditions.

In terms of magnitude, the results presented in column (2), the preferred specification, indicate that municipalities with better fiscal conditions reduce 1.2 and 2.5 deaths by COVID-19 or SARS per 100 thousand inhabitants, respectively. To size up the size of this effect, in 2020, considering only confirmed deaths by COVID-19, there were a total of 40 deaths per 100 thousand inhabitants in Brazil. The estimate presented in column (2) represents 3% of this value ((1.2 / 40) x 100). That is, approximately 3% of the deaths per 100 thousand inhabitants caused by COVID-19 in 2020 could have been avoided if the municipalities were with prior fiscal conditions classified as CAPAG A.

Table 1 - Local tax status and mortality from COVID-19 and SARS, Brazil, 2020.

	COVID-19 per 100 inhab.		SARS per 100 inhab.	
	(1)	(2)	(1)	(2)
Treatment	-1,737***	-1,225***	-3,468***	-2,253***
	(0,436)	(0,255)	(0,837)	(0,517)
Municipal Fixed Effect	Yes	Yes	Yes	Yes
Fixed Monthly Effect	Yes	Yes	Yes	Yes
Fixed effect state-month	No	Yes	No	Yes

Source: Own elaboration.

Notes: Table 1 presents the estimates of the effect of lockdown interacted with municipality fiscal status on mortality from COVID-19 and SARS. Standard errors, in parentheses, estimated using the clustering process, considering the interaction between unit (county and state) and month. Significance: ***1% **5% *10%.

As recently as 2020, there were approximately 195,000 deaths from COVID-19 in Brazil. Thus, having a municipality classified as CAPAG A could have prevented a total of approximately 11,000 lives.

In sum, the introduction of lockdown resulting from the COVID-19 pandemic caused a strong mortality shock in Brazil. However, municipalities with better fiscal conditions managed to mitigate the effect of the pandemic on deaths associated with respiratory syndromes, whether caused by SARS-COV-2 or not.

4.2 Results for Excess Mortality

As discussed earlier, the excess mortality measure captures the effect of the COVID-19 pandemic on overall mortality, computing its direct effect, deaths caused by SARS-COV-2 infection, and other indirect causes. The possibility of indirect fatalities caused by the pandemic is related to the economic impact of reduced social mobility and the exhaustion of the use of existing hospital capacity focused on treating COVID-19, leaving few resources for the care of other recurrent diseases.

Table 2 presents the estimates of equation (1) using the variables excess mortality and municipal p-score. Again, columns (1) use the specification that adds only municipal and monthly fixed effects. On the other hand, columns (2) include time-varying state fixed effects. The preferred specification is the one presented in columns (2) because they absorb several idiosyncratic characteristics of municipalities.

It can be seen from the Table 2 that the estimates are all negative, suggesting that municipalities in better fiscal pre-conditions present lower mortality than municipalities with some type of fiscal constraint. Furthermore, the joint analysis of the standard errors and the point estimates suggests that the fact that a municipality has good fiscal conditions matters significantly for reducing excess mortality. The exception was the p-score variable in column (2) which did not prove statistically significant. This suggests that despite the negative effect, it is not quite relevant when controlling for potential policies that states have implemented over 2020 to reduce mortality. Such an estimate reflects the average effect over the months of 2020 after the lockdown was enacted, so this non-significance may be explained in part by specific policies that states have adopted that have reduced the average effect over 2020.

Table 2 - Local fiscal situation and excess mortality, Brazil, 2020.

	Excess Mortality		p-score	
	(1)	(2)	(1)	(2)
Tratamento	-142,74***	-127,37***	-4,299***	-1,337
	(47,27)	(33,40)	(1,806)	(1,950)
Efeito Fixo Municipal	Sim	Sim	Sim	Sim
Efeito Fixo Mensal	Sim	Sim	Sim	Sim
Efeito Fixo estado-mês	Não	Sim	Não	Sim

Source: Own elaboration.

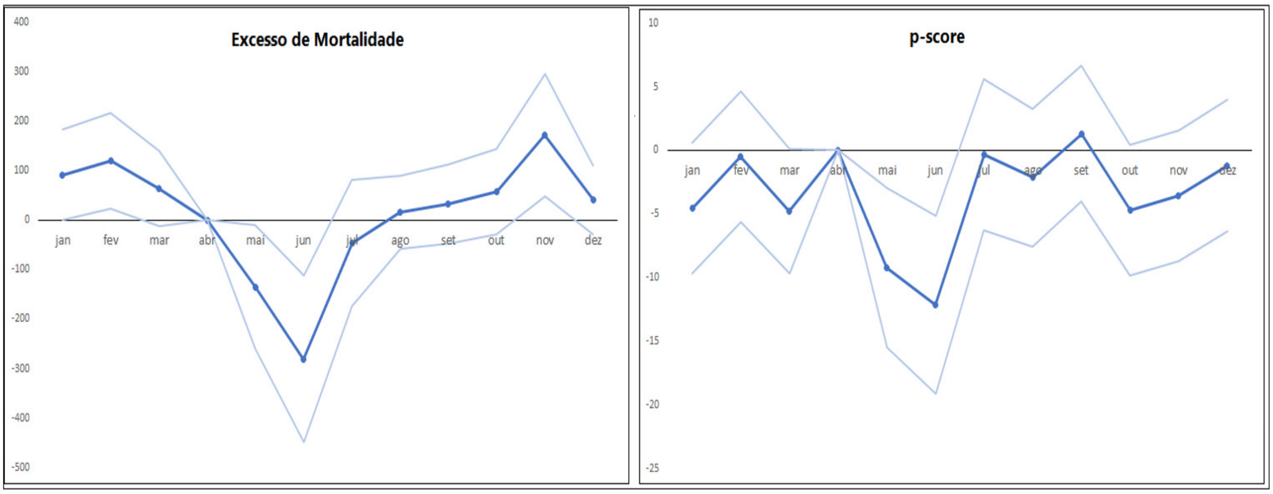
Notes: Table 2 presents the estimates of the effect of lockdown interacted with municipality fiscal status on excess mortality and municipal p-score. Standard errors, in parentheses, estimated using the clustering process, considering the interaction between unit (county and state) and month. Significance: ***1% **5% *10%.

To verify the temporal effect of the pandemic in municipalities with different fiscal characteristics, equation (2) is also estimated. In this specification it is possible to verify in which periods the impact was more relevant. Furthermore, the dynamic estimation of the DiD makes it possible to analyze one of the central hypotheses of this type of model, the parallel trends hypothesis.

The Figure 4 presents the estimates for both excess mortality and municipal p-score over the months of 2020. The month of April 2020 is taken as a reference and is excluded from the sample to avoid collinearity. The months preceding the start of the lockdown (January to March) are not expected to cause significant differences between the estimates, and are expected to be close to zero. The point estimate is shown in darker blue. In light blue are the confidence intervals.

FIGURE 4 – Dynamic model estimation for excess mortality and p-score

Excess Mortality p-score



Source: Own elaboration.

Notes: Figure 4 presents the results estimated by the dynamic model, for excess mortality and p-score. Both panels in Figure 2 present the evolution over the months of 2020, with April being the month of the introduction of lockdown measures, differentiated by better (CAPAG A) or worse (CAPAG B, C or D) municipalities. Point estimate in dark blue, confidence intervals (95%) in light blue.

It can be seen from the Figure 4 that in the months of May and June mortality, as measured by excess mortality or p-score, were strongly negatively affected. Such impact is negative and statistically significant in these months. Thus, the introduction of the lockdown in April 2020 affected the municipalities with better fiscal conditions less intensely. The effect is short-lived and ends in July 2020, coinciding with the sending of the first transfers of the Fiscal Aid to the municipalities, whose first installment was paid in June. It is important to note that the methods used in this research do not allow us to conclude whether the reduction in the effect of fiscal conditions on mortality was caused by the Fiscal Aid to municipalities or other factors related to the dynamics of the pandemic or actions taken by states and municipalities in worse fiscal situations.

In terms of magnitude, at the peak of the effect on excess mortality, municipalities with better conditions managed to have, in absolute terms, 200 fewer deaths when compared to municipalities with worse fiscal conditions. In percentage terms, this represents a 10% reduction compared to the average number of municipal deaths between 2015 and 2019.

Finally, it is noted that prior to the introduction of lockdown, for both excess mortality and p-score, municipal fiscal status is not sufficient to generate significant differences between municipalities, suggesting the absence of prior trends. This result indicates the validity of the parallel trends hypothesis, implying that the econometric strategy of differences-in-differences is adequate to analyze this problem.

We conclude, therefore, that the fiscal situation is relevant to differentiate mortality rates, either globally or specifically related to COVID-19. In other words, the local preconditions were relevant in facing the pandemic, enabling fewer fatalities.

This result highlights the importance of the local fiscal situation to face crises, be they pandemics, as in the case of COVID-19, or of other natures, such as natural disasters (droughts, floods, earthquakes) and recessions. Thus, it is essential that institutions be created that enable municipalities to have sufficient resources to face local challenges arising from such exogenous shocks to municipalities.

Another important question is to understand which channels explain the success of fiscally better-off municipalities in tackling the pandemic of COVID-19. The next section discusses a theoretical model that helps rationalize such results. Subsequently, the predictions of the theoretical model will be tested empirically.

5. Theoretical Model

5.1 Initial Structure

The model assumes the existence of only two periods: present period (period 1) and the future period (period 2). In the present period the economy faces the pandemic of COVID-19. In period 2, the post-pandemic period occurs, that is, the period when there is no longer a community circulation of the virus or when a significant part of the population is vaccinated[17]. The post-pandemic period represents the present value of all subsequent periods, infinitely repeated in the steady state after the pandemic.

The families are arranged on a continuum that measures 1 and each family is differentiated only by its ability a. This ability is related to the productivity of this household and, consequently, to its monetary return in the labor market.

The pandemic broadly understood has two direct economic costs to households. On the one hand, it negatively affects Total Factor Productivity (TFP). This is because households reduce their su-

17 It is important to note that at the time of the decision of public managers there is great uncertainty about the duration of the pandemic and the persistence of the pandemic. This supports the hypothesis that the mayors' decision is made thinking about during and after the pandemic.

pply of labor hours by adopting social distancing measures. On the other hand, for those households below a certain subsistence level, the pandemic may cause death due to insufficient basic survival resources. Therefore, it is assumed that households will only accept lockdown measures up to the point where economic losses do not exceed their subsistence level.

To cope with the expansion of the pandemic, the municipal[18] government can either enact lockdown θ or increase its expenditures (g), carrying out some policy to mitigate the effects of the pandemic. The adoption of lockdown deepens the economic recession caused by the proliferation of the SARS-COV-2 virus, as it further reduces the labor supply of households. However, lockdown prevents the increase in the number of cases and deaths from COVID-19.

In turn, public spending (g) is undertaken by the municipality seeking to reduce the number of fatalities of COVID-19 by enabling more adequate hospital care, increasing the efficiency of the lockdown policy, or reducing the adverse social effects of the pandemic. Since municipalities are not able to finance their spending through debt, then it is assumed that spending is limited to the municipality's fiscal situation in period 1 ($g \leq \bar{g}$), where $\bar{g}$ is determined from the accumulated fiscal conditions of periods prior to the current[19] period. For ease of exposition, it will be assumed that the municipal spending considered here will be directed toward increasing hospital physical capacity, not affecting labor supply and therefore having no relation to lockdown[20].

The social cost of the pandemic can be accommodated by the federal government through a lump-sum transfer T financed via debt. In the second period, the Federal Government levies a tax, also lump-sum, τ to finance the public debt. From the point of view of the municipalities, both the transfer T and the taxes τ from the point of view of the municipalities, both the transfer and the taxes collected in period 2 are considered exogenous [21].

5.1.1 Families

Families are arranged on a continuum of abilities (a) governed by the cumulative probability distribution (CDF), F(a) and support Λ. The skill of the family is defined by the probability density function (pdf), f(a). This implies that the presented model considers the heterogeneity of families in terms of their accumulated skill over time.

Households supply an inelastic, unitary quantity of labor. Lockdown (θ) reduces the labor supply of households, causing their current income to decline. Let l(θ) be the labor supply of the household in period 1. a The instantaneous utility of consumption of this household is given by:

18 The Supreme Court has given states and municipalities the right to take measures to reduce the pandemic's spread in the economy.

19 An important element not analyzed in this research refers to the sharing of responsibility for the provision of public goods during the pandemic among national entities. The uncertainty about who is responsible for providing the public good can generate underinvestment by municipalities (KRESH, 2020).

20 This hypothesis is empirically tested in section 6.2. It was not found that municipalities in a better fiscal situation were able to reduce social mobility (by adopting distancing measures or policies to stimulate labor supply) in comparison to other municipalities.

21 The transfer of resources via the Emergency Aid did not consider specific conditions of the municipalities. Additionally, Law 173/ 2020 that transferred resources to address municipal tax revenue losses adopted the distribution scheme by population size, not taking into consideration the severity of the pandemic nor the municipality's current fiscal situation.

$$u(c) = v(c) - \bar{c}, with\ v(c) = c$$

Where: $\bar{c}$ is the subsistence consumption level. Thus, the family will die if: $c < \bar{c}$. Death from economic causes, as well as potential death from COVID-19, takes place at the end of this period. The function v(c) is the linear[22] utility function.

Households are assumed to be non-Ricardian, that is, they do not have access to the credit market to be able to transfer the costs of the pandemic over time. Therefore, all their consumption in the present period is financed with current income. This is a common characteristic of the poorest households in developing countries, that is, those that will benefit from the expansion of public health services and potentially be affected by the lockdown.

Consider w the efficiency wage per unit of labor. The consumption in the period s={1,2}is defined by:

$$\begin{aligned} c^1(a;\ \theta, T) &= w^1 \cdot a \cdot l(a) + T \\ c^2(a;\ \tau) &= w^2 \cdot a - \tau \end{aligned} \qquad (1)$$

Consumption in period 2 is conditioned on the probability of survival in period 1. Thus, the expected utility of the household a is given by

$$u(a) = [\, w^1 \cdot a \cdot l(a) + T] - \bar{c} + \pi(a, g) \cdot \beta \cdot [(w^2 \cdot a - \tau)^{\alpha} - \bar{c}] \qquad (2)$$

The parameter β is the intertemporal discount rate. It is assumed that $\beta = \hat{\beta}/(1-\hat{\beta})$with $\hat{\beta} \rightarrow 1$. This implies that the intertemporal discount rate is very high, reflecting the fact that individuals highly value the present value of all the periods that individuals will potentially be alive after the pandemic, summarized in period 2.

In turn π(a,g) is the probability of survival of the family in period 1. a This probability increases if the municipality increases its public spending on expanding hospital capacity, either by hiring physicians or by offering new beds.

5.1.2 Pandemic

The pandemic affects the economy by reducing aggregate labor supply (LLet be the function that summarizes the effects of the pandemic $P(L) \in [0,1]$such that: $P(L) = L^{\lambda}, \lambda > 1$. The parameter λ measures the sensitivity of the pandemic to variations in aggregate labor supply. In the steady state L=1. The function P(L) can be understood as proportional to the total number of people infected with COVID-19 in period 1. The closer economic activity is to the steady state level, the smaller the social gap and the larger the number of people infected with COVID-19. The federal government, through cash transfer instruments in period 1 can reduce L maintaining the same level of consumption as in the steady state.

22 Two possible alternatives to this function are the exponential consumption function $v(c)=c^{\alpha}$ or the Stone-Geary function: $v(c)=u(c)=(c-\bar{c})^{\alpha}$. In both cases, taking such functional formats will not fundamentally change the results at the expense of increased complexity of the calculations.

The pandemic causes both COVID-19 and non-COVID-19 related deaths. The second type of mortality occurs due to difficult access to public health services in the pandemic or due to economic reasons, i.e., poor people who with reduced economic activity (L) reduce their consumption below the subsistence level.

The total number of pandemic fatalities is therefore proportional to the pandemic's impact in economic terms and the number of COVID-19 infected, both of which are summarized in P(L). This hypothesis is based on SIR models that attempt to model the behavior over time of the number of potential infected, also called susceptible (S), infected (I), and recovered (R)[23].

Eichenbaum et al (2020a) assumes that the mortality caused by the pandemic depends on two factors: the sensitivity of the population to SARS-COV-2 and the hospital capacity to care for the sick. In the first case, demographic characteristics such as proportion of elderly people, for example, may contribute to greater sensitivity to SARS-COV-2[24]. In Eichenbaum et al (2020b) hospital care capacity is given during the pandemic and therefore a sharp increase in the number of infected (P(L)→1) would have a greater impact in terms of mortality, suggesting that the mortality curve caused by the pandemic would be convex in L.

Here, it is assumed that the effect of the pandemic on mortality can be mitigated by expanding local hospital care capacity. That is, municipal governments can expand hospital care capacity in period 1, either by creating more beds or hiring more doctors and nurses, or by acquiring equipment (respirators) and materials (oxygen) that will allow them to cope with the increased number of infected.

So let it be, d(P,g) the number of deaths caused by the pandemic P and the municipal expense g. Thus, it is defined:

$$d(P,g) = [\delta - \gamma g(\mu^*{}_a)] \cdot P \qquad (3)$$

$$\gamma \in [-1,1]$$

In which: δ measures the sensitivity of the population to pandemic if there is no spending that expands hospital care capacity $\mu^*_a = \int_{\Lambda} \omega \cdot a \cdot f(a)\, da$ represents the average ability of the municipality weighted by ω. The dependence of municipal spending on weighted average ability has two interpretations. First, the weighting suggests that municipalities will undertake spending on expanding hospital capacity according to the weight that is assigned to everyone within the municipality. That is, political economy issues may influence local public spending. Second, the higher the average ability of the population, it is expected that the higher the fiscal capacity of the municipality to invest in health. This result is in line with international evidence that richer governments, also tax more (Besley and Persson 2009).

Three additional observations are important. First, it is believed that expanding local hospital

23 A vast literature in economics has endeavored to analyze optimal pandemic coping policies through SIR models, see: Alvares et al. (2020), Acemoglu et al. (2020), Alon et al. (2020), Céspedes et al. (2020), Eichenbaum et al. (2020a and 2020b), Krueger et al. (2020).

24 Also included in this category are factors that contribute to a greater effectiveness of the social distancing policy, such as fewer people close to the subsistence level (lower proportion of poor people), greater engagement of the distancing measures, a higher proportion of obese individuals, among others.

capacity is not sufficient to eliminate the effect of the pandemic on mortality, but only mitigates its impact. This implies that: $g'(\cdot)>0$ e $g''(\cdot)<0$. Second, the impact of local spending on pandemic mortality depends on the parameter $\gamma \in [-1,1]$ which may reflect different factors such as: initial hospital capacity, proximity to large urban centers that may exert externality on the decision to invest (Acemoglu, Garcia, and Robinson 2015), municipal political polarization that may interfere with the electoral gains of investing in hospital capacity, among others. Third, given the impossibility of expanding municipalities' fiscal capacity through debt, the current fiscal situation is assumed to limit the size of spending.

5.1.3 Policy instruments

5.1.3.1 Income transfers from the Federal Government

The federal government has at its disposal a policy instrument that allows it to mitigate the effects of the pandemic on the economy through income transfers financed by public debt. Such transfers are defined as a fraction of steady state GDP, defined by:

$$T = t \cdot \bar{A} \cdot \mu_a \tag{4}$$

Where: $\bar{A}$ is the steady-state TFP and $\mu_a = \int_{\Lambda} a \cdot f(a)\, da$ is the average skill of the municipality's inhabitants. Debt is restricted to sustainability of public debt in the steady state, thus: $t \leq b$. The interest rate charged on debt is r.

5.1.3.2 Municipal government

The municipal government has two policy instruments at its disposal. First, municipalities can enact lockdown θ and thereby intensify the reduction in labor supply, deepening the recession. However, enacting lockdown helps to decrease SARS-COV-2 infection by reducing the number of COVID-19 deaths caused by the pandemic. The optimal choice of lockdown enactment and its intensity represents a trade-off faced by municipalities.

On the other hand, municipalities can use their available fiscal resources to expand hospital capacity and mitigate the pandemic's impact on mortality. The spending g depends on the characteristics of the weighted average abilities of the population and is limited to current fiscal conditions ($\bar{g}$) given the impossibility of transferring the costs of the pandemic over time at the subnational level.

Assume that local spending on hospital capacity is proportional to the weighted average ability of the population, that is: $g(\mu^*_a) = \mu^*_a \cdot g$.

5.1.4 Production

Production depends on the productivity of labor, that is:

$$Y = A \int_{a \in \Lambda} a \cdot l(a) \cdot f(a)\, da$$

Where: A reflects the Total Factor Productivity (TFP), being equal to $\bar{A}$ in the steady state.

TFP reduces during the pandemic as a fraction of steady state TFP, via the following expression:

$$A = \bar{A} \cdot \vartheta_p \cdot h(\theta)$$

Where: ϑ_p - is the sensitivity of PFF arising from the pandemic, assumed to be negative;
h(θ) - is the effect of the lockdown on TFP;

The function is assumed to h(.) has the following properties:
i. $h(0) > h(1)$
ii. $h''(\cdot) < 0$
iii. $\vartheta_p \cdot h(\theta) < 1$for any $\theta \geq 0$

Given these characteristics, the TFP function is concave, suggesting that the effect of lockdown is increasing but exhibiting decreasing marginal rates. Furthermore, TFP without the introduction of lockdown is strictly larger than TFP over any type of lockdown, indicating that the lockdown decision generates a trade-off for the mayor who knows that it will deepen the recession.

It additionally assumes that markets are under perfect competition, implying that the efficiency wage of a unit of labor equals the marginal product of labor:

$$w = A \tag{5}$$

Finally, it is considered that in normal times (no pandemic) families can survive, i.e.: $\bar{A} \cdot a \geq \bar{c}$ for every $a \in \Lambda$.

5.2 Lockdown, labor supply and aggregate mortality

What is the minimum skill required for an individual to survive if lockdown is implemented? Since lockdown reduces the supply of labor, and therefore the wages of individuals, those closest to subsistence consumption may exceed the minimum survival threshold, eventually passing away due to economic conditions.

It is known that in the first period $c=w \cdot a \cdot l(\theta)+T$ of (1). Making $c=\bar{c}$, we have that the minimum ability to survive is given by:

$$a_2 = \frac{\bar{c} - T}{w \cdot l(\theta)}$$

From (4), (5) and if the lockdown has full compliance, i.e., individuals fully commit to complying with the lockdown, then $l(\theta)=(1-\theta)$ measures the intensity of lockdown θ on labor supply. Therefore, given the adoption of intensity lockdown θthe minimum skill level is:

$$a_2 = \frac{\bar{c} - t\bar{A}\mu_a}{A \cdot (1 - \theta)}$$

Therefore, individuals with skills $a \leq a_2$ will overstep the subsistence threshold, dying of economic conditions when lockdown θ is introduced.

If the municipal government does not enact the lockdown, then, l(0)=1. However, not enacting lockdown does not prevent the recession caused by the pandemic. This implies that poor individuals of ability close to the subsistence limit may still fall victim to the recession caused by the pandemic. This limit is given by:

$$a_1 = \frac{\bar{c} - t\bar{A}\mu_a}{A}$$

In other words, the number of recession fatalities will depend on the type of lockdown θ and the specific ability of a given individual with respect to the subsistence limit. The labor supply of individuals is given as follows:

$$l(\theta) = \begin{cases} (1-\theta), \ se\ a \geq a_2 \\ \dfrac{\bar{c} - t\bar{A}\mu_a}{aA}, \ se\ a_2 > a \geq a_1 \\ 1, \ caso\ contrá rio \end{cases} \qquad (6)$$

If/if/otherwise

From the condition in (6) one can define the aggregate labor supply in the period during the pandemic by:

$$L = F(a_1) + \int_{a_1}^{a_2} \frac{\bar{c} - t\bar{A}\mu_a}{aA} f(a)da + (1-\theta)[1 - F(a_2)] \qquad (7)$$

From (7) the labor supply will depend on the number of fatalities affected if the lockdown is implemented ($F(a_1)$), the number of people who will be victims of COVID-19, and the rest of the population that is not affected by any of the previous factors. If the local government does not introduce lockdown the household subsistence limit is given by a_1. Thus, the total mortality in this case is given by:

$$D = F(a_1) + [1 - F(a_1)][\delta - \gamma g(\mu^*{}_a)] \cdot P(L) \qquad (8)$$

The equation in (8) presents the trade-off faced by local governments in deciding whether to declare lockdown. If they implement lockdown, then the recession will deepen and individuals with abilities below $a_2 \geq a_1$ will die due to economic issues, i.e., not necessarily related to the COVID-19 disease. This mortality can be caused either by the absence of basic health care for treatment of non-COVID-19 diseases, or by poverty. Add to these fatalities those who will die from COVID-19.

On the other hand, if the local government does not implement the lockdown, then the population below the skill a_1 will die for economic reasons. Hausmann and Schetter (2020) called this dilemma a horrible trade-off, because managers must choose which lives will be lost. This choice is markedly more frequent in developing countries.

It is important to note that unlike the model of Hausmann and Schetter (2020), here the possibility of an attenuation of the direct effect and part of the indirect impact of the pandemic is introduced, either on victims of COVID-19 or victims of other diseases that also require hospital care. Such spending, however, does not impact on mortality caused by economic[25] reasons. In other words, such a policy instrument has limited impact in addressing the direct (COVID-19) and indirect (other diseases and economic) effects caused by the pandemic.

5.3 Welfare analysis

Local government has a choice in the introduction of lockdown θ and the number of public spending on hospital capacity expansion. The federal government distributes resources to ease the impact on consumer income, however, this transfer is done in an uncoordinated manner with the municipalities. This implies that local economic conditions do not determine the federal government's aid. Therefore, both the transfers T and taxation in period 2, τare considered exogenous to the municipality.

Assume that the local government suffers no power influence, treating all individuals with equal weight in deciding whether to implement lockdown. This means absence of the importance of political economy in the lockdown decision. However, with respect to spending the local government is allowed to make decisions about the number of spending according to preferences over individuals. Although here this is modeled generically, by assuming that g is a function of μ_a^* the empirical part will study in detail such heterogeneous effects.

The objective of the local government is to make decisions that maximize the aggregate welfare effect in the two periods, given by:

$$W = \int_{a \in \Lambda} [v(A \cdot a \cdot l(a) + t \cdot \mu_a \cdot \bar{A}) - \bar{c}] \cdot f(a)da +$$

$$+(1-D) \cdot \beta \cdot \int_{a \in \Lambda} \left[v\left(\bar{A} \cdot a - r \cdot \frac{t \cdot \mu_a \cdot \bar{A}}{1-D}\right) - \bar{c}\right] \cdot f(a)da \qquad (10)$$

The local government chooses the pair (θ,g) to maximize the function W subject to the constraints θ∈[0,1] e g(〖μ^*〗_a)≤g ̅. The values of A,$\{l(\theta)\}_{a \in \Lambda}$,P,D,T e τ.

Thus, conditioned on the values of l in (6), we have the following problem:

$$Max_{\theta,g}\ W = \int_{a \in \Lambda:\, a \le a_1} [v(A \cdot a \cdot l(a) + t \cdot \mu_a \cdot \bar{A}) - \bar{c}] \cdot f(a)da \ + \int_{a_1}^{a_2} [v(\bar{c}) - \bar{c}] \cdot$$

$$f(a)da + \int_{a \in \Lambda:\, a \ge a_2} [v((1-\theta) \cdot A \cdot a + t \cdot \mu_a \cdot \bar{A}) - \bar{c}] +$$

$$+ (1-D) \cdot \beta \cdot \int_{a \in \Lambda} \left[v\left(\bar{A} \cdot a - r \cdot \frac{t \cdot \mu_a \cdot \bar{A}}{1-D}\right) - \bar{c}\right] \cdot f(a)da$$

(11)

25 A more realistic hypothesis would allow that public spending on municipal health care affects both the mortality caused by COVID-19 and the economic side. However, the effect of hospital capacity expansion on indirect mortality caused by the pandemic will not be empirically analyzed. It will only be analyzed whether the expansion of hospital capacity impacts on mortality caused by COVID-19, because non-COVID-19 mortality has only been disclosed in a preliminary way and may generate errors in the estimates.

Note that if β→∞then the maximization problem focuses on optimizing the last term of (11). The assumption that β→∞ means that managers are more concerned with maximizing long-term welfare, represented by consumption at present value in the second term. Or rather, it is assumed that mayors consider the "value of life" to be very high. Such a hypothesis is consistent with other work (Eichenbaum et al 2020a, Alvares et al 2020).

5.3.1 Optimal Policy Analysis

Assume that β→∞that is, the public manager is primarily concerned with long term consumption and the survival of the population. Given this hypothesis, the economic recession represented by period 1 is not relevant to welfare. Thus, by integrating period 2, the manager's problem becomes:

$$Max_{\theta,g}\ \widehat{W} = (1 - D(g(\mu^*{}_a))[\bar{A} \cdot \mu_a - \bar{c}] - r \cdot t \cdot \bar{A} \cdot \mu_a \quad (12)$$

subject to $\theta \in [0,1]$

$$g(\mu^*{}_a) \leq \bar{g}$$

Note that in this case welfare is maximized depending on how lockdown θ and municipal spending affect the behavior of the variable Dwhich represents the total number of deaths due to the pandemic. Without loss of generality, disregard the restriction that θ∈[0,1] and the possibility that $g(\mu^*{}_a) = 0$. Thus, the first-order conditions are:

$$\frac{\partial \widehat{W}}{\partial \theta} = -\frac{dD}{d\theta} \cdot [\bar{A} \cdot \mu_a - \bar{c}] = 0 \quad (13)$$

$$\frac{d\widehat{W}}{dg} = -\frac{dD}{dg} \cdot [\bar{A} \cdot \mu_a - \bar{c}] \geq 0 \quad (14)$$

$$\left[-\frac{dD}{dg} \cdot [\bar{A} \cdot \mu_a - \bar{c}] - r \cdot \bar{A} \cdot \mu_a\right]\left[g(\mu^*{}_a) - \bar{g}\right] = 0 \quad (15)$$

This theoretical model makes it possible to detect some important predictions for understanding how the local fiscal situation matters for mortality during the COVID-19 pandemic. It is worth noting that it is being assumed here that public spending does not interfere with the efficiency of lockdown policy. While such an assumption is strong, in the following section it will be empirically demonstrated that it is valid in the context of Brazilian municipalities. More elaborate models can introduce this type of interaction, but would add little to the explanation of the phenomena in Brazil.

The first prediction of this model is that both municipal spending and lockdown policy can contribute to the reduction of COVID-19 mortality. However, since municipalities do not have the capacity to increase their fiscal space in the short run and there has been a delay in government aid to municipalities, then this spending is conditional only on the local current situation, represented by $\bar{g}$.

The lockdown policy has a major social cost, as it intensifies the economic recession and causes economic mortality. Spending does not suffer from this cost; however, it is limited to current spending, having a potential effect restricted to the local fiscal situation.

The second prediction of this model is that increased spending reduces mortality, but this does not necessarily imply increased welfare for the local government. The reason for this limitation is that municipal public spending depends on local political economy characteristics that matter in determining spending. For example, places with a large proportion of poor people may increase the demand for hospital services. However, such pressure on spending may not be relevant for local managers because they assign different weights to the importance of their citizens. This result is verified empirically in section 7.

Finally, the last important prediction of this model is that the expansion of the local fiscal situation can have relevant effects on COVID-19 mortality. This is represented in equation (15), where an increase in $\bar{g}$ represents a loosening of the constraint, making possible a consequent increase in g[26]. This result has already been evidenced empirically. In Figure 4 it is possible to observe that municipalities with better local fiscal conditions were able to reduce mortality during the COVID-19 pandemic. Moreover, such a difference persisted up to the point when there was the entry of resources from the federal government for aid to municipalities, starting in June 2020. In other words, making municipalities have the fiscal space to perform their local policies matters in tackling the pandemic of COVID-19.

Given the theoretical model and the first evidence that its conclusions are valid, two additional questions now need to be investigated. First, what policies were adopted by the municipalities in better fiscal conditions? This analysis is carried out in the next section (Section 6). Section 6 also investigates whether the better fiscal conditions had any effect on the implementation of policies to reduce social mobility and on social mobility itself.

Second, what local factors contributed to a greater expansion of municipal public spending in those municipalities with better fiscal conditions. This discussion is carried out in Section 7, which investigates the potential heterogeneous effects of local public spending on the expansion of hospital care capacity.

6. Fiscal situation and the response to the pandemic of COVID-19

This section discusses through which channels prior fiscal capacity contributed to mortality reduction during the COVID-19 pandemic. According to the predictions of the theoretical model, presented in the previous section, having better fiscal conditions during the pandemic enabled municipalities to make expenditures[27] that could expand hospital care capacity. Another possibility, also empirically tested, is that spending made non-pharmaceutical interventions (NPI) reducing social mobility more efficient. Both mechanisms can directly affect the mortality caused by the pandemic, whether that of fatal victims directly related to SARS-COV-2 infection, or fatal victims associated with other diseases or resulting from the economic shock on economic activity.

In this way, we will investigate what types of policies were adopted by municipalities with better fiscal capacity in relation to municipalities with previous fiscal difficulties. The first subsection discusses the expansion of hospital capacity, measured by the physical resources of hospital care (number of beds per 100 thousand inhabitants) and human resources (number of doctors per 100 thousand

26 It is being assumed that the constraint $g(\mu^*_a) \leq \bar{g}$ is active.

27 The greater fiscal capacity contributes not only to raise spending directly, but also to allow municipalities to increase spending on health, without compromising other destinations of public resources.

inhabitants). It will also be analyzed in this section if municipalities with better fiscal conditions were able to increase the quality of hospital care focused on the treatment of COVID-19 patients.

The second subsection discusses whether the previous fiscal situation allowed municipalities to adopt more effective measures to reduce social mobility. First, it is analyzed whether municipalities with less restrictive fiscal conditions were able to reduce social mobility related to going to work measured by Google through Android users. Subsequently, it is investigated if the fiscal situation contributes for the municipalities to adopt measures to control social mobility and if there was an effect on the duration of these measures.

6.1 Fiscal situation and the capacity of hospital care

To access whether the fiscal situation during the lockdown period affects the supply of hospital capacity the same empirical strategies used in the analysis on mortality will be used. The equation of interest defined by:

$$y_{it} = \beta_0 + \gamma\, Trat_i \times Lockdown_t + \mu_i + \tau_t + \varepsilon_{it} \qquad (16)$$

Where: y_{it} refers to the variable of interest in municipality i in period t. The variable $Trat_i$ represents the fiscal situation of municipality i in 2019. This variable assign value 1 for municipalities with CAPAG A and zero for the other CAPAG's (B, C and D). However, now the logarithm of the number of hospital beds per 100,000 inhabitants[28] and the logarithm of the hiring of doctors, nurses or other health professionals also per 100,000 inhabitants will be considered as outcome variables. These variables reflect both the physical and human capacity of hospital care. Since the outcome variables are in logarithm, the interpretation of the causal effect will be in terms of percentage points. Again, the variable $Lockdown_t$ is assigned a value of 1 for months after April 2020 and zero for months before that month. April 2020 represents the beginning of the period of mobility restrictions in Brazil, and March will be used as the reference month.

The parameter of interest is γ which measures the impact of lockdown adoption in municipalities with good fiscal prior conditions compared to municipalities with restricted fiscal situation on the different indicators of hospital care capacity. The variables μ_i e τ_t represent the municipal and monthly fixed effects used to absorb idiosyncratic differences between municipalities or national shocks in specific months that may affect the outcome variables.

In more demanding specifications state fixed effects multiplied by month are included. In addition, a set of predetermined variables are included for these results that seek to better control for the heterogeneity of Brazilian municipalities. We considered as predetermined variables those that could encourage mayors to alter municipal health spending to address the pandemic, such as the proportion of elderly, the municipal inequality index (Gini Index in 2010), the proportion of poor, and the

28 We used the total number of beds and not the number of ICU beds per municipality because there were public denouncements that the municipalities were disclosing an altered number of ICU beds (https://redepesquisasolidaria.org/wp--content/uploads/2020/06/boletim-9-pps_5junho.pdf) and also because small municipalities do not have the capacity to create ICU beds. Thus, the number of total beds may better reflect the municipality's effort to respond to the pandemic.

distance of the municipality to the capital[29]. All estimates were weighted by the population size of each municipality, officially measured in the last census of 2010.

An alternative specification is defined by the dynamic version of Equation 1 and seeks to analyze the evolution of the impact of the interaction between the lockdown period and the fiscal capacity of municipalities. This version is defined by:

$$y_{ist} = \beta_0 + \sum_{t=-6}^{-1} \beta_t Trat_i + \sum_{t=+1}^{8} \beta_t Trat_i \times Lockdown_t + \mu_i + \tau_t + u_{it} \quad (17)$$

In the Equation 17, six periods prior to the start of the lockdown (September 2019 through February 2020) and nine periods after (April 2020 through December 2020) the reference month, March 2020, are considered. The main validity hypothesis of the difference-in-difference (DiD) strategy is the parallel trend hypothesis, in which the behavior of municipalities should follow a similar trend in the absence of the pandemic shock. Although it is not possible to test such a hypothesis in practice, one way to approximate its validity is to observe whether differences in trends exist prior to the occurrence of the lockdown. Thus, it is expected that the parameters estimated before April 2020 do not show different trends. Finally, the causal identification is the same as that considered in the case of the analysis on the different mortality measures.

The Table 3 presents the estimates of the main results. Panel A refers to the logarithm of the number of beds per 100 thousand inhabitants. Panels B and C report the results for the logarithm of the number of doctors and nurses per 100,000 inhabitants, respectively.

Four different specifications are presented. The first considers only county and monthly fixed effects. The second includes state fixed effects multiplied with monthly fixed effects. The third specification adds a set of four predetermined municipal variables multiplied with time fixed effects. Finally, the fourth specification includes a monthly lag for the number of deaths per COVID-19 for each municipality. This last specification attempts to capture the influence that the intensity of COVID-19 mortality may have had on the expansion of municipalities' hospital capacity. Standard errors are in parentheses and were obtained by clustering by municipalities multiplied by month.

The estimates indicate that municipalities in a better fiscal situation before the pandemic (CAPAG A) increase the number of beds per 100 thousand inhabitants by approximately 5% more than municipalities with more restricted fiscal conditions (CAPAG B, C and D). This result is stable in different specifications, suggesting that the bed expansion is not driven by the absence of important control variables in the model. It is also noteworthy that the inclusion of the lag of the number of deaths by COVID-19 in municipalities does not significantly affect the estimates. This indicates that the adoption of policies to expand hospital capacity may vary independently of municipal exposure to the COVID-19 pandemic.

In turn, the effect of better fiscal conditions in 2019 is also relevant to differentiate the quantity of doctors and nurses during the pandemic. Panels B and C, in the preferred specification (model (4)), indicate that municipalities in better fiscal situations raise on average by up to 1.3% and 1.0% the number of doctors and nurses per 100,000 inhabitants relative to municipalities in worse fiscal conditions,

29 Municipalities closer to large centers, such as capital cities, may be less incentivized to undertake municipal spending due to the externality exerted by the prior hospital capacity of these large centers, see Acemoglu et al. (2015).

respectively. Again, the inclusion of more restrictive control variables does not significantly alter the estimates, suggesting that the results are robust.

Overall, the results suggest that better fiscal preconditions allowed for a larger expansion of hospital capacity during the pandemic period. In the literature, evidence is found that the existence of fiscal space is also important for countries' recovery from economic crises (ROMER AND ROMER, 2019; KOSE et al., 2017). Greater fiscal space allows countries to adopt countercyclical policies that enable the economy to recover more quickly. The result presented suggests that not only is national fiscal space important for adopting specific crisis coping policies, but also local fiscal space.

National incentives to adopt specific policies to address the pandemic are different from local incentives to undertake countercyclical policies for economic crises in general, such as recessions. In the case of the pandemic of COVID-19, the expansion of municipal capacity occurs in a situation where the provision of public services is shared with other government entities and in an environment of tight current revenue constraints.

TABLE 3 - Local tax situation and hospital capacity

Panel A: Quantity of Beds	(1)	(2)	(3)	(4)
Treatment	0,0403***	0,063***	0,051***	0,050***
	(0,004)	(0,005)	(0,004)	(0,004)
R2 - Adjusted	0,97	0,9709	0,9716	0,9716
Number of Deaths	84.091	84.091	84.091	84.091
Panel B: Physicians	(1)	(2)	(3)	(4)
Treatment	0,016***	0,023***	0,013***	0,013***
	(0,002)	(0,002)	(0,002)	(0,002)
R2 - Adjusted	0,9735	0,9737	0,9898	0,9898
Number of Deaths	85.093	85.093	85.093	85.093
Panel C: Nurses	(1)	(2)	(3)	(4)
Treatment	0,021***	0,024***	0,008***	0,010***
	(0,002)	(0,002)	(0,002)	(0,002)
R2 - Adjusted	0,9369	0,9375	0,9748	0,9748
Number of Deaths	85.095	85.095	85.095	85.095

Municipal Fixed Effect	Yes	Yes	Yes	Yes
Temporal Fixed Effect	Yes	Yes	Yes	Yes
State x FE Time	No	Yes	Yes	Yes
Predetermined	No	No	Yes	Yes
Additional Control	No	No	No	Yes

Source: Own elaboration.

Notes: The Table 3 presents the estimates of the effect of lockdown interacted with the municipality's fiscal situation on measures of hospital care capacity: number of beds, doctors and nurses per 100,000 inhabitants. Four different models are presented, varying according to the insertion of controls. Standard errors, in parentheses, were estimated using the clustering process considering the interaction between unit (municipality and state) and month. Significance: ***1% **5% *10%.

Both factors encourage a reduction in the supply of public goods and services by municipal governments that suffer negative externalities from other entities with greater capacity to increase fiscal space in the short term. Possibly, the little directive action of the federal government in Brazil, the severity of the health emergency caused by the COVID-19 pandemic, and the proximity of the municipal elections in 2020 have contributed to the municipalities acting even in the presence of strong incentives to the contrary.

The figure 5 presents the estimates for Equation 2, the dynamic model. For all estimations the preferred specification, model (4), which includes lagging the number of victims by COVID-19, predetermined variables, and state fixed effect multiplied by the monthly fixed effect, was considered. In addition to the results in Table 2, the impact on the logarithm of the number of other health professionals, non-physicians and non-nurses, also per 100,000 population is also reported. The blue line indicates the estimated parameters in each month and in light blue are the confidence intervals. The month of March 2020, used as a reference and removed from the sample to avoid collinearity, is represented by the value zero in Figure 5.

The results reported in the Figure 5 suggest no prior trends for the four variables of interest, implying that the introduction of the lockdown period combined with the prior fiscal situation of municipalities may have been primarily responsible for differentiating the temporal behavior of these variables. This result suggests the validity of the parallel trends hypothesis, which is necessary for the identification of causality through the difference-in-differences strategy. It is additionally noted that the first news about COVID-19, as well as the institution of lockdown in other countries, which occurred since December 2019, did not significantly affect the hospital capacity of Brazilian municipalities.

As for the results, it is observed that the quantity of beds responds more quickly to the beginning of the lockdown period. That is, municipalities in better fiscal conditions can rapidly expand their capacity to care for patients relative to municipalities in worse fiscal conditions. This effect is persistent until at least September 2020, five months after the lockdown is introduced. Starting in October 2020, the gap begins to narrow.

Regarding human resource capacity, the impact of the lockdown combined with fiscal conditions seems to be less instantaneous. In the case of physicians, a change in trajectory is observed from the beginning of the lockdown, but only from June 2020 does it become significant. Similarly, nurses and other health professionals show similar evolution, showing significant differences with respect to municipalities with worse fiscal conditions from October 2020, but changing the trajectory from April 2020.

The results suggest that the municipalities may have adopted different ways of acting in fighting the pandemic. Municipalities with lower fiscal restrictions were able to make more costly investments more quickly, such as expanding the number of beds. More fiscally constrained municipalities may have started their expenditures in fighting the pandemic by hiring doctors, so there were no significant differences between such municipalities in the first months after the lockdown, although the trajectory of the dynamic effect changed with the introduction of the lockdown favoring the expansion of doctors by CAPAG A municipalities.

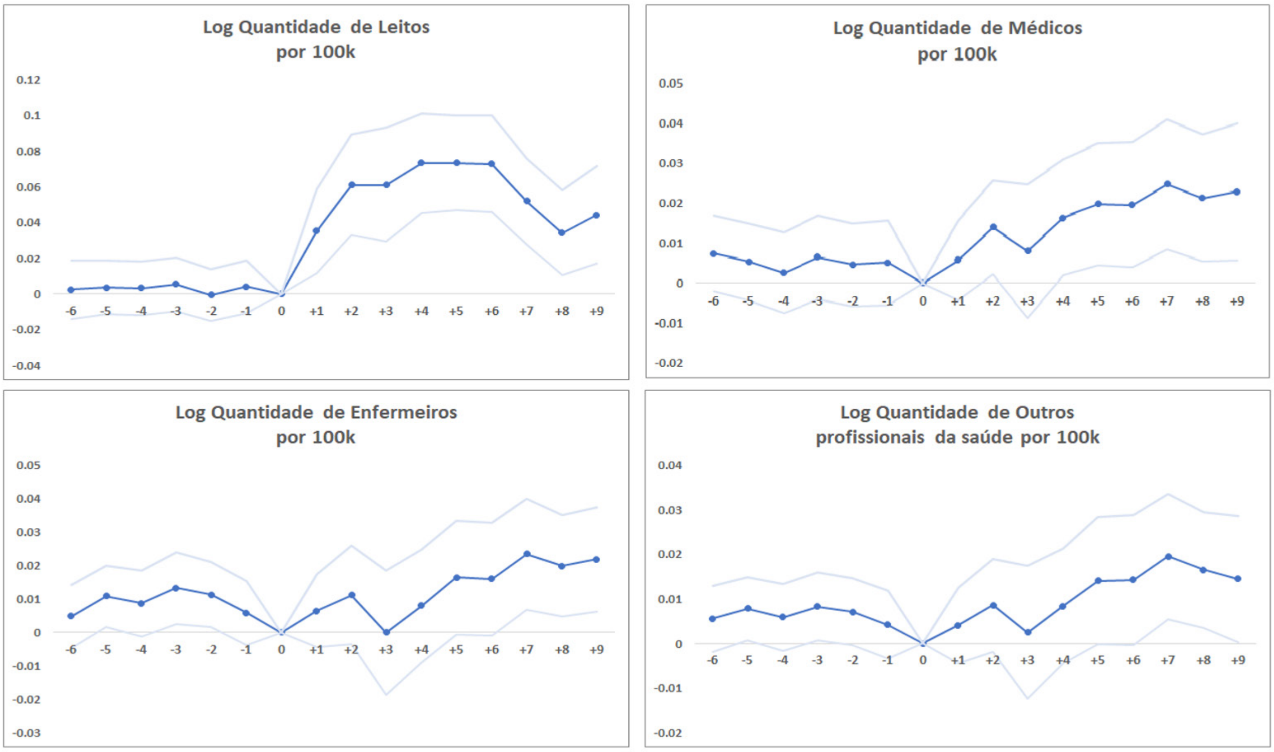
It is also worth noting that in the month of June 2020 (date +3 in Figure 5) the effect of hiring physicians and other health professionals decreases when comparing municipalities in better or worse fiscal conditions prior. In this month, municipalities were able to spend the resources from the first installment of the Federative Program for Confronting the SARS-COV-2 Coronavirus (Covid-19), launched by Complementary Law 173/2020. With the availability of fiscal resources and the mitigation of previous fiscal constraints, municipalities were able to expand the hiring of medical staff to deal with the COVID-19 pandemic. However, it is noted that this shock was temporary and in subsequent months the trajectories of the effects returned to the previous trend, suggesting that in the medium term, prior fiscal capacity is strongly associated with the pandemic coping response.

Four additional exercises were conducted to test the sensitivity of the results to different specifications of the econometric model. First, instead of considering April as the first month of exposure to the shock caused by the pandemic, the month of March 2020 was considered. In this month[30] the World Health Organization (WHO) announced that the new coronavirus infection as a global pandemic. This may have led some municipalities to anticipate the reduction in mobility in Brazil, which will take place starting in April 2020. All the results of the robustness exercises are presented in Table A2, located in the appendix. There was no evidence of the presence of anticipation on the main effect when considering the month of March 2020 for treatment initiation.

FIGURE 5 - Estimation of the dynamic model of hospital capacity

30 Specifically on March 11, 2020 it was announced that COVID-19 contamination would be elevated to pandemic status, by WHO Director Tedros Adhanom.

Log Number of Beds per 100k *Log Number of Physicians per 100k*



Log Number of Nurses per 100k *Log Number of Other Health Professionals per 100k*

Source: Own elaboration.

Notes: Figure 5 presents the evolution of the impact of introducing lockdown measures differentiating municipalities with better fiscal condition (CAPAG A) from those with worse (CAPAG B, C and D). Municipal and monthly fixed effects, variables pre-determined at the municipal level, state fixed effects interacted with monthly fixed effects, and the lag of the number of COVID-19 victims by municipality were used in all cases. In light blue, confidence intervals. Standard errors obtained by the clustering process considering the interaction between municipalities and months.

Second, Brazil currently has 5,570 municipalities with different characteristics and sizes. The presence of outliers can affect the results by intensifying the impact of shocks caused by the interaction between the lockdown period and local fiscal conditions. Table A1, presented in the appendix, indicated that municipalities in better economic development conditions had the best fiscal conditions in 2019. To check whether anomalous municipalities' behaviors drive the results, municipalities in the first and last population decile were excluded from the database. That is, the 10% most and least populous municipalities in Brazil were excluded. The regression with this restricted sample showed no significant differences from the unrestricted model, suggesting that outliers are not responsible for explaining the main results.

Third, all estimates presented in this section are weighted according to municipal population. It was also considered verifying whether this procedure causes distortion in the estimates the unweighted case. The results do not indicate that weighting alters the conclusions of this study.

Finally, it was checked whether changing the way of clustering the standard errors affects the significance of the estimates. The alternative of estimating the standard error clustering only at the level of municipalities was considered. Such a modification did not significantly affect the main results, except for the variable log the number of nurses per 100 thousand inhabitants.

6.1.2 Quality of hospital capacity expansion

The results presented so far show that municipalities with better fiscal conditions were able to expand hospital care capacity relative to municipalities with worse fiscal conditions. However, for the appropriate confrontation of the pandemic of COVID-19, specific hospital resources directed to fight influenza infections are necessary. In other words, just expanding hospital capacity may not necessarily be enough to cope with the demands of the COVID-19 pandemic.

To verify whether fiscal conditions matter for the quality of hospital services to face COVID-19, it will be compared if the hiring of physicians with specialties more adequate to the procedures required by the pandemic changes according to the previous municipal fiscal situation. That is, were municipalities with better previous fiscal conditions able to hire physicians with specialties focused on the care of patients infected by SARS-COV-2?

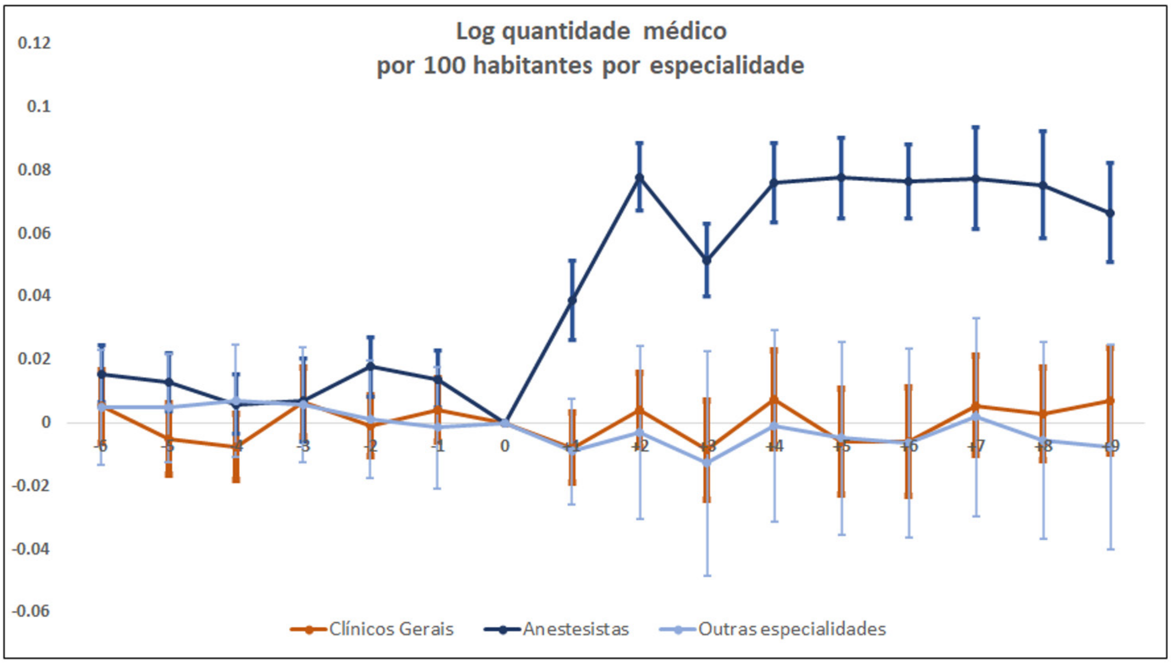
One of the procedures used for the care of severe cases of COVID-19 is intubation (Rocha et al. 2021). Medical anesthesiologists are fundamental to perform this procedure, thus being a medical specialty strongly required after the emergence of the pandemic. Thus, it will be analyzed whether municipalities in better fiscal conditions can expand the hiring of physician anesthesiologists in relation to municipalities in a more restricted fiscal situation.

For this exercise, the same empirical strategy of the dynamic difference-in-difference model will be used. The outcome variable will be replaced by the logarithm of the number of anesthesiologist physicians per 100 thousand inhabitants in each municipality i in month t. To check if the results are particular for this type of medical specialty, the same exercise will be performed considering the logarithm of the number of general practitioners and other medical specialties per 100 thousand inhabitants. General practitioners are physicians intended for primary care, but not necessarily focused on patients with COVID-19.

FIGURE 6 - Estimation of the dynamic model of quality of hospital care

Log quantity of physicians per 100 inhabitants per specialty

General Practitioners – Anesthetists – Other Specialties



Source: Own elaboration.

Note: Figure 6 presents the combined impact of the lockdown policy differentiated by the fiscal situation of the municipalities. In dark blue is the log of the number of anesthesia physicians per 100,000 population. Estimates are obtained from specifications that include municipal and monthly fixed effects, predetermined variables, state fixed effects multiplied with monthly fixed effects, and the one-month lag of the number of victims by COVID-19 for each municipality. Standard errors obtained when clustering by county multiplied by month.

Figure 6 presents the estimations for the dynamic model of the empirical strategy. We considered the most demanding specification that includes: additive municipal and monthly fixed effects, predetermined variables, state fixed effects multiplied with monthly fixed effects, and the one-month lag of the number of fatalities by COVID-19 for each municipality. Standard errors were obtained by clustering county multiplied by each month.

In dark blue is the estimate for the log of the number of anesthesiologists per 100 thousand inhabitants. In orange and light blue, the log of the number of general practitioners and other medical specialties, both per 100 thousand inhabitants, respectively. It can be observed in Figure 6 that municipalities in a better fiscal situation strongly expand the hiring of anesthesiologist physicians in comparison with other medical specialties. This effect represents a significant increase, on average, of 6% more anesthesiologist physicians than municipalities with lower fiscal space. Thus, it is possible to affirm that the local fiscal situation enabled the municipalities to hire doctors with specialties more directed to the treatment of COVID-19 patients.

On the other hand, the hiring of physicians with other specialties, whether general practitioners or not, does not differ among the municipalities according to their previous fiscal conditions. That is, it is not possible to affirm that the fiscal situation of the municipalities affects the number of general practitioners or physicians with other specialties. This result suggests that municipalities with better fiscal conditions sought to hire physicians with specialties appropriate to the treatment of COVID-19 and not any type of physician who may not have the same efficiency in the care of those infected with SARS-COV-2.

Importantly, the results presented in the Figure 6 also suggest the absence of prior trends for such variables of interest, suggesting the validity of the main hypothesis for causal identification in difference-in-differences (DiD) model.

Taken together, the results suggest that the fiscal capacity of municipalities prior to the coronavirus pandemic mattered for the management of the acquisition of physical and human capital resources during the pandemic. That is, the municipalities with a good fiscal situation before the pandemic were the ones that invested the most during the crisis in the expansion of beds, and in hiring physicians and other health professionals. It was also verified that municipalities with better fiscal conditions were able to hire doctors with specialties adequate for the treatment of severe cases of COVID-19, such as anesthesiologists. Thus, the municipal fiscal situation was also relevant to the quality of the supply of public services to confront the COVID-19 pandemic.

Expanding the capacity and quality of hospital care may have contributed to the fact that municipalities with better fiscal pre-conditions reduced the number of fatalities per COVID-19 relative to municipalities with more restricted fiscal conditions. It is worth noting that other potential channels may also have contributed to this result, such as a greater effectiveness of social distancing measures in municipalities with better fiscal situations. This issue is investigated in the following subsection.

6.2 Local tax situation and social distancing measures

This section documents the potential impact of prior local fiscal conditions on measures of social distancing. First, it is checked whether local fiscal conditions moderate the impact of lockdown on social mobility, as measured using cell phones with Android device. Subsequently, using city-level information of measures taken to control the movement of people, it will be tested whether the local fiscal situation contributed to certain measures being taken.

6.2.1 Impact of the local tax situation on social mobility

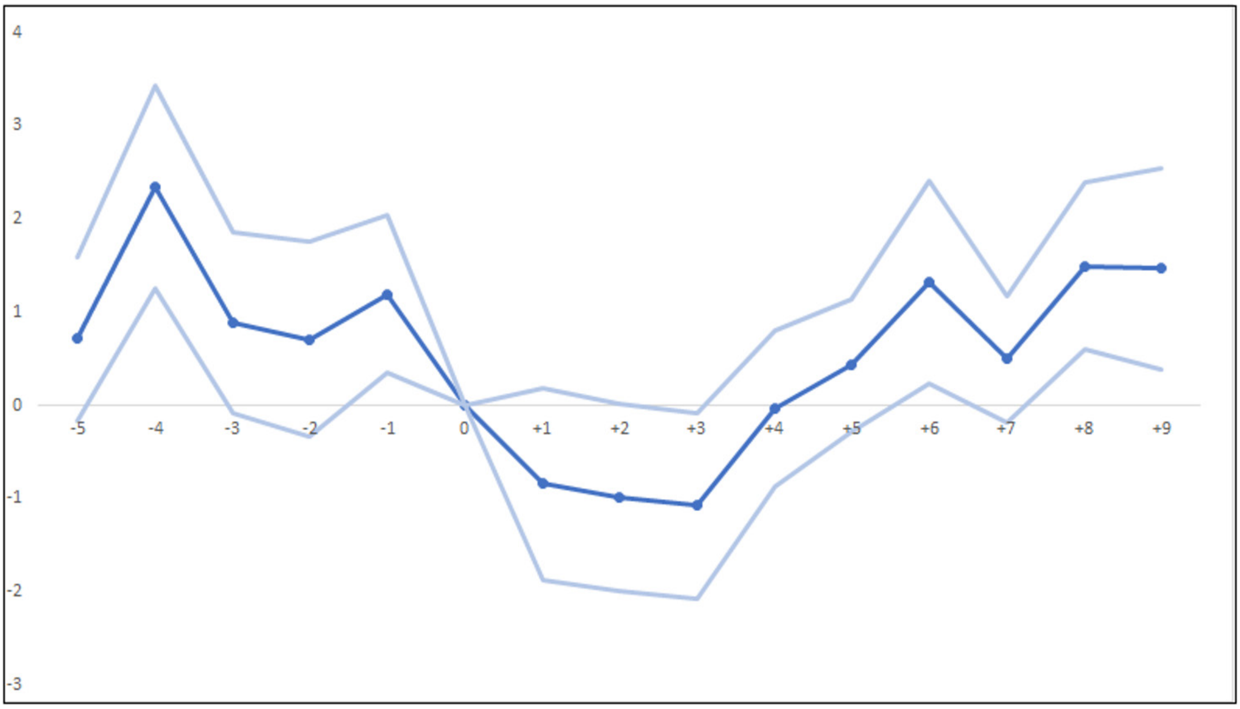
To measure social mobility, it was used mobility indexes made available by Google at the municipal level. These indexes present information about the displacement of people who use Android devices, focusing on different reasons for the occurrence of mobility, such as going to parks, going to work, shopping at supermarkets, among others. Although social mobility can be performed for various purposes, here we have chosen to limit it to social mobility for going to work. This type of social mobility has the largest coverage of municipalities with information measured by Google, with a total of 2282 (40%) Brazilian municipalities. Mobility for other purposes has a much smaller coverage, being concentrated in large urban centers. Furthermore, going to work is an important predictor of social mobility because it suggests that economic activity is still going on and that potentially the means of public transportation have not been paralyzed.

The social mobility index has a daily frequency; however, it will be aggregated in weekly frequency to reduce the potential noise in the time series, mainly related to seasonal variations such as weekends. These values are presented as the percentage difference over time of the social mobility category, in this case going to work, in relation to a fixed reference period. This period, defined by

Google, is from January 3 to February 6, 2020.

To estimate the effect of the introduction of lockdown the same empirical dynamic difference-in-difference strategy is used as in the previous subsection, considering the same model specifications as used in the results in Figure and 45. Figure 7 presents the results for social mobility.

FIGURE 7 - Dynamic model estimation on social mobility indicator



Source: Own elaboration.

Notes: Figure 7 presents the combined impact of the lockdown policy differentiated by municipalities' fiscal status for the social mobility case. Estimates are obtained from specifications that include county and monthly fixed effects, predetermined variables, state fixed effects multiplied with monthly fixed effects, and the one--month lag of the number of victims by COVID-19 for each county. Standard errors obtained by clustering by county and month. The light blue line indicates the confidence interval (95%).

A drop of approximately 1% in social mobility is observed in municipalities with better fiscal conditions. However, such a reduction was not significant, indicating that having better fiscal preconditions is not as relevant in explaining differences in social mobility across municipalities. Table A3 in the appendix presents the results of the point estimates. The effect is quite sensitive to the introduction of control variables, suggesting that other factors may have contributed more to the dynamics of municipal social mobility.

6.2.2 Adoption of social control measures

Better fiscal conditions during the time of the pandemic shock caused by COVID-19 may have contributed to the adoption of more effective social control measures. With more resources available, municipalities can hire staff to monitor whether measures are being followed, can transfer resources directly to citizens to mitigate the economic effects of the pandemic, or can purchase and distribute materials that help minimize the spread of SARS-COV-2, such as masks and alcohol gels.

To verify whether the adoption of such measures may have been affected by the previous fiscal situation a model is estimated using cross-sectional data, whose outcome variables represent the adoption of measures by municipalities. The source of such variables is a survey conducted by the National Confederation of Municipalities (CNM) and made available by Sousa Santos et al (2021).

Five measures potentially adopted by municipalities are analyzed: Adoption of sanitary barriers at the entrance of the municipalities, Adoption of measures for the reduction of crowding (control of the circulation of people in the street, for example), Adoption of social isolation measures (e.g., closing of commercial establishments and maintenance of the provision of essential public services), Implementation of the mandatory wearing of masks and Reduction of the supply of public transport. All these variables are binary, with a value of 1 assigned if the municipality has adopted any of these measures and zero otherwise.

To verify whether the tax situation influenced the intensity of social control measures, we will also use the variable that measures the duration of adoption of social isolation measures, that is, the number of days that such measure was adopted throughout the year 2020. Finally, to avoid problems related to multiple testing, an index of the adoption of isolation measures was created as the first factor of the principal components method applied to the six previous variables.

The model to be estimated is defined by:

$$y_{is} = \beta_0 + \gamma \, Trat_i + X_i + \tau_s + \varepsilon_{is} \qquad (18)$$

Where: y_{is} refers to the variable of interest in county i in state s. The variable $Trat_i$ represents the fiscal situation of municipality i in 2019. This variable assigns value 1 for municipalities with CAPAG A and zero for the other CAPAG's (B, C and D). A vector of predetermined variables is added, X_i. This is analogous to the models used in the previous subsection. Finally, state level fixed effects are added to capture specific variations in state public policies. Again, the parameter of interest is γ which indicates how much having prior fiscal conditions contributed to explain the adoption or duration of such measures. The standard error is estimated by clustering at the municipal level.

The results are presented in Table 4. It is apparent that tax status did not have a significant effect in explaining the probability of adopting the social isolation measures. In the case of the adoption of sanitary barriers, the only variable that was statistically significant, having better fiscal conditions reduced the probability of adopting this measure. This result is not in accordance with what was expected, however, it may be due to problems related to multiple testing.

When considering the aggregate estimator (Index of Adoption of Isolation Measures), it is found that the effect is small and not significant. That is, having better fiscal conditions does not seem to contribute to the adoption of social isolation measures. Therefore, the effect of fiscal status on the reduction of mortality related to the COVID-19 pandemic can be explained by the expansion of hospital care capacity, either in quantitative or qualitative terms.

TABLE 4 - Local tax situation and social mobility measures

Variables	Sanitation Barriers	Measures for reduction of agglomeration	Measures for social isolation	Mandatory use of masks	Reduction of public transport offer	Duration of the social isolation measures	Adoption Rate of social isolation measures
Treatment	-0,047**	-0,006	0,0091	-0,0032	0,0356	2,511	-0,007
	(0,021)	(0,007)	(0,020)	(0,009)	(0,023)	(1,678)	(0,100)
R2 - Adjusted	0,2515	0,0107	0,0502	0,033	0,0505	0,141	0,165
Number of municipalities	3.924	3.913	3.906	3.900	3.856	1.556	693
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Source: Own elaboration.

Notes: Table 4 presents the results of the relationship between previous fiscal situation and social mobility measures to face the pandemic of COVID-19. Only in the estimation for health barriers was there statistical significance of the coefficient of interest, however it escapes the expected. Standard errors in parentheses. Significance: ***1% **5% *10%.

7. Heterogeneous Effects

This section discusses the heterogeneous effects of municipal response given their prior fiscal situation. First, it will be analyzed to what extent some municipal characteristics generate different responses from municipalities with better fiscal conditions to the pandemic. Four municipal characteristics will be investigated, which have a strong relationship with the determination of local public spending. Subsequently, it will be analyzed whether different types of fiscal constraints cause differentiated impacts in response to the COVID-19 pandemic.

7.1 Heterogeneous effects for certain municipal characteristics

The pandemic episode of COVID-19, although tragic for humanity, allows us to understand how local public spending is carried out in situations of high demand for public services given different population characteristics. These results are important because they help predict the behavior of public managers in different scenarios (such as economic crises, natural disasters, strong changes in the economic cycle) and understand the way in which these actors face such problems.

This monograph is interested in understanding what municipal characteristics contribute to a greater (or lesser) response in coping with the pandemic when better fiscal conditions are in place compared to municipalities in a worse fiscal situation. The central concern is whether there are local factors that generate a greater local response to coping with the COVID-19 pandemic when adequate fiscal conditions exist. It is important to note that this analysis is quite propitious to be applied in the Brazilian context that has many municipalities with different local and fiscal characteristics, in which they were affected by the pandemic in a specific way.

To this end, the municipalities will be separated into subsamples according to certain local characteristics, and the same empirical strategy employed in the previous sections will be reapplied to each subsample. Such analysis will focus on four sets of local characteristics: proportion of poor, proportion of elderly, income inequality, and political polarity. These local factors are important determinants of municipal spending. The section dealing with the relationship to the literature in this monograph discusses some work that substantiates the choices of these characteristics as relevant to how municipal managers make their spending decisions.

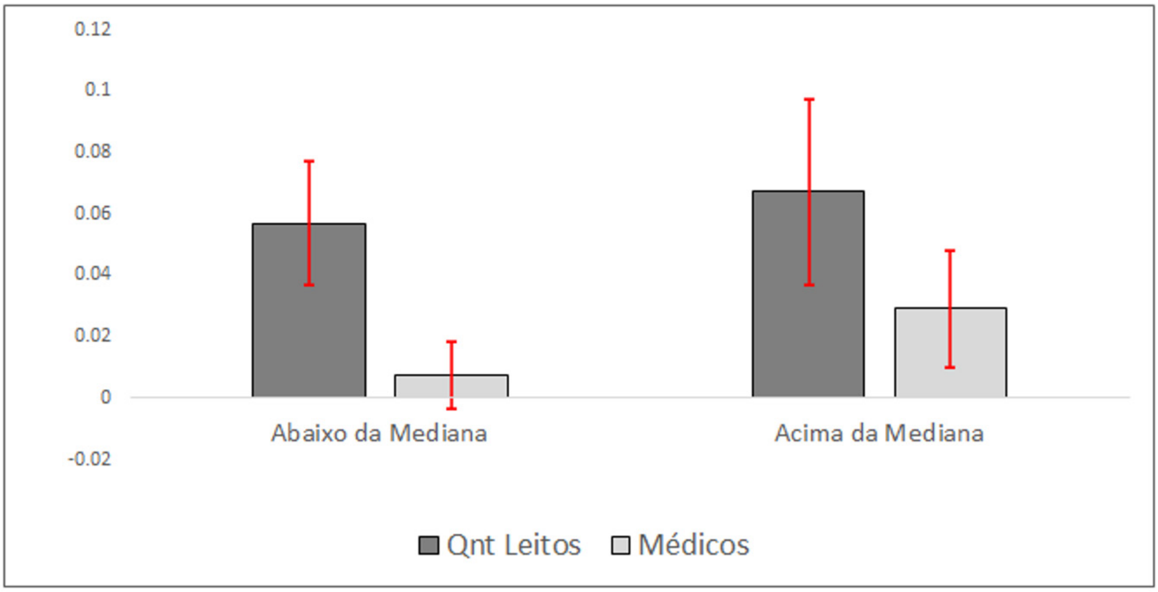
The analyses will focus on two outcome variables only: total beds and doctors per 100,000 inhabitants. These variables were the ones that had a positive effect in those municipalities with better fiscal conditions.

7.1.1 Demand for hospital services during the pandemic of COVID-19: Proportion of the poor and proportion of the elderly

Both the larger numbers of poor individuals and the higher proportion of elderly people are local characteristics that account for much of the demand for public health services during a pandemic. The poorest population, especially in developing countries, is quite vulnerable to the introduction of lockdown, as discussed in the section on the theoretical model. Similarly, it is the case for municipalities that have a high proportion of elderly individuals. As these have low immunity due to advanced age, there is a need for further expansion of hospital care capacity. In both cases, municipalities are expected to increase hospital capacity in response to the increased demand for such services during the COVID-19 pandemic.

Municipalities with a higher proportion of elderly will be defined as those that are located above the median in the distribution of the proportion of elderly. In turn, municipalities with lower proportion of elderly are those that are below the same median. The estimates are obtained by estimating the same regression as in the section 6 applied now only to these subgroups. Importantly, the specification used to obtain these estimates includes both municipal and time-varying state fixed effects. The Figure 8 presents the effect of the subgroup analysis for municipalities with higher or lower proportions of elderly. In dark gray is the impact on municipalities in better conditions compared to other municipalities for the number of beds per 100,000 inhabitants. In lighter gray is the impact on the number of doctors per 100,000 inhabitants in each of the subgroups. In red is the confidence interval of the point estimate.

FIGURE 8 - Heterogeneous effects for the proportion of elderly



Below Median – Above Median

Quantity of Beds - Physicians

Source: Own elaboration.

Notes: Figure 8 presents the estimation of heterogeneous effects for proportion of elderly.

The specification used to obtain such estimates includes city and time fixed effects, in addition to time-varying state fixed effects.

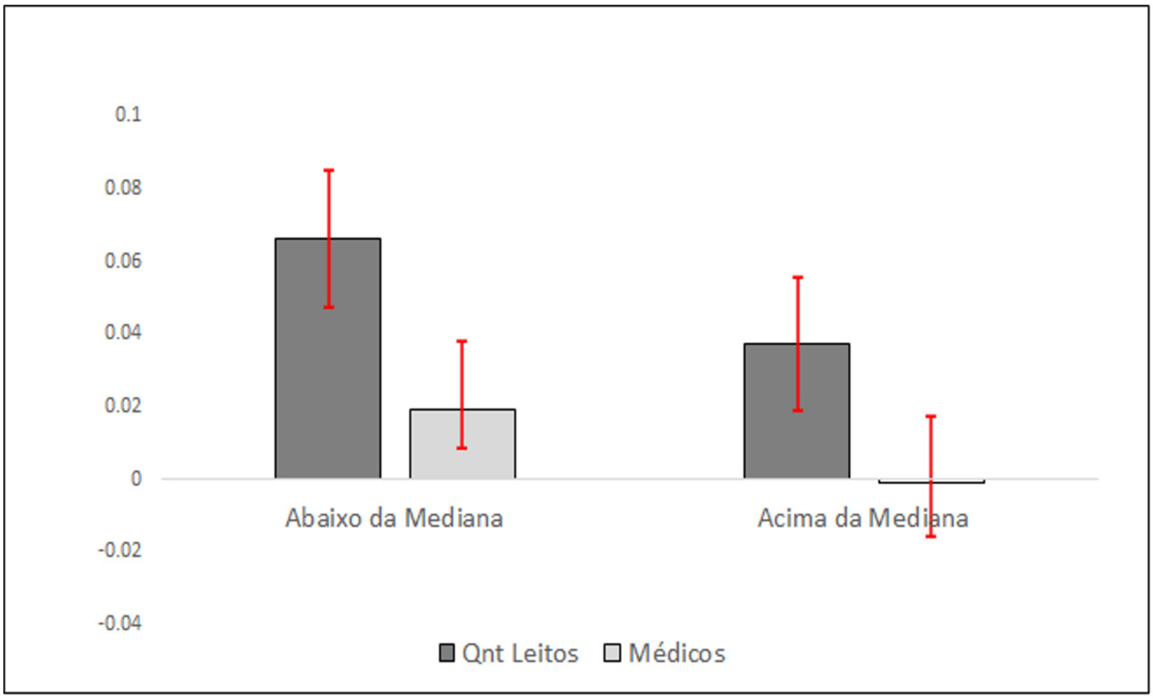
The higher the proportion of elderly in the municipalities (above the median) the greater tends to be the effect of the introduction of lockdown on both the quantity of beds and the quantity of doctors in the municipalities with better fiscal conditions. Thus, the Figure 8 suggests that such municipalities reacted positively to this demand stimulus for public health services.

In turn, the Figure 9 presents the same analysis for the case of the proportion of poor individuals. The separation between more or less poor municipalities is carried out in the same way as for the proportion of the elderly, but taking into account the distribution of the proportion of poor individuals among Brazilian municipalities. Contrary to the case of the elderly, poorer municipalities in better fiscal conditions expanded hospital capacity less. This result is valid for both the number of doctors and the number of beds.

These estimates suggest that not all the demand stimulus for public spending on health during the pandemic was met, even if there was fiscal space to do so. While the higher proportion of poor people caused the better-off municipalities to spend more, this was not the case for the poorer municipalities. Two hypotheses may help explain these differences. First, poorer individuals have less local political power, and therefore mayors may not be interested in meeting the demand for health services from these individuals. Compared to the results in Figure 8, the elderly may have a more relevant political economy effect if their demand is not met.

Second, mayors might not have had the real understanding of the impact of the pandemic on poorer individuals, so they might have spent less. As opposed to the impact of the pandemic on the elderly. While this hypothesis is theoretically plausible, there are two important caveats. First, if there was a lack of understanding of the effect of the pandemic on the poorest, it was expected that such a phenomenon would not be solely concentrated in the poorest municipalities. That is, it was expected that the estimates would be more similar between the two groups above and below the median poverty distribution. Second, when the lockdown starts in Brazil, some countries were already reporting that more socially vulnerable individuals would tend to be more affected by the COVID-19 pandemic.

FIGURE 9 - Heterogeneous effects for the proportion of poor



Below Median – Above Median

Quantity of Beds - Physicians

Source: Own elaboration.

Notes: Figure 9 presents the estimation of heterogeneous effects for proportion of poor.

The specification used to obtain such estimates includes city and time fixed effects, in addition to time-varying state fixed effects.

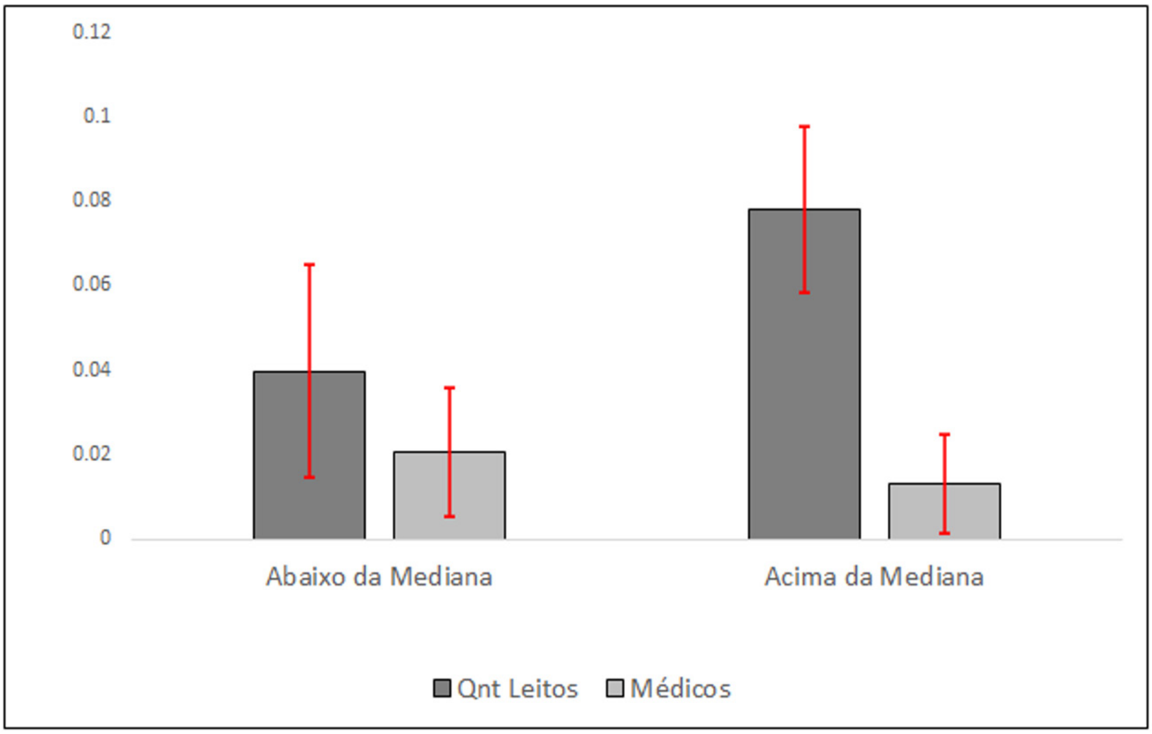
In any case, the results presented show that there was a partial response to a greater demand for hospital services at the local level, even when these municipalities had the fiscal capacity to spend more.

7.1.2 Income inequality

Income inequality is an important determinant of the balance of local power. More unequal municipalities tend to have political and economic power concentrated in the hand of a few people and this can influence public spending decisions (GÄCHTER et al 2017; BERGSTROM, BLUME, and VARIAN 1986; OSTROM et al 1994). Thus, it is expected that in more unequal places the response to the pandemic, when fiscal space exists, will be smaller than in less unequal municipalities in which political and economic power is more decentralized.

The Figure 10 presents the estimates considering the subgroups above and below the median of the income inequality distribution, measured by the Gini index. The results are not similar with respect to the number of beds and doctors per 100 inhabitants.

FIGURE 10 - Heterogeneous effects for income inequality



Below Median – Above Median

Quantity of Beds - Physicians

Source: Own elaboration.

Notes: The Figure 10 presents the estimation of heterogeneous effects for income inequality (Gini Index). The specification used to obtain such estimates includes municipal and time-varying fixed effects, in addition to time-varying state fixed effects.

More unequal municipalities (above the median) with better fiscal conditions spent more on expanding the number of beds than less unequal municipalities (below the median), also with good fiscal conditions. However, the result was the opposite when the number of doctors was analyzed. More unequal municipalities (above the median) with better fiscal conditions spent less on expanding the number of doctors than less unequal municipalities (below the median), also with good fiscal conditions.

It is concluded that only spending in relation to physicians seems to be affected by municipal income inequality according to what is predicted by economic theory. In the case of the number of beds, greater income inequality generated a positive effect on the expansion of hospital capacity.

7.1.3. Political polarization

Environments with high political polarization are more difficult to reach consensus on deciding where and how to allocate public resources (ALESINA et al 1999; ALESINA and LA FERRARA

2000; GERRING et al 2015; ASHRAF and GALOR 2013). Thus, more polarized locations are expected to have a greater difficulty in providing an efficient response to pandemic COVID-19 in terms of expanding hospital capacity.

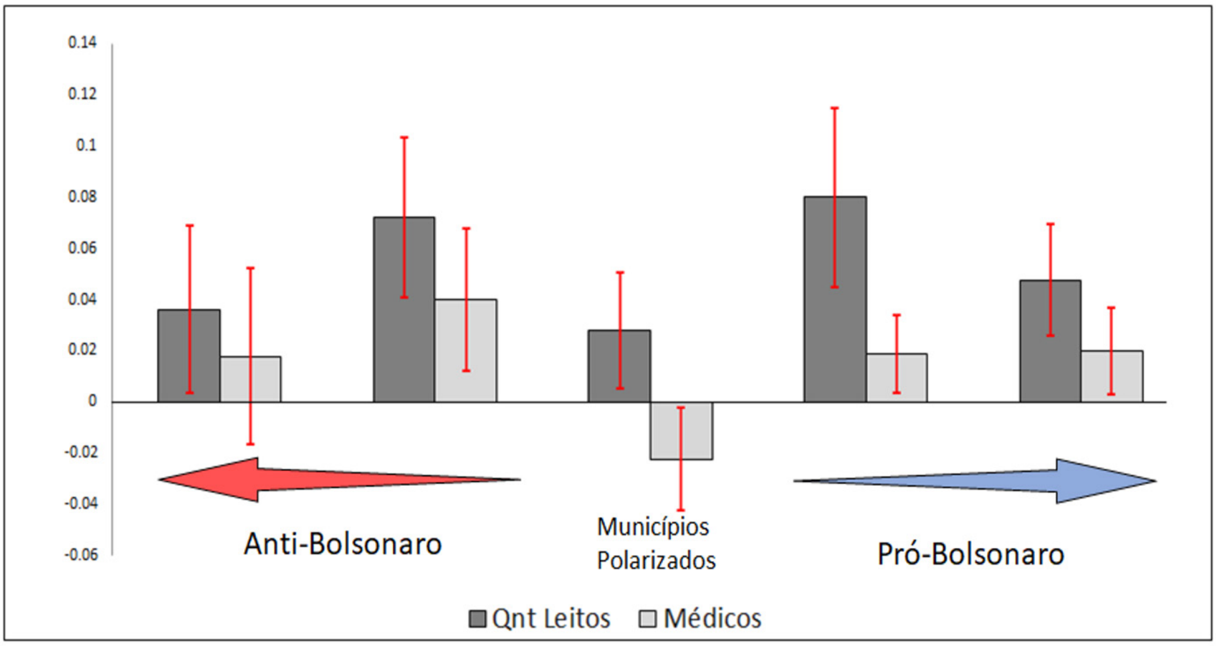
To measure political polarization at the local level, we used the proportion of votes for President Jair Bolsonaro in the 2018 election during the runoff election. The 2018 runoff elections are well suited to the goals of this section for three reasons. First, it was held in all Brazilian municipalities. Second, it was held before the first case of COVID-19 was recorded in the world, which ensures that support for a particular candidate was not influenced by how he would handle the pandemic. Third, President Jair Bolsonaro advocates different pandemic coping measures than his opponents in 2018, represented by the Workers' Party (PT) candidate, Fernando Haddad.

To address such a question, the sample of municipalities was divided into five quintiles according to the proportion of votes President Jair Bolsonaro had in the 2018 runoff elections. Municipalities located below the 20th percentile are called strongly supportive of candidate Fernando Haddad. In turn, municipalities located between the 21st percentile and the 40th percentile are called municipalities that support candidate Fernando Haddad. On the other hand, those municipalities that are located above the 80th percentile are called municipalities with strong support for President Jair Bolsonaro and those located between the 60th and 79th percentiles are named as having supported President Jair Bolsonaro.

Finally, those municipalities in which there was no clear consensus of support for either President Jair Bolsonaro or candidate Fernando Haddad (those located between the 40th and 59th percentiles) will be called politically polarized municipalities. The definition of polarization here is based on the dispute of two groups with different views around a specific issue. In municipalities where there was no clear support for either candidate, discussions about what kind of response should be employed during the pandemic are expected to be less consensual.

The Figure 11 presents the estimated results of the subgroup analysis and two clear patterns are observed in Figure 11. First, more polarized municipalities had worse performance in responding to the pandemic even in the presence of fiscal space. Both for the number of beds and the number of doctors per 100 thousand inhabitants, the impact of the expansion was lower in these municipalities. In the case of doctors, the response was negative, suggesting that municipalities in worse fiscal conditions were able to hire more doctors to be able to serve the population than those municipalities in better fiscal conditions. This result is strongly related to the difficulty of reaching consensus for the supply of public goods in very polarized environments.

FIGURE 11 - Heterogeneous effects for political polarization



← *Against Bolsonaro – Polarized Municipalities – In favor of Bolsonaro* →

Quantity of Beds - Physicians

Source: Own elaboration.

Notes: The Figure 11 presents the estimation of heterogeneous effects for political polarization. The specification used to obtain such estimates includes city and time-varying fixed effects, in addition to time-varying state fixed effects.

The second pattern observed in the graph is that municipalities that extremely supported either candidate perform worse than those municipalities that moderately supported either candidate Fernando Haddad or President Jair Bolsonaro. This suggests that local political dominance influences how local governments respond to pandemic when they have the fiscal space to provide public services. Surprisingly, such an observation is not dependent on the political party for which voters have supported. That is, the response to the pandemic for those municipalities in better fiscal conditions depends much more on the existence of a political consensus than on the defense of a specific ideological agenda.

7.2. The heterogeneous effect of coping with the pandemic of COVID-19 to different types of fiscal constraints

This subsection will investigate whether different types of local fiscal conditions enable hospital capacity expansion in a specific way. For this purpose, instead of measuring the municipal fiscal situation through the CAPAG indicator, its sub-indicators will be considered: indebtedness, current savings and liquidity. Like the previous discussion, a municipality is considered to have an adequate fiscal situation, group treated, if it is graded A in the sub-indicators. Otherwise, the municipality will be considered as part of the control group.

The empirical strategy adopted is the same as that presented in Equation 16, and the outcome variables will be the logs of the quantities of beds, doctors and nurses per 100 thousand inhabitants.

The specification adopted to estimate each of the models is more demanding, which includes: additive municipal and monthly fixed effects, predetermined variables, state fixed effects multiplied with monthly fixed effects, and the one-month lag of the number of fatalities by COVID-19 for each municipality. Standard errors were obtained by clustering by county multiplied by each month.

The Table 5 reports the results. Regarding the expansion of the number of beds, being in an adequate fiscal situation is important in all three sub-indicators. The current savings, represented by the weighting of the primary surplus in the last three years, is the one with the greatest impact on this type of hospital resource, being in agreement with the results presented in Table 5. In fact, municipalities with better current savings can expand by up to 4.6% the total number of beds in relation to municipalities with worse fiscal conditions in this item.

In turn, with respect to the number of physicians, the municipal debt indicator does not seem to be relevant. Current savings is again the fiscal characteristic with the greatest magnitude. Municipal fiscal liquidity also has a significant average impact, but less than current savings. In relation to the total number of nurses, debt and liquidity have quite similar magnitudes. Current savings has a significant effect, but the size of the estimate is smaller.

Taken together, the results indicate that current savings, successive periods of primary surplus, and the existence of liquidity are the fiscal indicators with the greatest impact on hospital capacity during the pandemic. These results may be associated with the existence of available resources for immediate and emergency use, or in the absence of expenditure obligations, allowing a shift of items to health spending. Future studies could evaluate whether there was an increase in health spending in the period or a change in the composition of expenditures.

TABLE 5 - Heterogeneous effects for different types of fiscal constraints

Variables	Indebtedness	Liquidity	Current Savings
Total number of beds	0,0291***	0,011***	0,046***
	(0,003)	(0,002)	(0,003)
Total number of physicians	0,002	0,008***	0,0100***
	(0,002)	(0,002)	(0,002)
Total number of nurses	0,0106***	0,011***	0,005**
	(0,002)	(0,002)	(0,002)
Municipal Fixed Effect	Yes	Yes	Yes
Temporal Fixed Effect	Yes	Yes	Yes
State x FE Time	Yes	Yes	Yes
Additional Control	Yes	Yes	Yes
Predetermined	Yes	Yes	Yes

Source: Own elaboration.

Notes: Table 5 presents the estimates of the effect of lockdown interacted with the fiscal situation of the municipality on the total number of beds, doctors and nurses. Fiscal situation is measured by the CAPAG sub-indicators: debt, liquidity and current savings. Municipal and monthly additive fixed effects, predetermined variables, state fixed effects multiplied with monthly fixed effects, and the one-month lag of the number of fatalities by COVID-19 for each municipality are considered in the estimation. Standard errors in parentheses, estimated by the clustering process considering the interaction between county and month. Significance: ***1% **5% *10%.

In the case of the expansion of the number of beds, the municipality's indebtedness is quite relevant and this may be related to the costs of expanding physical resources for health care. Unlike the hiring of personnel, the expansion of the number of beds may require a greater contribution of initial resources and higher maintenance costs in the medium term. Having little debt may allow these municipalities to make such investments through this instrument.

8. Conclusions

This monograph sought to understand the importance of the local fiscal situation to face the SARS-COV-2 pandemic. The SARS-COV-2 pandemic represented, and still represents, a huge challenge for public management in all entities, since the main control measures of SARS-COV-2 directly affect tax revenue. On the other hand, the public policies necessary for the proper response to the pandemic involve increased public spending and redirection of commitments, which are difficult to achieve in a short period of time. In the case of subnational entities, the challenges are even greater because they are not able to expand their fiscal space through debt. In this context, the existence of better fiscal conditions can be fundamental to the response of municipalities to face the pandemic.

To verify the validity of such hypothesis, it was tested whether the local fiscal situation contributed to municipalities having lower mortality rates during the year 2020. The results indicate that having better fiscal conditions contributed to reduce total mortality, measured by excess mortality and p-score, and mortality directly associated with SARS-COV-2 infection. This result is unique in the literature on the topic and helps to understand the importance of institutions capable of providing greater fiscal space for municipalities during periods of crisis.

Subsequently, a theoretical model was developed that seeks to understand the mechanisms by which the prior local fiscal situation can affect mortality during the pandemic. The heterogeneous agent model suggests that municipalities have two tools at their disposal to mitigate the effects of the pandemic: lockdown policy and local public spending. The introduction of lockdown reduces the circulation of SARS-COV-2, but negatively affects economic activity that indirectly can victimize the most vulnerable individuals. On the other hand, local public spending allows municipalities to increase hospital care capacity, but is restricted to the existence of fiscal space for extraordinary expenditures. Both policies have trade-offs that are considered by mayors, however, in the absence of local fiscal space, mayors are left to adopt the lockdown policy, which deepens the recession naturally caused by the pandemic.

To verify if the predictions of the model are correct, it was empirically analyzed if municipalities in better fiscal conditions manage to increase the capacity of hospital care in comparison to municipalities in a restricted fiscal situation. The results indicate that the local fiscal situation contributed to the increase in the number of beds, doctors, and nurses per 100 thousand inhabitants. Additionally, it was documented that such municipalities were also able to provide a more focused public hospital care on the problems related to facing COVID-19, through the higher hiring of anesthesiologist physicians. No relationship was found between local fiscal conditions and the effectiveness of lockdown policies.

Finally, we analyzed whether these results have heterogeneous effects according to the characteristics of the municipalities. The subsample analysis indicated that a higher demand for health services, represented by the proportion of elderly people, raises the impact of the local fiscal situation on the response of municipalities. However, the same result was not found for the demand driven by the higher presence of individuals in poverty. Income inequality showed mixed results, with a greater effect on the acquisition of hospital beds when inequality is higher, and a higher effect on the hiring of doctors when inequality is lower. The last factor analyzed was political polarization in which it was found that municipalities with greater political polarization have more difficulty in expanding the capacity of hospital care, even in the face of fiscal space to make expenditures.

Taken together, the results documented in this monograph underscore the importance of local fiscal conditions for coping with crises such as the COVID-19 pandemic, or other crises requiring exceptional spending such as natural disasters and economic downturns. Two aspects should be emphasized as policy directions. First, it is necessary to rethink institutions that contribute to maintaining the proper fiscal position of municipalities. Institutions such as the Fiscal Responsibility Law (LRF) or the restrictions imposed by the CAPAG should be improved to ensure that municipalities maintain control over local fiscal conditions.

Second, it is necessary to rethink the mechanisms for expanding local fiscal capacity in periods of crisis. In Brazilian fiscal federalism, the Federal Government is responsible for raising the fiscal capacity of subnational entities in periods of crisis through intergovernmental transfers. However, in periods when the Federal Government itself has difficulty in sustaining its public debt, the mechanism of intergovernmental transfers is compromised[31]. An alternative may be the institution of rescue funds for subnational entities. These funds are known as Rainy-Day Funds and have been recurrently applied in the United States. Such an instrument can reduce the risk of local fiscal exposure to exogenous shocks, and can be an alternative for countries with historically low fiscal capacity and high economic volatility (Clemens, Ippolito, and Veurger 2021; Matton 2003).

31 For example, in 2021 there was no help for the subnational entities from the Federal Government, even though the second wave of the pandemic was more severe. One of the reasons for this is the recent growth of federal public debt that compromises the sustainability of public debt.

9. References

Acemoglu, Daron. 2005. "Politics and economics in weak and strong states." Journal of monetary Economics (527): 1199-1226.

Acemoglu, Daron, Victor Chernozhukov, Iván Werning, Michael D Whinston, et al. A 2020.multi-risk SIR model with optimally targeted lockdown. Working Paper 27102. National Bureau of Economic Research.

Acemoglu, Daron, Camilo García-Jimeno, and James A Robinson. 2015. "State capacity and economic development: A network approach." American Economic Review (1058): 2364-2409.

Acemoglu, Daron, and James A Robinson. 2019. "Rents and economic development: the perspective of Why Nations Fail." Public Choice (1811): 13-28.

Alesina, Alberto, Reza Baqir, and William Easterly. 1999. "Public goods and ethnic divisions." The Quarterly journal of economics (1144): 1243-1284.

Alesina, Alberto, and Eliana La Ferrara. 2000. "Participation in heterogeneous communities." The Quarterly Journal of Economics (1153): 847-904.

Alon, Titan, Minki Kim, David Lagakos, and Mitchell VanVuren. 2020. How should policy responses to the COVID-19 pandemic differ in the developing world? Working Paper 27273. National Bureau of Economic Research.

Alvarez, Fernando, David Argente, and Francesco Lippi. 2021. "A Simple Planning Problem for COVID-19 Lock-down, Testing, and Tracing." American Economic Review: Insights (33): 367-82.

Ashraf, Nava, Edward L Glaeser, and Giacomo AM Ponzetto. 2016. "Infrastructure, incentives, and institutions." American Economic Review P&P, (1065): 77-82.

Ashraf, Quamrul, and Oded Galor. 2013. "Genetic diversity and the origins of cultural fragmentation." American Economic Review (1033): 528-33.

Aum, Sangmin, Sang Yoon Tim Lee, and Yongseok Shin. 2021. "Inequality of fear and self-quarantine: Is there a trade-off between GDP and public health?" Journal of Public Economics 194:1-9.

Bassier, Ihsaan, Joshua Budlender, Rocco Zizzamia, Murray Leibbrandt, and Vimal Ranchhod. 2021. "Locked down and locked out: Repurposing social assistance as emergency relief to informal workers." World Development 139:1-23.

Bergstrom, Theodore, Lawrence Blume, and Hal Varian. 1986. "On the private provision of public goods." Journal of public economics (291): 25-49.

Besley, Timothy, Ethan Ilzetzki, and Torsten Persson. 2013. "Weak states and steady states: The dynamics of fiscal capacity." American Economic Journal: Macroeconomics (54): 205-35.

Besley, Timothy, and Torsten Persson. 2009. "The origins of state capacity: property rights, taxation, and politics." American economic review (994): 1218-44.

. 2011. Pillars of Prosperity: The Political Economics of Development Clusters. Princeton University Press. ISBN: 9781400840526.

Brotherhood, Luiz, Tiago Cavalcanti, Daniel Da Mata, and Cezar Santos. 2020. Favelas and pandemics. Working Paper Series N° 2020/35. Cambridge-INET.

Cabanas, Pedro, Bruno Kawaoka Komatsu, and Naercio Aquino Menezes Filho. 2014. "Income Growth and Young People's Choices between Studies and the Labor Market." National Economics Meeting.

Clemens, Jeffrey, Benedic Ippolito, and Stan Veuger. 2021. "Medicaid and fiscal federalism during the COVID-19 pandemic." Public Budgeting & Finance.

Eichenbaum, Martin S, Sergio Rebelo, and Mathias Trabandt. 2020a. The macroeconomics of epidemics. Working Paper National 26882. Bureau of Economic Research.

____. 2020b. The macroeconomics of testing and quarantining. Working Paper National 27104. Bureau of Economic Research.

Gachter, S, F Mengel, E Tsakas, and A Vostroknutov. 2017. "Growth and inequality in public good provision." Journal of Public Economics 150:1-13.

Gerring, John, Strom C Thacker, Yuan Lu, and Wei Huang. 2015. "Does diversity impair human development? A multi-level test of the diversity debit hypothesis." World Development 66:166-188.

Goldstein, Patricio, Eduardo Levy Yeyati, and Luca Sartorio. 2021. "Lockdown fatigue: The diminishing effects of quarantines on the spread of COVID-19." Research Square.

Haug, Nils, Lukas Geyrhofer, Alessandro Londei, Elma Dervic, Amélie Desvars-Larrive, Vittorio Loreto, Beate Pinior, Stefan Thurner, and Peter Klimek. 2020. "Ranking the effectiveness of worldwide COVID-19 government interventions." Nature human behavior (412): 1303-1312.

Hausmann, Ricardo, and Ulrich Schetter. 2020. Horrible trade-offs in a pandemic: Lockdowns, transfers, fiscal space, and compliance. Working Paper n° CID382. Faculty at Harvard University.

Henderson, J Vernon, and Matthew A Turner. 2020. "Urbanization in the developing world: too early or too slow?" Journal of Economic Perspectives (343): 150-73.

Jain, Radhika, and Pascaline Dupas. 2021. The Effects of India's COVID-19 Lockdown on Critical Non- COVID Health Care and Outcomes: Evidence from a Retrospective Cohort Analysis of Dialysis Patients. Working Paper Under Review. medRxiv.

Joanis, Marcelin. 2014. "Shared accountability and partial decentralization in local public good provision. "Journal of Development Economics 107:28-37.

Kermack, William Ogilvy, and Anderson G McKendrick. 1927. "A contribution to the mathematical theory of epidemics." Proceedings of the royal society of London. Series A, Containing papers of a mathematical and physical character (115772): 700-721.

Kose, M Ayhan, Sergio Kurlat, Franziska Ohnsorge, and Naotaka Sugawara. 2017. A cross-country database of fiscal space. Working Paper 48/2017.

Kresch, Evan Plous. 2020. "The Buck Stops Where? Federalism, Uncertainty, and Investment in the Brazilian Water and Sanitation Sector." American Economic Journal: Economic Policy 12 (3): 374-401.

Krueger, Dirk, Harald Uhlig, and Taojun Xie. 2020. Macroeconomic dynamics and reallocation in an epidemic: Evaluating the "Swedish Solution". Working Paper 27047. National Bureau of Economic Research.

Maia, Alexandre Gori, Leticia Marteleto, Cristina Guimarães Rodrigues, and Luiz Gustavo Sereno. 2021. "The short-term impacts of coronavirus quarantine in São Paulo: The health-economy trade-offs." PloS one (162): 1-18.

Mattoon, Richard. 2003. "Creating a national state rainy day fund: a modest proposal to improve future state fiscal performance." In Proceedings. Annual Conference on Taxation and Minutes of the Annual Meeting of the National Tax Association, 96:118-124. JSTOR.

MS. 2020. Epidemiological Surveillance Guide. Public Health Emergency of National Importance by Coronavirus Disease 2019 Ministry of Health - Secretariat of Health Surveillance.

Oates, Wallace E. 1972. "Fiscal Federalism, Harcourt Brace Jovanovich." New York 35.

WHO 2020. Media briefing on COVID19. World Health Organization. Accessed March 16, 2020. https://twitter.com/i/broadcasts/1djxXQkqApVKZ.

UN. 2020. Inequality in a Rapidly Changing World. UNDESA World Social Report 2020.

Ostrom, Elinor, Roy Gardner, James Walker, James M Walker, and Jimmy Walker. 1994. Rules, games, and common-pool resources. University of Michigan Press.

Rocha, Rudi, Rifat Atun, Adriano Massuda, Beatriz Rache, Paula Spinola, Letícia Nunes, Miguel Lago, and Marcia C Castro. 2021. "Effect of socioeconomic inequalities and vulnerabilities on health-system preparedness and response to COVID-19 in Brazil: a comprehensive analysis." The Lancet Global Health.

Romer, Christina D, and David H Romer. 2019. Fiscal Space and the Aftermath of Financial Crises: How It Matters and Why. Working Paper National 25768. Bureau of Economic Research.

Schotte, Simone, Michael Danquah, Robert Darko Osei, and Kunal Sen. 2021. The labor market impact of COVID-19 lockdowns. Working Paper 2021/27. United Nations University World Institute for Development Economics Research.

Souza, Celina. 2018. Public Policy Coordination. National School of Public Administration (ENAP).

Souza Santos, Andreza Aruska de, Darlan da Silva Candido, William Marciel de Souza, Lewis Buss, Sabrina L Li, Rafael HM Pereira, Chieh-Hsi Wu, Ester C Sabino, and Nuno R Faria. 2021. "Dataset on SARS-CoV-2 non-pharmaceutical interventions in Brazilian municipalities." Scientific data 8 (1): 1-6.

Ulyssea, Gabriel. 2018. "Firms, informality, and development: Theory and evidence from Brazil." American Economic Review (1088): 2015-47.

____. 2020. "Informality: Causes and consequences for development." Annual Review of Economics 12:525-546.

Appendix

Table A1 - Descriptive Statistics, Brazil, 2020

Variables	CAPAG A		CAPAG B, C and D		Difference	p-value
	Average	S.D	Average	S.D		
COVID						
Number of Deaths	39,02	116,96	44,62	420,3	-5,6	0,5190
Number of Cases	2081,45	5545,42	1542,74	9282,37	538,71	0,0427
Deaths per 100k	61,08	41,48	56,98	43,56	4,1	0,0194
Cases per 100k	3670,35	2450,77	3011,43	2090,15	658,92	0,0000
Hospital capacity pre-pandemic (2019)						
Nº of SUS beds	213,69	179,87	208,83	161,2	4,86	0,5836
Total of Physicians	268,75	227,84	199,5	184,73	69,25	0,0000
nurse	113,94	56,86	110,31	52,57	3,63	0,1170
General practitioner	96,48	81,07	76,3	79,59	20,19	0,0000
Anesthesiologist	18,81	33,36	16,64	17,85	2,17	0,2420
Other doctors	168,1	151,93	125,24	112,75	42,86	0,0000
Hospital capacity in the pandemic (2020)						
No. of SUS beds	219,14	181,3	212,01	164,68	7,13	0,4266
Total of Physicians	292,06	246,74	214,39	204,91	77,67	0,0000
nurse	128,26	63,74	123,05	57,22	5,22	0,0438
General practitioner	110,61	96,73	85,7	98,92	24,91	0,0000
Anesthesiologist	20,49	39,92	17,36	20,26	3,13	0,1591
Other doctors	177,36	159,23	129,8	118	47,56	0,0000
Predetermined						
Proportion of elderly	12,32	6,62	12,15	2,99	0,16	0,2608
Gini Index 2010	0,49	0,07	0,5	0,06	-0,01	0,0000
Proportion of poor	4,91	7,15	10,98	11,08	-6,07	0,0000
Distance	227,25	153,52	256,14	165,88	-28,89	0,0000

Source: Own elaboration.

Table A2 - Robustness exercises for the relationship between tax status and hospital capacity

Variables	N° of Beds	No. of Doctors	N° of Nurses
Panel A: Anticipation			
Treatment	0,047***	0,012***	0,008***
	(0,004)	(0,002)	(0,002)
R2 - adjusted	9,716	9,648	9,73
Number of Deaths	84.091	84.907	84.907
	N° of Beds	No. of Doctors	N° of Nurses
Panel B: Removing Outliers			
Treatment	0,040***	0,007**	0,0040*
	(0,004)	(0,003)	(0,002)
R2 - adjusted	9,626	9,769	9,412
Number of Deaths	69.389	70.145	70.146
	N° of Beds	No. of Doctors	N° of Nurses
Panel C: Standard Errors			
Treatment	0,05***	0,013***	0,01***
	(0,004)	(0,002)	(0,002)
	[0,016]	[0,008]	[0,009]
	N° of Beds	No. of Doctors	N° of Nurses
Panel D: No Population Weight			
Treatment	0,037***	0,020***	0,017***
	(0,002)	(0,002)	(0,002)
R2 - adjusted	9,711	9,738	9,378
Number of Deaths	84.091	84.905	84.905
Municipal Fixed Effect	Sim	Sim	Sim
Temporal Fixed Effect	Sim	Sim	Sim
State x FE Time	Sim	Sim	Sim
Predetermined	Sim	Sim	Sim
Additional Control	Sim	Sim	Sim

Source: Own elaboration.

Notes: Table A2 presents the robustness exercises. Significance: ***1% **5% *10%.

Table A3 - Tax status and social mobility as measured by Google

Variáveis	(1)	(2)	(3)	(4)
Treatment	0,527	-0,223	-0,790*	-0,803*
	(1,255)	(0,794)	(0,004)	(0,087)
R2 - Adjusted	0,81	0,85	0,88	0,88
Number of Deaths	20.779	20.779	20.746	20.746
Municipal Fixed Effect	Sim	Sim	Sim	Sim
Temporal Fixed Effect	Sim	Sim	Sim	Sim
State x FE Time	Não	Sim	Sim	Sim
Predetermined	Não	Não	Sim	Sim
Additional Control	Não	Não	Não	Sim

Source: Own elaboration.

Notes: Table A3 presents the combined impact of the lockdown policy differentiated by municipalities' fiscal status for the social mobility case. Estimates are obtained from specifications that include county and monthly fixed effects, predetermined variables, state fixed effects multiplied with monthly fixed effects, and the one--month lag of the number of victims by COVID-19 for each county. Standard errors obtained by clustering by county and month. Significance: ***1% **5% *10%.