# Analyzing Fiscal Decentralization: Findings from a Quasi-Experimental Study in Municipalities*

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**Abstract**

This thesis investigates the impact of fiscal decentralization on health management at the municipal level, especially during health emergencies. Using Bolivian municipalities as a case study, the research employs a quasi-experimental design incorporating instrumental variable (IV) models and spatial autoregressive (SAR) regressions to analyze the effects of fiscal autonomy on health outcomes. The main finding is that increased fiscal autonomy significantly enhances health management, as evidenced by a higher detection rate of covid cases. This improvement is linked to better resource management and increased health expenditure in municipalities with greater fiscal autonomy. Additionally, the study reveals positive spillover effects on neighboring municipalities. These results underscore the importance of decentralization and fiscal autonomy in improving the ability of local governments to respond to health crises. This research provides valuable insights for policymakers aiming to design more effective decentralization policies that enhance public health management.

**Keywords:** Territorial Decentralization, Fiscal Autonomy, Health Management.
**Clasificación JEL:** H71, H75, H77, R53

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# 1. Introduction

Fiscal decentralization is the process through which fiscal authority and responsibility are transferred from the central government to local governments, allowing them to manage their own resources and make decisions suited to their specific needs (Del Campo & Sánchez Reinón, 2023). This approach is generally promoted as a mechanism to improve the efficiency of public spending, as local governments can better adjust their policies and mobilize underutilized resources (Bardhan, 2002; Kyriacou et al., 2015; Oates, 1972; Rodríguez-Pose & Ezcurra, 2010). The literature on fiscal autonomy links it to better management of health services, reducing the need for central government intervention and enabling local governments to address specific regional problems more efficiently (Rocha et al., 2016). Despite these potential benefits, empirical evidence suggests that decentralization does not always significantly improve service delivery, as it depends on local administrative efficiency and other contextual factors (Bank, 2003; Rocha et al., 2016). While many studies focus on the general effects of decentralization on the efficiency of public service provision (Bardhan, 2002; Kyriacou et al., 2015; Oates, 1972; Rodríguez-Pose & Ezcurra, 2010), there is a gap in specific analyses on how fiscal autonomy affects health management at the municipal level, especially in health crisis contexts like the covid pandemic. Although fiscal decentralization is promoted for its potential to increase response efficiency, adaptability, and accountability of local governments (Faguet, 2004; Tiebout, 1956), empirical evidence on its effects in such contexts remains limited.

This study aims to fill this gap by examining whether a higher level of fiscal autonomy has a positive effect on health management at the territorial level. The context of health management in Bolivian municipalities provides a valuable setting for this analysis. During the 1990s, historical territorial claims for federalism in Bolivia led to an intensification of the fiscal decentralization process, resulting in the creation of numerous new municipalities and the transfer of responsibilities and resources to them (Faguet, 2004). Despite these changes, the central government retained significant political, administrative, and legislative control, limiting the execution capacities of local governments. Continued demands for greater fiscal autonomy and decentralized governance culminated in the approval of a new Political Constitution in 2009, which conferred autonomous qualities to subnational levels, including the direct election of authorities and the administration of economic resources by autonomous governing bodies (Bojanic, 2018; Diaz-Cayeros, 2006). A crucial aspect of this decentralization process has been the assignment of fiscal autonomy to municipalities, giving them the responsibility to manage their own resources and make decisions on their allocation in various sectors, including health. However, the variability in municipalities' ability to generate their own resources has led to unequal dependence on central government transfers, creating disparities in their capacity to manage public health. This study investigates how varying levels of fiscal autonomy influence health management at the municipal level, specifically focusing on the ability of

municipalities to finance and respond effectively to the covid pandemic.

To investigate the research question, this study employs a rigorous methodological approach, combining an instrumental variable (IV) technique and a spatial autoregressive (SAR) model with endogenous covariates. The IV technique addresses potential endogeneity issues, ensuring an accurate capture of the causal relationship between fiscal autonomy and health management. The SAR model accounts for spillover effects, recognizing that fiscal autonomy in one municipality can influence neighboring areas. The primary variables in this analysis include the incidence of covid (number of positive cases detected) and fiscal autonomy. Additionally, to explore the mechanisms through which fiscal autonomy impacts health management, the study examines two further variables: covid expenditure and total health expenditure. These variables help to clarify how increased fiscal autonomy influences resource allocation, particularly during health crises. By integrating the IV technique to handle endogeneity and the SAR model to capture spatial dependencies, this methodological approach ensures the reliability and validity of the findings. The analysis includes both the direct impact of fiscal autonomy on health management within municipalities and the indirect impact on neighboring areas, providing a comprehensive understanding of its effects at the municipal level.

The main finding of this study is that greater fiscal autonomy at the municipal level significantly improves health management, as shown by the increase in the identification of covid cases. A 1% increase in fiscal autonomy results in 6 more positive covid cases identified per 100,000 inhabitants, indicating a stronger capacity of municipalities to manage and respond to the pandemic. To understand the mechanisms behind this relationship, the study examined the effects of fiscal autonomy on covid-specific expenditure and total health expenditure, confirming positive impacts on both variables. Additionally, the spillover effects reveal that fiscal autonomy positively impacts neighboring regions, with an additional 3 positive covid cases per 100,000 inhabitants in neighboring municipalities. These findings underscore the importance of considering spatial interactions when designing fiscal decentralization policies, as the benefits extend beyond individual administrative boundaries. Promoting policies that increase fiscal autonomy can enhance public health management by enabling municipalities to allocate resources more effectively, benefiting both individual municipalities and their neighboring regions.

The document is structured into six sections. The first reviews relevant literature on fiscal decentralization and health management. The second describes institutional characteristics related to municipal competencies, the economic-financial scope, and general guidelines for pandemic management. The third provides the data description. The fourth outlines the empirical strategy employed, detailing the design of the instrumental variable model and the spatial model used to capture territorial effects. The fifth presents the results. Finally, the sixth offers the conclusions of the study.

## 2. Literature Review

The review of relevant literature that supports the research is presented, highlighting the contribution this study aims to make in the field of fiscal decentralization and its impact on health management. The first component, Fiscal Decentralization, is known as the transfer of authority and fiscal responsibility from the central government to local governments. This allows the second level of government to manage their own resources and make decisions tailored to their specific needs (Del Campo & Sánchez Reinón, 2023). In Bolivia, this process has resulted in the creation of numerous new municipalities, the transfer of resources from the central government to local governments, and the development of innovative local governance institutions (Faguet, 2004).

Decentralization can enhance efficiency by better aligning public spending with local preferences and mobilizing underutilized resources, creating competition among subnational governments (Bardhan, 2002; Rodríguez-Pose & Ezcurra, 2010). Decentralized governments are expected to be better informed about local conditions and more capable of meeting citizens' preferences (Ahmad et al., 2008; Kyriacou et al., 2015; Oates, 1972; Tiebout, 1956). Fiscal decentralization may also reduce regional disparities by promoting competition for fiscal resources among subnational jurisdictions, acting as a check on inefficient local government and promoting regional convergence (Kyriacou et al., 2015). In Latin America, fiscal decentralization has enabled local governments to better manage resources and respond to specific community needs, including health services management (Diaz-Cayeros, 2006).

However, decentralization can also lead to a concentration of resources in more prosperous regions, increasing fiscal disparities, especially in countries with weaker institutions and pre-existing inequalities (Rodríguez-Pose & Ezcurra, 2010). Decentralization can also be problematic due to the lack of technical and administrative capacities at the local level (Bardhan, 2002). Empirical evidence suggests that fiscal decentralization contributes to regional convergence in high-income countries but tends to increase disparities in poorer countries (Kyriacou et al., 2015). For example, in Colombia, restrictions on revenue collection and spending decisions imposed by the central government have prevented decentralization from improving government efficiency (Bonet, 2006).

The literature can also be referred to for understanding the concept of fiscal autonomy, defined as the ability of local governments to generate and manage their own revenues rather than relying exclusively on central government transfers (Del Campo & Sánchez Reinón, 2023; Faguet, 2004). However, the fiscal autonomy of local governments is often strongly influenced by central government financial grants and non-financial regulations, significantly shaping local governments' fiscal and spending behavior (Renaud & Van Winden, 1991). In Bolivia, the autonomy of subnational governments has been conditioned by normative centralism and fiscal inequality in their capacity to finance

responsibilities (Del Campo & Sánchez Reinón, 2023).

If we analyze the effect of decentralization on sectors under the responsibility of subnational governments, the literature shows that local public education can significantly improve in a decentralized context, where local governments have greater control over resources and school administration (Ansari, 2020; Letelier & Ormeño, 2018). Municipalities with greater fiscal autonomy have demonstrated better performance in managing public schools, reflecting a better adaptation to local needs. Focusing on the health sector, the literature suggests that greater fiscal autonomy at the subnational level can lead to better health service provision due to local governments' ability to respond more quickly and effectively to community needs (Rocha et al., 2016). Local governments with higher fiscal autonomy have shown a better capacity to manage and finance their health systems, reducing the need for central government intervention (Diaz-Cayeros, 2006).

However, despite extensive research on the general effects of fiscal decentralization, there is a significant gap in analyzing how fiscal autonomy affects health management during health crises and whether fiscal autonomy presents spillover effects at the municipal level. In this sense, the present study aims to fill this gap in the literature by empirically examining the direct and indirect impact of fiscal autonomy on health management during the covid pandemic, taking Bolivian municipalities as a case study. This research explores whether municipalities with higher fiscal autonomy present better outcomes in the policy of identifying positive covid cases. This is relevant considering empirical evidence indicates that greater detection of covid cases is associated with a decrease in the fatality rate (Cao et al., 2020).

In addition to considering Fiscal Autonomy as an explanatory variable (Rodríguez-Pose & Burlina, 2021), the literature associates control variables with the incidence of covid, including the social and economic conditions of populations, geographic characteristics, mobility and connectivity of areas, and the age of the population. Additionally, factors such as population density and agglomeration have shaped the epidemic intensity of covid, with higher prevalence in large cities compared to rural areas (Fatima et al., 2021). Spatial analysis of the variable has been important for understanding its spatial autocorrelation, with clear patterns of positive spatial autocorrelation observed in all waves of the pandemic (Cao et al., 2020; Moreno & Vayá, 2023).

By using an instrumental variable (IV) approach and spatial regression techniques, this study not only examines the direct effects of fiscal autonomy on health management but also investigates potential spillover effects across neighboring municipalities. This comprehensive approach provides a deeper understanding of how fiscal decentralization can influence public health outcomes during a crisis, contributing valuable insights to the existing literature. The endogeneity of the main variable, fiscal autonomy, can be addressed using the distance between a municipality and the departmental capital as an instrumental variable. The distance to the capital influences the valuation of real estate,

which is the main source of property tax revenues (McDonald, 2008; Ramajo et al., 2020).

The comprehensive review of the existing literature underscores the significance of decentralization and the fiscal adaptability of local governments. However, it also highlights the need for more empirical evidence on the specific effects of fiscal autonomy on health management during crises. This study aims to address this gap by investigating the specific mechanisms through which fiscal autonomy influences health management at the municipal level, with a particular focus on the covid pandemic.

# 3. Institutional Setting

## 3.1 Historical Background of Decentralization in Bolivia

Bolivia has undergone a gradual decentralization process, evolving from a highly centralized state to a more decentralized and autonomous one [1]. During the 1980s, Bolivia faced a municipal crisis due to excessive state centralism. Local governments lacked autonomy and resources, and rapid urbanization overwhelmed the administrative capacity of cities, weakening local governments both politically and institutionally. Municipal authorities were imposed by the central government, and clientelism and prebendalism prevailed. The management of mayors was ineffective, both socially and technically.

In 1985, the Organic Municipal Law was approved, which introduced some elements of decentralization. This law granted autonomy to municipal governments, established periodic elections for local authorities, and legitimized local governments by creating representative municipal councils. Additionally, it granted powers to collect and invest resources. However, these reforms had significant limitations, such as excessive dependence on the national government, lack of modernization of the municipal apparatus, and the absence of effective mechanisms for social control and citizen participation.

The true transformation began in 1994 with the implementation of the Popular Participation Law No. 1551 and the Administrative Decentralization Law No. 1654. These laws introduced a new model of decentralization based on sustainable development and popular participation. The Popular Participation Law aimed to redistribute national revenues (Tax Sharing, 20%) in favor of municipalities and expand their competencies in sectors such as health, education, local roads, sports, culture, and micro-irrigation. This law also granted municipalities the authority to collect their own revenues through taxes on rural and urban property, vehicles, licenses, and fees.

The approval of the Municipalities Law No. 2028 in 1999 consolidated the decentralization model, grouping municipal resources into tax and non-tax resources, in addition to the resources from Tax Sharing (Central Government Transfer). Subsequently, more

[1] State Service of Autonomies of Bolivia. Methodological Guide for the Identification and Application of Municipal Own Resources, 2021.

resources were allocated to municipalities, including the Direct Tax on Hydrocarbons in 2005 (Central Government Transfer).

The approval of the new Political Constitution of the State in 2009 marked an important milestone by recognizing the autonomous quality of subnational governments, consolidating a decentralized and autonomous model. Autonomy allows for the direct election of authorities, the exercise of legislative, regulatory, supervisory, and executive powers, as well as the administration of their economic resources.

## 3.2 Competencies and Resources of Local Governments

The Political Constitution of the State of Bolivia establishes a territorial organization composed of departments, provinces[2], municipalities, and indigenous native peasant territories (see Table 1), with the possibility of creating or modifying territorial units and the creation of regions. According to Bolivian regulations, this is a system of territorial organization that configures territorial units functionally and spatially integrated in a harmonious and balanced manner. However, the municipal and indigenous native peasant territories constitute 339[3] local government units characterized by great heterogeneity in terms of population, geographic size, and socioeconomic conditions. However, the assignment of responsibilities to these government units does not consider territorial differences, which could represent at least one difficulty in fulfilling them.

The recognition of subnational governments as decentralized and autonomous entities led to a greater allocation of spending responsibilities, with the municipal level of government receiving more than 60 competencies. These competencies cover crucial sectors such as Health Management, Education, Infrastructure, Transportation, Productive Projects, Basic Services, Planning, Sports, Culture, Enterprises, among others. Municipal spending by programs for the 2019 management reports that Health Management is the main spending sector, with 16% of the total budget. It is followed by Education Management with 14% and Urban and Rural Infrastructure with 10%(see Figure A1).

[2]The only territorial unit that does not have a governing body as levels of government according to the Law No. 031, 2010.

[3]According to data for the year 2019, there are 2 indigenous native peasant territories and 337 Municipal Territories. Ministry of Economy and Public Finance.

Table 1: Territorial Organization, Autonomous Governments, and Competencies

| TERRITORY ORGANISATION | AUTONOMOUS GOVERNMENTS | GOV. BODIES | COMPETENCIES |
|---|---|---|---|
| Department | Departmental government | Departmental Assembly<br>Governorate/Governor | 36 exclusive |
| Province | NO | NO | NO |
| Municipality | Municipal government | City Council<br>Executive Body/Mayor | 43 exclusive |
| Indigenous territory | Indigenous government | Uses and customs | 23 exclusive |

Notes: Exclusive Competencies, assigned to all types of autonomy due to the existence of matters where it is advisable for actions to start and finish within the same government, as they pertain to regional or local issues with specific particularities. In this competency, there is the possibility for regulatory and executive powers to be transferred or delegated partially or completely, while always maintaining ownership of the competency and the exercise of legislative power. Subnational governments also receive responsibilities for 16 concurrent competencies and 7 shared competencies. In concurrent competencies, legislation is the responsibility of the central level of the State, which will establish responsibilities for each level of government, and the other levels of government simultaneously exercise regulatory and executive powers. Shared competencies, with the main characteristic is that legislative power is shared among the different levels of government to which this type of competency is assigned.

To ensure the financing of the assigned responsibilities, an expansion of municipal powers to generate Own Resources was established. Additionally, the transfer of resources from the central government was reaffirmed, and other sources of financing such as Mining Royalties, Credits, Donations, and other Transfers were defined[4] (see Table 2).

Table 2: Resources of Municipal Autonomous Territorial Entities

| | |
|---|---|
| **OWN RESOURCES** | - Taxes created under Law No. 154.<br>- Fees, patents for economic activities, and special contributions.<br>- Sale of goods, services, and asset disposal. |
| **CENTRAL GOV. TRANSFERS** | - Transfers for tax revenue sharing.<br>- Transfers from the Direct Tax on Hydrocarbons. |
| **MINING ROYALTY** | - For municipalities where the mineral is extracted. |
| **CREDITS/DONATIONS** | - Internal and external credits and loans.<br>- Bequests, donations, and other similar revenues. |
| **OTHER** | - Transfers for delegation or transfer of competencies.<br>- Intergovernmental transfers. |

Notes: OWN RESOURCES, result from the entity's own activities and can be classified into tax and non-tax revenues. - Taxes created under Law No. 154: Tax on urban and rural real estate property; Tax on motor vehicle property; Municipal tax on real estate and motor vehicle transfers; Other less relevant taxes. CENTRAL GOV. TRANSFERS. - Transfers for tax revenue sharing, transfer of 20% of the revenue from 7 national taxes (IVA, RC-IVA, IUE, RE, ICE, IT, ISAE,GA). - Transfers from the Direct Tax on Hydrocarbons, which taxes the production of hydrocarbons in its first stage of commercialization, with a rate of 32%. Of the amount corresponding to each department, 66.99% is allocated to the municipal level according to the number of inhabitants. MINING ROYALTY, corresponds to a compensation in favor of the State, for the exploitation of non-renewable mineral, benefiting the municipalities where the mineral is extracted. CREDITS, income from loans from entities and institutions residing inside or outside the country. DONATIONS, non-refundable contributions granted in money, goods, or any other modality, coming from multiple organizations, and others.

[4]Art. 103, Law No. 031, 2010

The income structure in 2019 reports that 70% of municipal revenues come from Central Government Transfers. Own Resources constitute 29%, and within these, they are broken down into municipal taxes, sale and rental of goods and services, and other minor revenues. Municipal Taxes represent 83% of Own Resources, highlighting the Property and Transfer of Real Estate Tax as the most relevant, with a 49% share (see Figure A2).

## 3.3 Municipal Management and Response to the Covid Pandemic

The decentralized and autonomous state model has played an important role in managing the covid pandemic, where autonomous territories, especially municipal governments, had a prominent role.

As one of the first guidelines to combat the pandemic, on March 5, 2020, territorial governments were authorized by Supreme Decree (SD) No 4174 to directly contract medicines, medical devices, supplies, reagents, medical equipment, and health personnel consulting services to combat the covid emergency. A total quarantine was declared across the entire territory of the Plurinational State of Bolivia to prevent the spread and contagion of covid (SD-No 4199, Mar-2020). Additionally, Autonomous Municipal Governments were allowed to encapsulate neighborhoods, zones, communities, districts, and municipalities to mitigate the contagion and spread of the virus (SD-No 4245, May-2020).

The next step was the transition from quarantine to the post-confinement phase, with active community surveillance measures to control the spread of covid. This required both the central level of the State and the territorial entities to implement measures of epidemiological surveillance, prevention, containment, diagnosis, treatment, and active search for positive cases (SD-No 4314, Aug-2020).

At the beginning of 2021, it was established that the subsectors of the National Health System should prioritize the supply of medicines, medical devices, supplies, reagents, and medical equipment according to the evolution of the epidemiological profile. This responsibility fell on the territorial entities, which had to ensure the adequate provision of these supplies to their health facilities. The Ministry of Health and Sports distributed antigenic and RT-PCR diagnostic tests, as well as covid vaccines, free of charge to the Autonomous Governments. The Autonomous Governments were responsible for conducting these tests and vaccinations, including logistics, administration, and reporting of results. Additionally, mandatory biosecurity measures were defined, such as the use of masks, frequent hand washing, and physical distancing, which territorial units had to guarantee within their jurisdictions (SD-No 4451, Jan-2021). Furthermore, it was established that the subsectors of the National Health System should implement active and intensified epidemiological surveillance with timely reporting, where territorial entities were responsible for daily reporting of epidemiological records in the Integrated Epidemiological Surveillance System (SIVE) of the Ministry of Health and Sports (SD-No 4451, Jan-2021). Subsequently, territorial entities were authorized to purchase of vaccines and diagnostic tests, ensuring their

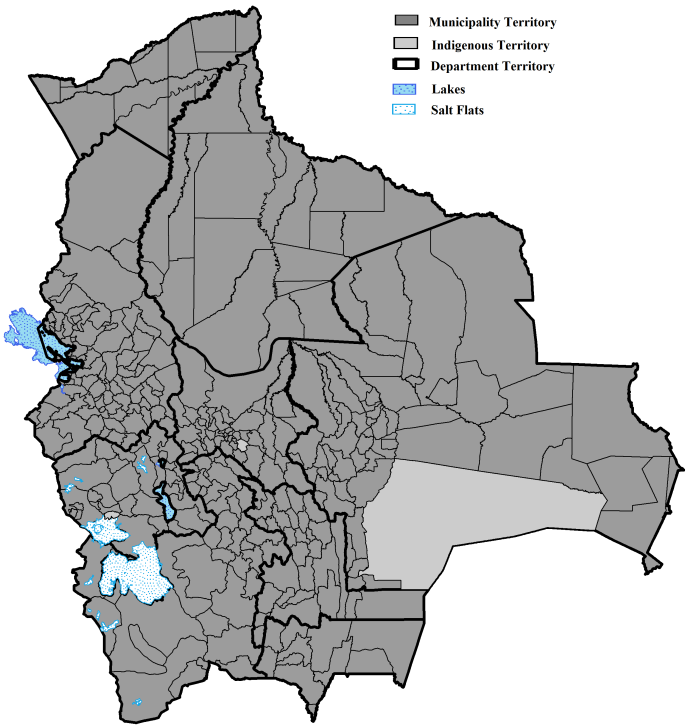
quality, universality, and voluntariness (SD-No 4521, Jun-2021 ; SD-No 4432, Dec-2021).

There is no doubt that Bolivian regulations during the covid pandemic have clearly delineated the responsibilities of municipal governments, emphasizing their crucial role in modifying their budgets to significantly increase health allocations, acquiring medical supplies, conducting diagnostic tests, implementing vaccination programs, enforcing biosecurity measures, and carrying out epidemiological surveillance.

# 4. Data

The study population consists of 339 territorial units in Bolivia (see Figure 1), recognized up to 2019 and part of the 9 departmental territories, with an average population of 34,871 inhabitants; a maximum population of 1,867,673; and a minimum population of 383. Among these territories, the total of the autonomous municipal governments (336[5]) and 3 indigenous native peasant territories, the only ones that had formed autonomous governments by that year, are taken into account. The government of Indigenous Native Peasant territories is exercised through their own norms and forms; however, they are responsible for the same competencies assumed by municipal governments, such as the management of the health system[6].

Figure 1: Territorial Units of Bolivia




*Source: Own elaboration based on data from GeoBolivia, 2019*

[5]The municipal territory of Mizque is considered as the Indigenous Native Peasant territory of Raqaypampa.

[6]Art. 303, Political Constitution of the Plurinational State of Bolivia.

## 4.1 Covid Incidence

The number of positive covid cases in Bolivia, reported in 2021, increased by 177% compared to those recorded in 2020, rising from 162,055 to 448,976. This increase is explained by the implementation of inefficient covid case identification policies during 2020. At the beginning of 2021, the central government distributed covid tests to the municipalities for them to handle the application. Additionally, municipalities gained greater regulatory tools for acquiring supplies, reagents, and medical equipment to enable early detection of covid cases and thereby reduce the mortality rate. Another important aspect is that municipal mayoral elections were held in March 2021 across all territories, with the newly elected mayors assuming office in May of the same year. For all these reasons, the number of positive covid cases detected in 2021 is considered the dependent variable. It is expected that municipalities with greater logistical capabilities for deployment, economic and human resources, and more robust prevention policies would perform better in identifying covid cases. The variable is standardized by dividing the number of positive cases detected in municipality i by its total population and multiplying this result by 100,000.

## 4.2 Fiscal Autonomy

The well-known Fiscal Autonomy indicator, part of the Regional Authority Index (RAI) (Hooghe et al., 2021), measures the ability of regional governments to raise their own revenues. However, this index is primarily designed to assess the authority of regional governments, such as departments, provinces, or equivalents, rather than focusing on smaller administrative levels like municipalities. This study, however, aims to analyze Fiscal Autonomy at the municipal level for Bolivia. To achieve this, indicators of Own Resources, which are revenues not dependent on other units (Oates, 1972), and Fiscal Dependency, which are transfers from other government units (Rose, 1985), will be considered. Additionally, a municipal Fiscal Autonomy index is proposed, defined as the ratio between Municipal Own Resources and Transfers from the Bolivian Central Government.

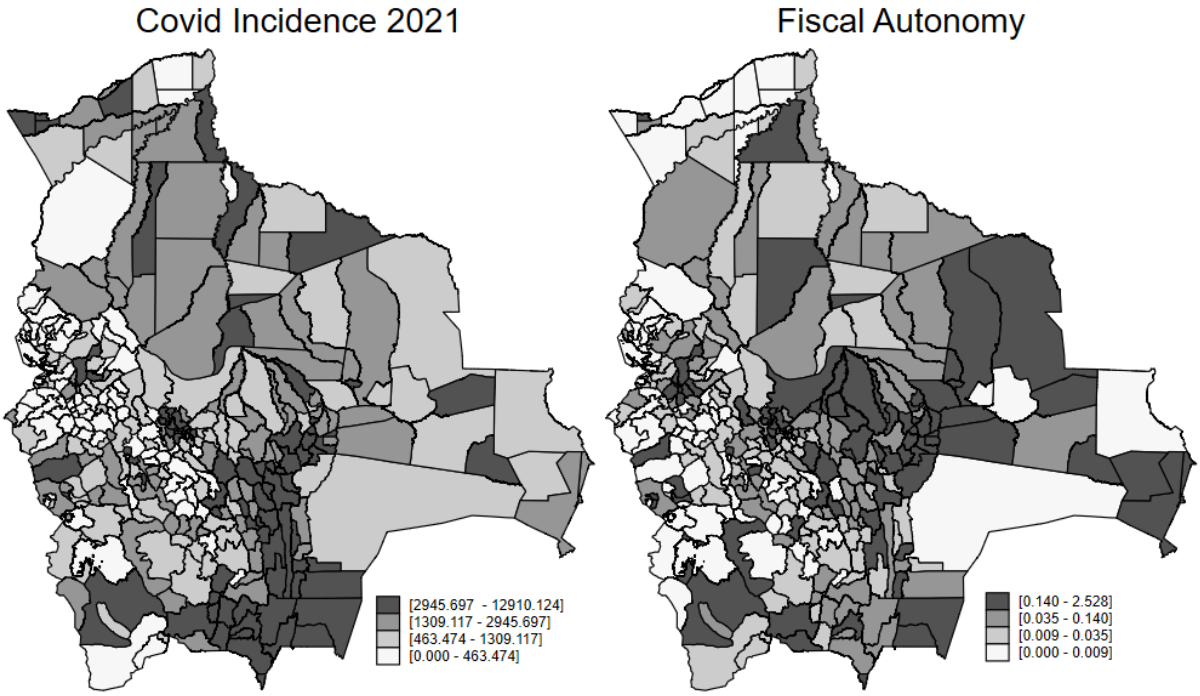
Formally, it is expressed as:

$$\text{Fiscal Autonomy}_i = \frac{\text{Own Resources}_i}{\text{Central Government Transfers}_i} \tag{1}$$

Where a high index suggests that the municipality has greater fiscal autonomy, as it relies less on Central Government Transfers. Conversely, a low index indicates higher fiscal dependency, showing that the municipality heavily relies on transfer funding to exercise its competencies. For the research, the Fiscal Autonomy index for the year 2019 is considered, in order to avoid potential distortions caused by the pandemic shock on both national and local revenue structures starting from 2020.

The territorial distribution of the variables Covid Incidence and Fiscal Autonomy across the country is presented below:

Figure 2: Spatial Distribution




*Source: Own elaboration based on data from Ministry of Health and Ministry of Economy and Public Finances, 2019*

The territorial distribution of the variables suggests the possibility of spatial autocorrelation. In the case of covid incidence, there is extensive evidence in the literature supporting the existence of spatial autocorrelation, indicating that the reporting of covid incidence in one municipality may be influenced by the situation in neighboring municipalities. This study incorporates a spatial regression model to account for spatial dependencies, allowing for a more accurate analysis of how these variables interrelate and how fiscal autonomy may be affecting health management.

## 4.3 Historical Health Expenditure

Municipal expenditure can be classified by type: Activities and Projects. Expenditure on Activities includes eligible and/or recurrent expenses by competency, such as hiring medical personnel, purchasing supplies, among others. Projects consider expenses aimed at creating, expanding, and improving capital (both physical and human[7]). Municipalities that have historically spent or invested more in health may have better infrastructure, more accessible services, better-trained personnel, and a greater capacity to respond to health crises such as the covid pandemic. In this regard, historical investment in health is

[7]Municipalities Law, October 28, 1999.

key to controlling health outcomes. The variable Historical Health Expenditure is equal to the per capita total health expenditure between 2011 and 2019.

## 4.4 Weighted Density

Population density is generally used to assess the concentration of the population in a territory i. However, to evaluate the impact of density on phenomena such as health management and the incidence of diseases like covid, it is important to consider a more precise measure that better reflects population distribution (Carozzi et al., 2020). Therefore, weighted density is used, defined as follows:

$$\text{Density}_i = \frac{\text{Total population}_i}{\text{Total area}_i} \rightarrow \text{Weighted Density}_i = \frac{\text{Density}_i \times \text{Population}_i}{\text{Total Population}} \tag{2}$$

This calculation provides a measure of density that better reflects how the population is distributed across the country, taking into account the variations in population density of each municipality and their relative contribution to the country's total population.

## 4.5 Region

Bolivia is geographically divided into three main regions: the Altiplano, the Valleys, and the Plains. The Altiplano is located in the western part of the country, the Valleys are in the intermediate area between the Altiplano and the Plains, and the Plains occupy the eastern part. The Valley region has experienced a faster pace of urbanization compared to the other regions since the 19th century (Carozzi et al., 2020). This urbanization process can have significant implications for health management, especially in response to health emergencies like the covid pandemic. Additionally, the temperate climate of the valleys creates favorable conditions for agriculture and other economic activities, which can influence the municipalities' ability to generate fiscal revenues, providing a more stable and resilient economic base. For this reason, the Valley region is included as a dummy control variable.

## 4.6 Population Category

Population size is a fundamental criterion for the distribution of resource transfers from the central government to municipalities in Bolivia. Therefore, the population criterion is considered for municipal categorization. The "Population Category" variable classifies municipalities in Bolivia according to their total population, following the classification established by Supreme Decree No. 26451 of 2001. The categories are as follows: A, up to 5,000 inhabitants; B, from 5,001 to 14,999 inhabitants; C, from 15,000 to 49,999 inhabitants; D, 50,000 or more inhabitants.

Since municipal population size is associated with the fiscal revenues that each municipality receives from central government transfers, it is relevant to consider this population category as a variable to better capture the variability in fiscal revenues among different municipalities, thereby isolating the effect of fiscal autonomy on health management. Higher revenues may enable better health management and a greater capacity to respond to health emergencies like the covid pandemic. Category C (municipalities with a population of 15,000 to 49,999 inhabitants) is included as a dummy control variable due to its intermediate position and proximity to the departmental capital cities, thereby controlling for socioeconomic and demographic characteristics more akin to urban areas.

### 4.7 Young Population

The variable measures the number of people aged 0 to 19, which represents on average 38% [8] of the total population of the municipalities. Including this variable allows capturing how differences in demographic composition influence the needs for public services such as health. By controlling for the proportion of young people, the effect of fiscal autonomy on health management can be better isolated. Since municipalities with a larger young population may need to divert more resources towards educational services and social programs, this variable provides necessary context for understanding the fiscal and management dynamics in different municipalities.

## 5. Estimation Strategy

### 5.1 Identification

The main objective of this study is to estimate the causal effect of fiscal autonomy on municipal health outcomes. In this section, the primary output considered is the Covid Incidence in 2021. Two additional health outputs (Covid Expenditure and Health Expenditure) will be analyzed in the results section. Equation (3) represents the linear regression:

$$Y_i = \alpha_0 + \delta_1 A_i + \gamma_k X_i + \lambda_m + \epsilon_i \tag{3}$$

Where $Y$ denotes the number of positive covid cases detected in municipality $i$ (Covid Incidence), $A$ represents the level of fiscal autonomy in municipality $i$ reported in 2019, and $X$ represents other regressors: Historical health expenditure, weighted density, region dummy (Valley, intermediate region between the Altiplano and the Plains, historically with higher urbanization growth), dummy variable for population category (which captures intermediate regions closer to departmental capitals), and population structure (captures differences in demographic composition that influence public service needs). $\epsilon$ is the unobserved error term, $\delta$ is the coefficient of interest, and $\lambda_m$ represents the province

[8] National Institute of Statistics, 2021

fixed effects to control for the differences among municipalities grouped in 109 provincial territories.

The variable of interest is considered endogenous, as its determination may be influenced by factors that also affect the dependent variable in the model. For example, municipalities with better administrative capacity may impact health management. To address the endogeneity problem of the main explanatory variable, it is necessary to understand how it is determined. This variable represents the ratio of two components: Municipal Own Resources (Oates, 1972) and Central Government Transfers (Rose, 1985), where the latter is exogenous to municipal management as it depends on macroeconomic and external variables, such as the international oil price. The structure of the Own Resources component shows a composition of 83% from Municipal Taxes and the remaining 17% from Sales of Goods and Services, which is irrelevant in most cases. When analyzing Municipal Taxes, it is found that rates, patents, property tax and transfer of motor vehicles, environmental pollution tax, among others, represent 50% or less of the total tax revenues, while 50% or more comes from the property tax and transfer of real estate, making it the most relevant income in the Own Resources component (see Figure A2).

To understand what property tax depends on, it is necessary to describe some technical aspects: **the active subject** is the Autonomous Municipal Government, **the passive subject** comprises legal or natural persons and undivided estates that own the property, **the taxable event** is the exercise of ownership of urban or rural real estate, **the tax base** corresponds to the cadastral value which is based on the value of the land and the value of buildings and improvements, **the rate** is the fixed or percentage value established by municipal law, applicable to the tax base, and **exemptions** for agricultural and community property.

From these technical aspects, it can be concluded that the rate is entirely correlated with municipal management. However, the tax base and exemptions present an exogenous factor to municipal management. The value of the land depends on its economic valuation, which is based on supply and demand, accessibility to services such as education, health, job sources, urbanization rate, among others [9]. A relevant fact to mention is that 70% of the Bolivian population lives in urban areas[10]. This fact is related to the exemptions that exclude small property in rural areas, leaving sparsely populated and rural municipalities with a low possibility of generating resources through the property tax on real estate.

These exogenous factors can be captured using the distance between a municipality and the departmental capital[11]. The distance to the capital influences the valuation of real estate, which is the main source of property tax revenues (McDonald, 2008; Ramajo et al., 2020). Municipalities closer to the capital tend to benefit more in terms of property

[9] Law No. 843, 1986

[10] Instituto Nacional de Estadística Boliviano, 2018.

[11] The 9 municipalities that are the departmental capitals were removed from the analysis. Considering them could introduce some bias in the results.

valuation, and calculating the inverse distance accentuates this relationship, providing a more suitable instrumental variable. Therefore, to address the endogeneity of the main variable, fiscal autonomy, the distance between a municipality and the departmental capital is used as an instrumental variable. Thus, the potential model for the level of Fiscal Autonomy can be approximated as:

$$A_i = \Theta + \phi Z_i + \beta X_i + \lambda_m + \mu_i \tag{4}$$

where $Z$ represents the instrument, which is the Inverse Distance from a municipality to the departmental capital, and $\mu$ is an error term that captures other determinants of Fiscal Autonomy, possibly correlated with $\epsilon$. This instrument serves the important function of isolating the exogenous variation in the level of Fiscal Autonomy from the potentially endogenous variation due to correlation with the unobserved error term $\mu$. Therefore, the endogeneity of Fiscal Autonomy is no longer a concern. The validity of the instrument is summarized by meeting the following criteria:

- Relevance: Proximity to the department capital center likely translates into higher property values in nearby municipalities, which in turn may influence the magnitude of tax revenue collection from municipal property taxes, and thus, the level of fiscal autonomy of those municipalities.

- Exogeneity: This means that the municipal distance to the capital center is not influenced by any factor related to municipal management or decisions. The geographical location of a municipality relative to the regional capital center is likely determined by historical, geographical, and urban factors unrelated to local administration.

- Exclusion restriction: The inverse distance to the regional capital center has no direct effects on the incidence of covid in a municipality, measured as the number of positive cases identified. This assumption is plausible because the primary mechanism through which distance influences municipal fiscal autonomy is indirect and operates through property valuation and tax collection. Specifically, the inverse distance affects fiscal capacity, which in turn affects resource allocation and health management decisions. The distance to the capital center is a fixed and historical geographic location, which supports the exclusion restriction, $\text{Cov}(Z, \epsilon) = 0$, as any observed effect on covid incidence must be channeled through the variations in fiscal autonomy influenced by property values and taxation capabilities. Furthermore, the distance to the regional capital does not directly influence health outcomes such as covid incidence because health management decisions are primarily made based on local conditions and needs, rather than geographical proximity to the regional capital.

## 5.2 Spatial regression modelling

Given the territorial distribution of the output variable, as shown in Figure 2, it is reasonable to assume the existence of spatial autocorrelation, which refers to the degree of spatial association between the value of the dependent variable $Y$ (Covid Incidence) in one municipality and the values in neighboring municipalities. The model in (3) does not account for spatial dependence issues that may arise with cross-sectional data. To address this, we specify a spatial autoregressive (SAR) model that introduces the possibility of spatial externalities across our units of analysis. This model adds a spatially lagged variable ($Y$), indicating that the value of $Y$ in location $i$ influences observations in location $j$, and vice versa. Consequently, the equation for the spatial autoregressive model with endogenous covariates is represented as:

$$Y_i = \rho\omega Y_i + \beta_1 A_i + \beta_k X_i + \lambda_m + \epsilon_i \tag{5}$$

where $\rho$ captures the degree of spatial autocorrelation present in the data, that is, the influence that the values of $Y$ in neighboring locations (j) have on the value of $Y$ in the current location (i). Therefore, the term $\rho\omega Y$ represents the dependent externality across the municipalities. $Y$, $A$, and $X$ represent the vector of observations of the output variable, the main explanatory variable (Fiscal Autonomy), and other explanatory variables, respectively. $\epsilon$ is the error term and $\omega$ is the neighborhood matrix.

### 5.2.1 Weight Matrix

The analysis of spatial autocorrelation and subsequent modeling of direct and spillover effects at the municipal level for the variable of interest requires constructing spatial weight matrices that adequately capture the relationships between municipalities. For this purpose, two types of matrices have been considered: distance-based matrices and contiguity-based matrices. Each of these matrices provides a different way of modeling spatial interaction and the influence of one municipality over its neighbors.

- **Inverse Distance**: Inverse distance has been applied because it is expected that a shorter distance between territorial units will imply a greater influence on the output. The formula used to calculate the spatial weights is:

$$\omega_{ij} = \frac{1}{d_{ij}^{\alpha}} \tag{6}$$

  where the effect of observation j on i is a decreasing function of the distance between them. In this study, the rate of decrease of the effect, $\alpha$, is considered to be 1 (linear decrease). For the calculation of distances, the capital points of each municipality have been considered. This is because the population is concentrated in these points, which allows capturing the proximity between municipal populations

adequately. Four matrices are constructed with different specifications: one without a band, including all distances without restriction, and three with bands, considering distances of 100 km, 50 km, and 25 km. These bands limit the influence to closer neighbors and allow us to observe how spatial autocorrelation changes. In the cases with bands, a binary matrix (1/0) is used, where a value of 1 indicates that the distance between two units is within the specified band, signifying they are neighbors, and 0 otherwise.

- **Contiguity:** The weight matrix based on contiguity considers whether a target object and one or more other objects are spatially close. Given the spatial distribution pattern of municipalities in Bolivia and the coordination characteristics, the Queen's Case method (corner and edge contiguity) has been adopted, considering first-order contiguity. A row-standardized matrix and a non-standardized matrix are calculated.

Having differentiated spatial weight matrices allows this study to adequately capture the spatial interaction between municipalities, providing a solid foundation for spatial autocorrelation analysis and spatial effects modeling.

### 5.2.2 Direct and Spillover Effects

The analysis of spatial regression models must account for both direct and spillover (indirect) effects to fully understand the spatial dependencies in the data. Considering model (3), the direct effect of the explanatory variable is equal to the coefficient estimate of that variable ($\beta_k$), while its indirect effect is zero by construction (Elhorst, 2014). Direct effect refers to the impact of the explanatory (Fiscal Autonomy) variable on the dependent variable (Covid Incidence) within the same spatial unit. Spillover effects, on the other hand, capture how changes in an explanatory variable in one spatial unit affect the dependent variable in neighboring units.

In the spatial model given in (5), the direct effect is the average impact on the dependent variable within the same spatial unit and is represented by the diagonal elements of $(I - \rho\omega)^{-1}\beta_k$. Formally, it is given by:

$$\text{Direct Effect} = \text{diag}\left((I - \rho\omega)^{-1}\beta_k\right) \tag{7}$$

The spillover (indirect) effect measures the impact on the dependent variable in neighboring spatial units, which results from changes in the explanatory variable in a given unit. This is captured by the off-diagonal elements of $(I - \rho\omega)^{-1}\beta_k$. Formally, it is expressed as:

$$\text{Indirect Effect} = \text{off-diag}\left((I - \rho\omega)^{-1}\beta_k\right) \tag{8}$$

where off-diag indicates the focus on the off-diagonal elements of the resulting matrix, which capture the spillover effects. The off-diagonal elements represent the interactions between different spatial units, rather than the impact within the same unit. $(I-\rho\omega)^{-1}$ is the inverse of $(I-\rho\omega)$. This operation captures the accumulation of spatial effects through multiple iterations of the impact of one unit on its neighbors. The inverse accounts for how a change in one unit propagates through the spatial network defined by $\omega$. $I$ is the identity matrix, a square matrix with ones on the diagonal and zeros elsewhere, representing no change in the spatial structure. $\rho$ is the spatial autoregressive parameter. $\omega$ is the spatial weights matrix and $\beta_k$ represents the coefficient of the $k$-th explanatory variable.

Understanding these effects allows for a more precise interpretation of spatial regression results, leading to better-informed decisions that consider both direct and spillover impacts. These effects underscore the importance of accounting for spatial dependencies in policy analysis. Direct effects help policymakers understand the immediate impact of fiscal autonomy within their own municipalities, while spillover effects highlight the need for regional cooperation, as policies in one area can influence health outcomes in neighboring municipalities. In the context of covid, recognizing spillover effects can lead to coordinated public health interventions across municipalities, enhancing the effectiveness of containment measures.

# 6. Results

## 6.1 Output and Fiscal Autonomy

Table 3 shows the OLS regression results for covid incidence in 2021, using fiscal autonomy as the main explanatory variable, along with other controls. Fiscal autonomy shows a positive and significant coefficient in all models, indicating a positive correlation between fiscal autonomy and the outcome. This may reflect that municipalities with greater fiscal autonomy responded more efficiently to the identification of positive covid cases in 2021, which may potentially be associated with a greater availability of resources for purchasing supplies, hiring health personnel, and a higher logistical capacity to mobilize to urban and rural areas to conduct testing.

Naturally, this positive correlation between fiscal autonomy and covid incidence does not imply causation. Given that fiscal autonomy may be influenced by factors that also affect health management, it is necessary to address potential endogeneity. Therefore, an instrumental variable approach is used to ensure exogeneity, providing more accurate and reliable estimates of the impact of fiscal autonomy on health management during a health crisis in Bolivian municipalities. This approach helps to isolate the causal impact of fiscal autonomy by using instruments that are correlated with fiscal autonomy but not directly with the covid incidence. As a result, we can better understand the true effect of fiscal decentralization on the municipalities' capacity to manage health crises effectively.

Table 3: Fiscal Autonomy and Covid Incidence: OLS estimates

| **Dep. variable** | Covid Incidence | | | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| lnFisAutonomy | 419.719*** | 407.321*** | 405.315*** | 401.190*** | 430.779*** | 446.277*** |
| | (64.407) | (66.595) | (64.770) | (69.108) | (67.964) | (68.552) |
| lnHistHealthExp | 1592.145*** | | | | | 1574.975*** |
| | (320.272) | | | | | (317.526) |
| WtdDensity | | -0.909*** | | | | .577 |
| | | (0.253) | | | | (.374) |
| Region | | | | | | |
| High and Low Valley | | | 591.104** | | | 657.630*** |
| | | | (256.895) | | | (219.838) |
| Young Population (0 to 19 years) | | | | 0.007 | | -.012 |
| | | | | (0.026) | | (.020) |
| Population Category | | | | | | |
| CAT C | | | | | -507.151** | -413.745* |
| | | | | | (221.406) | (232.487) |
| Cons | 8900*** | 3269.093*** | 2931.916*** | 2988.097*** | 3503.419*** | -8392.961*** |
| | (2418.241) | (298.219) | (266.236) | (1132.722) | (346.605) | (2347.935) |
| Obs | 287 | 287 | 287 | 287 | 287 | 287 |
| $R^2$ | 0.23 | 0.12 | 0.14 | 0.12 | 0.13 | 0.28 |
| Province FE | YES | YES | YES | YES | YES | YES |

Notes: OLS regressions. Standard errors clustered by Province allowing for arbitrary correlations within municipalities. * Significant at 10%; ** Significant at 5%; *** Significant at 1%. Covid Incidence is expressed as the number of positive cases of covid per 100,000 inhabitants in 2021. lnFisAutonomy is the logarithm of the ratio of Own Resources to Central Government Transfers in 2019. lnHistHealthExp corresponds to the logarithm of historical per capita expenditure on Health from 2011-2019, in Bolivianos (national currency). WtdDensity refers to (Population density * Population of observation)/Total population in 2021. High and Low Valley is a dummy variable taking the value of 1 if municipalities are classified into this geography area. Young Population corresponds to the rate per 100,000 inhabitants between 0 to 19 years. CAT C is a dummy variable that takes the value of 1 if municipalities have between 15,000 to 49,999 inhabitants. Province is a level of territorial organization of Bolivia, 109 provinces.

## 6.2 Instrumental Variable Strategy

Table 4 presents the reduced form and first-stage estimates. The reduced form allows us to observe the link between the instrument and the output, while the first stage shows the relationship between the instrument and the level of Fiscal Autonomy. To analyze the results of the reduced form, the logic should be as follows: the inverse distance between a municipality and the departmental capital is correlated with fiscal autonomy, which in turn influences the output. Therefore, a significant coefficient of the instrument on the output should be found, controlling for other regressors.

The reduced form column shows a positive and significant coefficient for the instrument, indicating that municipalities closer to the capital tend to have better capacity for identifying and reporting cases in municipalities with greater fiscal autonomy. Regarding the first stage, as expected, the estimated coefficient of the inverse distance is positive and highly significant. The Table 4 shows this result, indicating that a shorter distance to the capital (represented by a higher inverse distance value) is associated with greater fiscal autonomy.

Table 4: Fiscal Autonomy and Covid Incidence: Reduced Form and First Stage estimates - OLS and Instrumental Variable estimates.

| Dep. variable | Covid Incidence Reduce Form | Fiscal Autonomy First Stage | Covid Incidence OLS | Covid Incidence IV |
|---|---|---|---|---|
| Distance | 16778.62 | 27.7616 | | |
| | (7028.104)** | ( 5.138)*** | | |
| | (11560.27) | (6.147)*** | | |
| InfisAutonomy | | | 446.277 | 604.382 |
| | | | (58.210)*** | (236.888)** |
| | | | (68.552)*** | (348.368)* |
| Province FE | YES | YES | YES | YES |
| Controls | YES | YES | YES | YES |
| F statistics | | | | 29.20 |
| Obs | 287 | 287 | 287 | 287 |

Notes: Reduce Form and First Stage ; OLS and Instrumental Variable estimates. Robust standard errors in parentheses (below: clustered by Province, allowing for arbitrary correlations within municipalities). KPLM statistic is the test of the excluded instruments, with a Chi-sq(1) P-val = 0.0013. F statistics is the weak instruments test . *Significant at 10%; **Significant at 5%; ***Significant at 1%.

The last column of Table 4 shows the second-stage regression using the instrumental variables (IV) model. This result represents the estimation of the effect of the level of Fiscal Autonomy on health management in a health emergency scenario, measured as the identification of positive covid cases in 2021, using inverse distance as an instrumental variable. The coefficient of fiscal autonomy is positive and significant at the 5% level when robust standard errors are used, and at the 10% level when clustered standard errors are used. This result implies that a 1% increase in fiscal autonomy is associated with an increase of approximately 6.04 positive covid cases per 100,000 inhabitants. This suggests a greater capacity of municipalities with higher fiscal autonomy to manage and respond to the pandemic, reflected in greater identification and reporting of cases.

Comparing these results with those obtained in the OLS model, it is observed that this estimated coefficient (4.46) is lower than the IV model. Therefore, controlling for endogeneity using inverse distance as an instrument, the effect of fiscal autonomy on the output is more pronounced. The Kleibergen-Paap LM statistic is significant with a p-value of 0.0013, rejecting the null hypothesis that the model is under-identified. The F statistic is 29.20, higher than the Stock-Yogo critical values for all levels, indicating that the implemented instrument is strong enough to provide reliable estimates. Robust standard errors and clustered by province are employed to account for heteroscedasticity and spatial correlation.

In summary, the results provide robust evidence that greater fiscal autonomy is associated with a higher capacity to manage and respond to the covid pandemic in Bolivian municipalities. The comparison with OLS results underscores the importance of using

instrumental variables to obtain unbiased estimates of the effect of fiscal autonomy.

## 6.3 Spatial Regression with Instrumental Variable

The relevance of conducting a spatial regression analysis using an instrumental variable approach lies in its ability to capture both the direct and spillover effects of the level of Fiscal Autonomy on health management outcomes at the municipal level. Traditional regression models assume independence between observations, which is often not met when analyzing data with the presence of spatial autocorrelation. By employing a spatial regression model, it is possible to account for dependencies between territorial units and better understand the analyzed output.

To ensure the robustness of this spatial analysis, Moran's I tests were performed for all considered spatial weight matrices (see Figure A3): without band, including all distances without restriction; with band, considering 100 km, 50 km, and 25 km bands to limit the influence to closer neighbors, as well as contiguity matrices with row-standardized and non-standardized matrices. The results indicated significant positive spatial autocorrelation for all considered weight matrices, suggesting that municipalities with high (or low) incidence are clustered. This significant correlation validates the need to use spatial econometric techniques, as ignoring spatial dependencies could lead to biased and inefficient estimates.

Table 5 shows comparative results between a SAR model with and without an instrumental variable. Regressions (1), (2), (3), and (4) present the SAR model estimates using inverse distance-based weight matrices without band and with 100 km, 50 km, and 25 km bands, respectively, and columns (5) and (6) correspond to estimates using contiguity-based weight matrices. The estimated coefficients for municipal fiscal autonomy are positive and significant at the 1% level in all models, suggesting that greater fiscal autonomy is associated with higher output. The p-values of the Wald test Chi2(1) indicate that the spatial terms are significant in all SAR model specifications ($p < 0.05$). This suggests that spatial autocorrelation is an important factor to consider in analyzing covid incidence, where its values in one municipality are associated with values in neighboring municipalities. However, given that the main variable is endogenous, these results are limited to representing simple spatial relationships.

Table 5: Fiscal Autonomy and output: Spatial Autoregressive and Spatial Instrumental Variable Regression.

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | Spatial Autoregressive Regression Model (SAR) | | | | | |
| Covid Incidence | | | | | | |
| lnFisAutonomy | 402.334*** | 397.027*** | 397.808*** | 404.546*** | 267.112*** | 322.199*** |
| | (61.953) | (61.967) | (61.605) | (60.880) | (50.111) | (55.244) |
| Wald test Chi2(1) p-value | 0.019 | 0.010 | 0.008 | 0.008 | 0.000 | 0.000 |
| | Spatial Instrumental Variable Regression | | | | | |
| Covid Incidence | | | | | | |
| lnFisAutonomy | 812.648*** | 688.742*** | 514.441*** | 378.818* | 368.276*** | 632.519*** |
| | (133.701) | (154.122) | (171.406) | (216.255) | (142.707) | (155.470) |
| Wald test Chi2(1) p-value | 0.685 | 0.913 | 0.288 | 0.047 | 0.000 | 0.0001 |
| Obs | 286 | 286 | 286 | 286 | 287 | 287 |

Notes: Spatial Autoregressive and Spatial Instrumental Variable Regression. *Significant at 10%; **Significant at 5%; ***Significant at 1%. Columns (1), (2), (3), and (4) represent estimates that consider inverse distance weight matrices without a band, and with band of 100km, 50km, and 25km, respectively. Columns (5) and (6) correspond to estimates using contiguity weight matrices, with column (5) using a row-standardized matrix and column (6) using a non-standardized matrix. A low p-value in the Wald test (generally $< 0.05$) indicates that at least one of the spatial terms has a significant effect in the model.

In the second part of Table 5, the results for the spatial regression with instrumental variable are shown. In the first three models (columns 1, 2, and 3), which use weight matrices without band and with bands of 100 km and 50 km, respectively, the spatial terms are not significant (Wald test Chi2(1) p-value $> 0.05$). This may be due to the spatial term not being adequate, potentially omitting important effects that neighboring observations have on the output. This can cause an overestimation of the effect of the main variable of interest, in this case, fiscal autonomy. However, in the models using a 25 km band (column 4) and weight matrices based on standardized and non-standardized contiguity (columns 5 and 6), the spatial terms are significant (Wald test Chi2(1) p-value $< 0.05$). This indicates that, in these cases, spatial dependence between municipalities affects covid incidence and should be considered in the analysis of spillover effects.

Table 6 illustrates the direct and spillover effects of Fiscal Autonomy on the health outcome of interest, Covid Incidence, as shown in regressions (4) and (6) from Table 5. The direct effect, as indicated in column (4) using a weight matrix with a 25 km band, suggests that a 1% increase in fiscal autonomy correlates with an increase of approximately 4 positive cases of covid identified per 100,000 inhabitants in the considered municipality. Furthermore, the spillover effect suggests that the fiscal autonomy of a municipality not only impacts the identification of covid cases within its territory but also positively and significantly influences neighboring municipalities. Specifically, a 1% increase in fiscal autonomy of a municipality results in an increase in the identification of covid cases in neighboring municipalities by approximately 0.2 cases per 100,000 inhabitants.

Table 6: Spatial spillover Effects of Fiscal Autonomy.

| Dep. variable | Covid Incidence | |
|---|---|---|
| | (4) | (6) |
| Direct effects | | |
| lnFisAutonomy | 379.636* | 645.749*** |
| | (216.117) | (156.057) |
| Indirect effects | | |
| lnFisAutonomy | 18.627** | 273.376*** |
| | (8.849) | (101.895) |
| Total effects | | |
| lnFisAutonomy | 398.263* | 919.126*** |
| | (219.297) | (211.437) |

Notes: * Significant at 10%; ** Significant at 5%; *** Significant at 1%. Column (4) represents estimates considering an inverse distance weight matrix with a bandwidth of 25 km. Columns (6) corresponds to estimates using contiguity weight matrices, using a non-standardized matrix.

The coefficients for the contiguity weight matrix are presented in column (6), where the direct effect indicates that there is an increase in approximately 6 cases of covid identified per 100,000 inhabitants given a 1% increase in the level of Fiscal Autonomy. In this case, there's a notably larger positive spillover effect. A 1% increase in fiscal autonomy within a municipality has an impact of about 3 covid cases per 100,000 inhabitants in neighboring municipalities. These findings emphasize the importance of analizing the decomposed impact of fiscal autonomy on health outcomes considering the existence of spatial dependencies. The spillover effects discovered demonstrate that it's important to consider not only the direct impact of fiscal autonomy within individual municipalities but also its effect on health outcomes in neighboring municipalities. Recognizing the connection between fiscal autonomy and health outcomes in municipal clusters is crucial for making informed policy decisions, which can lead to coordinated public health interventions.

## 6.4 Mechanisms: Health Expenditure

This study has demonstrated that a higher level of fiscal autonomy has a positive effect on the incidence of covid at the municipal level, interpreted as a greater municipal capacity to mobilize human and economic resources to conduct more tests, thus identifying positive covid cases with the purpose of having fewer complications. However, this interpretation may be debatable, as it could be argued that greater fiscal autonomy might result in poorer health management and, consequently, higher covid contagion due to the lack of resource management during a health crisis, because having more resources available (higher fiscal autonomy) doesn't necessarily mean that municipalities are allocating more resources to the healthcare sector in general and for specific covid-related care.

Demonstrating that there is an increase in healthcare spending given an increase in the level of fiscal autonomy would propose this relationship as the mechanism behind the influence of fiscal autonomy and the higher detection of covid cases. In this sense, if the increase in healthcare spending is the pathway through which a higher level of fiscal autonomy affects the output (Covid Incidence), a more robust mechanism would be to demonstrate that fiscal autonomy has a positive effect on healthcare spending specifically directed towards addressing the covid emergency. This was achieved by constructing a variable that captures resources allocated exclusively to financing covid care in the 2021 management [12]. In this regard, to provide robustness to the obtained results, the effect of the level of fiscal autonomy on two additional health outcomes was estimated. These additional analyses will allow verification of whether municipalities with greater fiscal autonomy effectively managed the health crisis better by increasing their healthcare efforts to address the pandemic.

**Total Health Expenditure:** The first additional health output considered is the total health expenditure. This analysis includes the entire budget allocated to the municipal health sector. The impact of the level of fiscal autonomy on this output is estimated to assess whether municipalities with greater fiscal autonomy to reallocate more resources to the health sector in response to the health emergency. According to the hypothesis, municipalities with greater fiscal autonomy are expected to be able employ more resources in health, allocating a larger proportion to the health sector to address both the general health needs of the population and pandemic-related requirements.

**Covid-Specific Expenditure:** The second additional health output to be analyzed is the specific expenditure on supplies, hiring personnel, and other resources specifically aimed at addressing the covid emergency. This analysis supports the hypothesis that municipalities with greater fiscal autonomy have responded better by adjusting their budgets within the health sector or other to increase specific funding for combating covid. Higher specific covid expenditure, given a greater fiscal autonomy, indicates a more disponibility of resources to mobilize in response to a health crisis scenario.

Table 7 presents the results of the estimates using OLS and the instrumental variables (IV) model for two additional outputs: covid-specific expenditure (Covid Expenditure) and total health sector expenditure (Health Expenditure). These results provide a more comprehensive view of the impact of fiscal autonomy on municipal health management during the pandemic.

[12]Program 20, Activity 150, Ministry of Economy and Public Finances of Bolivia

Table 7: The influence Fiscal Autonomy on Covid Expenditure and Health Expenditure: OLS and Instrumental Variable estimates .

| Dep. variable | Covid Expenditure | | Health Expenditure | |
|---|---|---|---|---|
| | OLS | IV | OLS | IV |
| InfisAutonomy | 0.167 | 0.336 | 0.042 | 0.063 |
| | (0.055)*** | (0.157)** | (0.015)*** | (0.033)* |
| | (0.052)*** | (0.156)** | (0.052)*** | (0.033)* |
| Province FE | YES | YES | YES | YES |
| Controls | YES | YES | YES | YES |
| F statistics | | 26.044 | | 31.684 |
| Obs | 235 | 235 | 276 | 276 |

Notes: OLS and Instrumental Variable estimates. Robust standard errors in parentheses (below: clustered by Province, allowing for arbitrary correlations within municipalities). KPLM statistic is the test of the excluded instruments, with a Chi-sq(1) P-val = 0.0019 and 0.0010, espectively. F statistics is the weak instruments test. *Significant at 10%; **Significant at 5%; ***Significant at 1%.

In the Covid Expenditure columns, both the OLS and IV models show significant coefficients for fiscal autonomy. According to the IV model, a 1% increase in fiscal autonomy leads to a 0.34% increase in specific covid expenditure. Similarly, in the Health Expenditure column, the IV model indicates that a rise in fiscal autonomy results in a 0.063% increase in total health expenditure. These findings support the initial hypothesis that greater fiscal autonomy positively impacts health management at the municipal level. Municipalities with higher fiscal autonomy have increased their budgets for the healthcare sector overall, specifically allocating more funds for covid care. Consequently, they have greater financial capacity to identify positive covid cases within their jurisdictions.

By considering different health output measures, a more comprehensive and accurate view is obtained of how fiscal autonomy influences municipalities' capacity to manage health emergencies. Additionally, these analyses help rule out the possibility that the initial results were due to unconsidered factors. Thus, robust and detailed evidence is provided of the impact of fiscal autonomy on health management in Bolivian municipalities, especially in health emergency contexts such as the covid pandemic.

In the spatial regression subsection 6.3, a spatial analysis of the effect of fiscal autonomy was conducted, considering the presence of autocorrelation in the dependent variable data. However, the variables considered in this robustness analysis, such as specific Covid Expenditure and total Health Expenditure, do not show significant spatial autocorrelation (see Figure A4). This was determined through Moran's I tests, which showed the absence of spatial clustering patterns for these additional outputs. For this reason, the spillover analysis is not extended to these outputs.

# 7. Conclusion

This study has demonstrated that greater fiscal autonomy at the municipal level significantly improves health management. This positive outcome is attributed to better management in conducting covid tests by municipalities with more fiscal autonomy and potentially more own resources. To understand the mechanism behind this relationship, the study tested two key variables: "covid expenditure" and "health expenditure." The analysis revealed that municipalities with greater fiscal autonomy not only invest more in health overall but also prioritize resources to address the pandemic specifically. This suggests that these municipalities, being closer to their citizens, are more responsive to their needs and thus allocate resources more effectively to manage health crises, including the identification of covid cases. Additionally, the findings indicate that the benefits of increased fiscal autonomy extend beyond individual municipalities, positively impacting neighboring regions as well.

Specifically, the results obtained through the instrumental variables strategy show that a 1% increase in fiscal autonomy is associated with an increase of 6 positive covid cases identified per 100,000 inhabitants. This indicates a greater capacity of municipalities with higher fiscal autonomy to manage and respond to the pandemic. Compared to the results from the OLS model, where the estimated coefficient was 4.46, the use of instrumental variables allowed for control of endogeneity, resulting in a more pronounced effect. Further analyses showed that a higher level of fiscal autonomy leads to an increase in health spending, confirming the mechanism behind the initial results. A 1% increase in fiscal autonomy results in a 0.34% increase in covid-specific expenditure and a 0.063% increase in total health expenditure. These findings confirm that municipalities with greater fiscal autonomy are more likely to allocate resources effectively to both general health needs and specific pandemic requirements, thus improving their capacity to manage health emergencies, particularly by conducting more tests. By considering different health outcome measures, this study provides a comprehensive and accurate view of how fiscal autonomy influences municipal health management during the covid pandemic.

Additionally, the analysis of spillover effects reveals that fiscal autonomy not only benefits individual municipalities but also has a significant positive impact on neighboring municipalities. Specifically, the direct effect analysis shows that a 1% increase in fiscal autonomy leads to an increase of approximately 4 to 6 positive covid cases per 100,000 inhabitants within the municipality, depending on the weight matrix used. The spillover effect is also significant, indicating that an additional 1% increase in fiscal autonomy results in an additional 0.2 to 3 positive covid cases per 100,000 inhabitants in neighboring municipalities. These findings underscore the importance of recognizing the interdependence between fiscal autonomy and health outcomes within municipal clusters. By acknowledging these relationships, policymakers can make more informed decisions that promote coordinated public health interventions. The robustness of these conclusions is

validated by the use of instrumental variable models and spatial regression techniques, which effectively control for potential endogeneity and spatial dependencies.

The results have important policy implications for Bolivia and other territories with similar administrative structures. Promoting policies that increase the level of fiscal autonomy can lead to more efficient and effective public health management, especially in health crisis scenarios, by enabling municipalities to allocate resources where they are most needed. Policymakers should consider reforms that enhance the financial independence of local governments and their capacity to generate their own revenues. Additionally, the findings highlight the importance of coordinated public health interventions at the municipal level. Such coordination ensures that efforts are well-organized and resources are used optimally, benefiting not only individual municipalities but also their neighboring regions.

A limitation of this study is the lack of reliable data on the number of covid-related deaths at the municipal level. Including this variable could enhance the robustness of the findings by allowing for an examination of the potential negative relationship between higher fiscal autonomy and covid mortality rates. Additionally, the analysis is confined to data from Bolivian municipalities, which may limit the applicability of the results to other regions. The focus on the covid pandemic as the specific health crisis studied may also not fully represent the broader effects of fiscal decentralization on other public services.

There is a need for further research to deepen the understanding of fiscal autonomy's impact on public health management. Future studies should explore the long-term effects of fiscal decentralization on a variety of public services beyond health. Additionally, examining the impact of varying degrees of fiscal autonomy and the influence of local administrative capacities on the effectiveness of decentralized governance would be valuable. Comparative analyses between countries with different levels of fiscal decentralization could also shed light on the generalizability of these findings. Such research can offer a more comprehensive view of the benefits and challenges of fiscal decentralization, ultimately informing more effective policy decisions.

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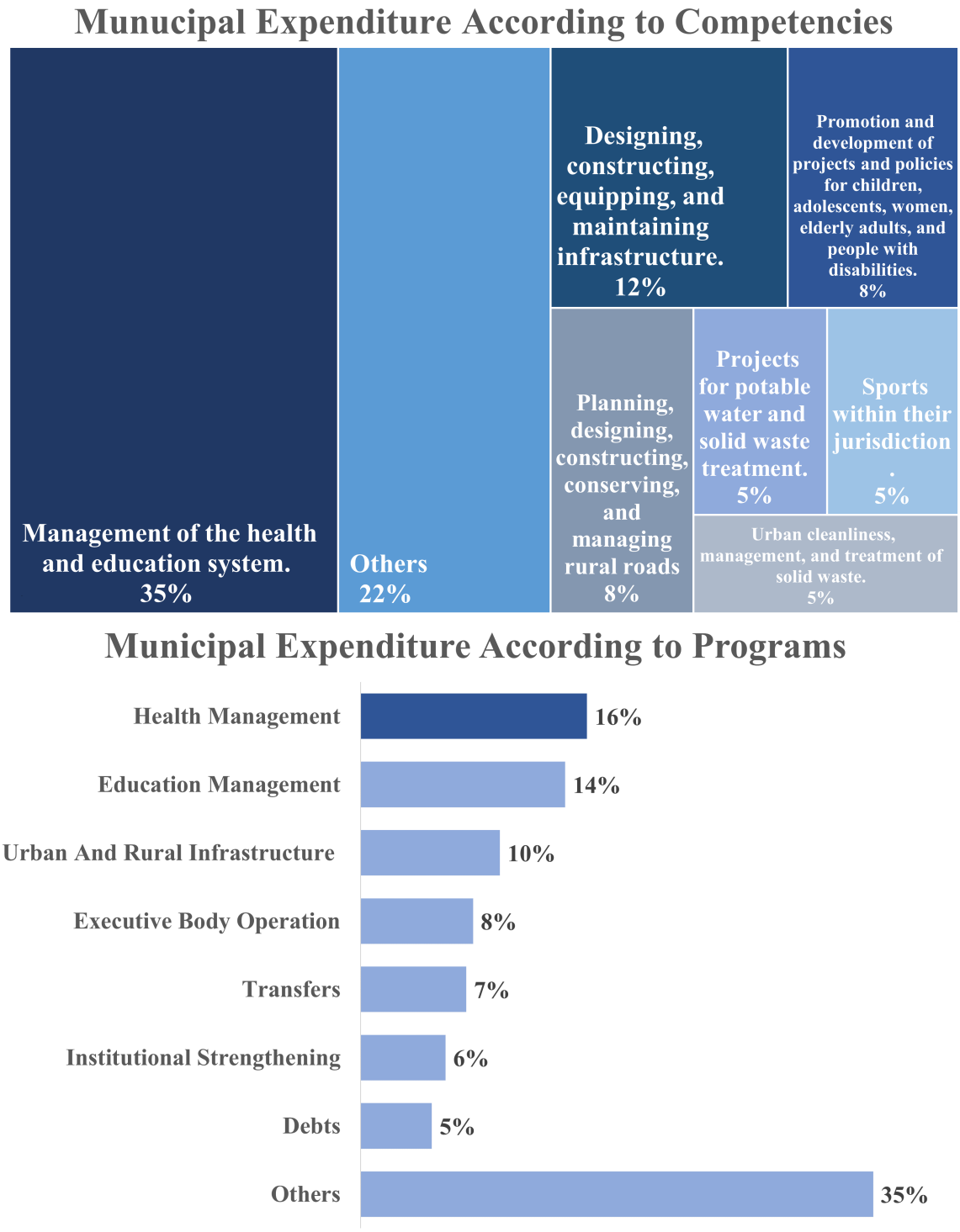
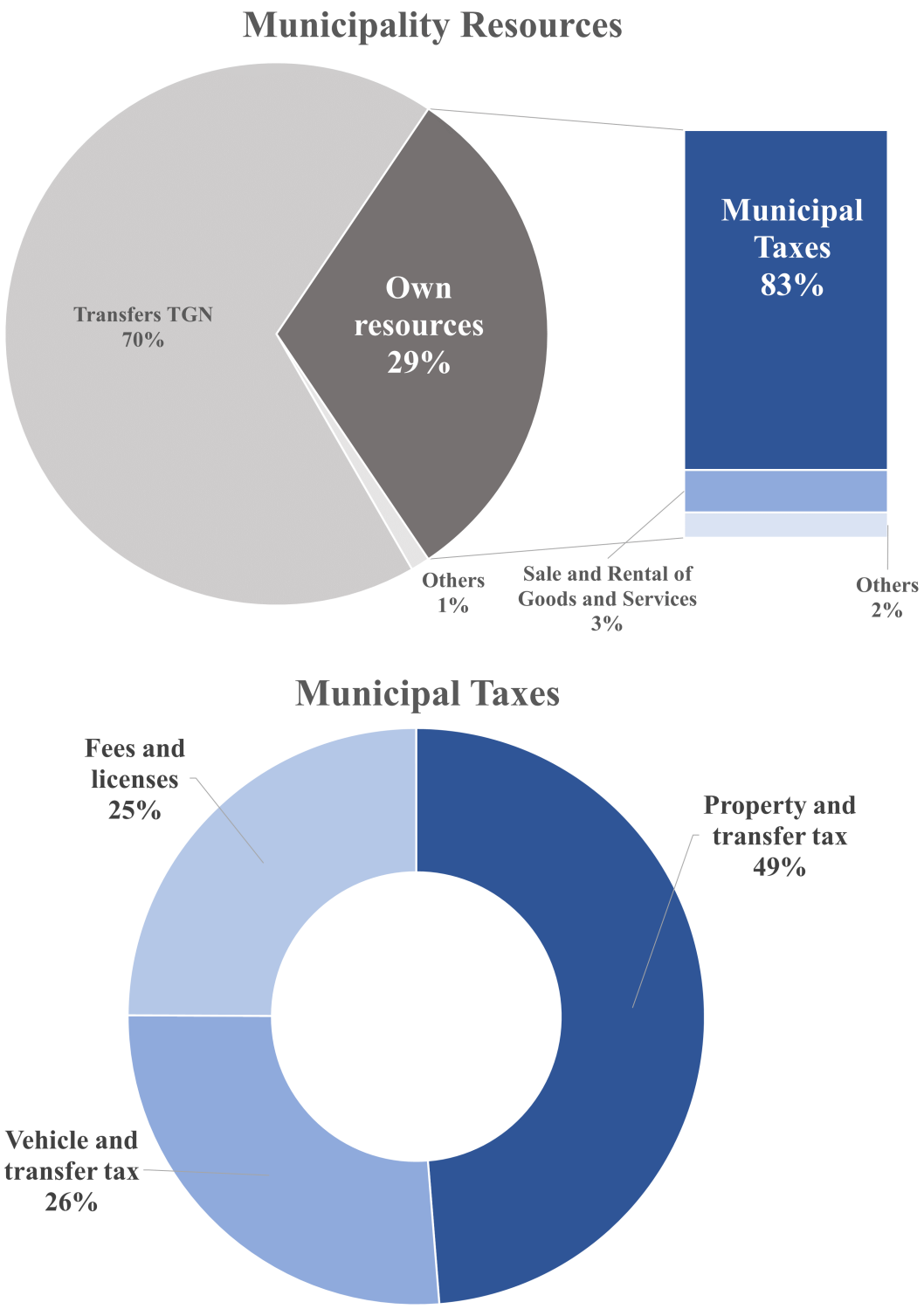
# A. Appendix

Figure A1: Municipal Expenditure




*Source: Own elaboration based on data from the Ministry of Economy and Public Finance of Bolivia, 2019*

Figure A2: Municipal Income




*Source: Own elaboration based on data from the Ministry of Economy and Public Finance of Bolivia, 2019*

Table A1: Summary and Descriptive Statistics of the Variables

| Variable | Obs | Mean | Std. Dev. | Min | Max | Source |
|---|---|---|---|---|---|---|
| Covid Incidence (1) | 329 | 1992.004 | 1876.367 | 11.832 | 9042.383 | Ministry of Health |
| Covid Expenditure (2) | 313 | 16.788 | 20.295 | 0 | 132.782 | |
| Health Expenditure (3) | 316 | 260.669 | 108.76 | 91.499 | 694.758 | |
| Fiscal Autonomy (4) | 333 | 0.109 | 0.172 | 0 | 1.009 | |
| Historic Health Expenditure (5) | 339 | 2256.019 | 1091.646 | 506.037 | 7877.994 | Ministry of Economy and |
| Province (6) | 339 | | | 1 | 109 | Public Finances |
| Dummy variables, Population Category (7) | | | | | | |
| CAT C | 339 | | | | | |
| Weighted Density (8) | 339 | 6.21 | 59.586 | 0 | 960.817 | |
| Population by Age (9) | | | | | | National Institute |
| Population Age 1 (0 - 18 years) | 339 | 37648.146 | 5367.449 | 23440.955 | 51037.226 | of Statistics |
| Dummy variables, Region (10) | | | | | | |
| High and Low Valley | 339 | | | | | Fundación Tierra |

Notes: The table summaries all dependent and independent variables and provides the main descriptive statistics: the number of observations, the mean, the standard deviation and the minimum and maximum values. A total of 339 local territorial units are considered, as recognized up until 2019. (1) Territories where no covid cases are registered are not included, and outliers above the 98% percentile are excluded. The variable is expressed as the number of positive cases per 100,000 inhabitants in 2021. (2) Values are excluded when conditions (1) and (3) are zero, and outliers above the 98% percentile. The variable is reported as per capita expenditure in Bolivianos for 2021 (national currency). The logarithm of the variable has fewer observations due to zero values. (3) Considers the executed expenditure in 2021 within the budgetary program 20 "Health". Values are excluded when health expenditure is zero, as well as outliers below the 2% percentile and above the 98% percentile. The variable is expressed in per capita expenditure in Bolivianos (national currency). (4) The ratio of Own Resources to Central Government Transfers in 2019 excludes observations with extreme values above the 98% percentile. The logarithm of the variable presents fewer observations due to zero values. (5) Historical per capita expenditure on Health from 2011-2019, in Bolivianos (national currency). (6) Province corresponds to a level of territorial organization as per the Political Constitution of the Plurinational State of Bolivia. Observations are grouped into 109 provinces, according to Bolivia's geographical classification. (7) Classification based on S.D. No. 26451, 2001. Category A: up to 5,000 inhab.; Category B: from 5,001 to 14,999 inhab.; Category C: from 15,000 to 49,999 inhab.; and Category D: with a population equal to or greater than 50,000 inhab. (8) The calculation (Population density * Population of observation) / Total population in 2021 is used for demographic analysis. (9) The 2021 population, distributed by age ranges, is adjusted to a rate per 100,000 inhabitants. (10) Local territories are classified according to the geography of the country.

Table A2: Fiscal Autonomy and Covid Incidence: OLS and Instrumental Variable estimates.

| Dep. variable | Covid Incidence | |
|---|---|---|
| | OLS | IV |
| InfisAutonomy | 446.277 | 604.382 |
| | (58.210)*** | (236.888)** |
| | (68.552)*** | (348.368)* |
| lnHistHealthExp | 1574.975 | 1595.502 |
| | (262.762)*** | (258.168)*** |
| | (317.527)*** | (303.920)*** |
| WtdDensity | 0.577 | 0.185 |
| | (0.309)* | ( 0.611) |
| | (0.374) | (0.872) |
| Region | | |
| High and Low Valley | 657.630 | 672.160 |
| | (187.832)*** | (219.838)*** |
| | (187.139) *** | (210.202)*** |
| PopAge1 (0 to 19 years) | -0.013 | -0.019 |
| | (0.016) | (0.020) |
| | (0.019) | (0.024) |
| Population Category | | |
| CAT C | -413.745 | -499.513 |
| | (201.194)** | (232.488)* |
| | (227.026) ** | (275.541)* |
| Cons | -8400 | -7800 |
| | (1956.288)*** | (2347.935)*** |
| | (2155.244)*** | (2713.186)*** |
| Obs | 287 | 287 |
| Province FE | YES | YES |

Notes: OLS and Instrumental Variable estimates. Robust standard errors in parentheses (below: clustered by Province, allowing for arbitrary correlations within municipalities). *Significant at 10%; **Significant at 5%; ***Significant at 1%.

Table A3: The influence of Inverse Distance on output and Fiscal Autonomy: reduced form and first stage estimates.

| Dep. variable | Covid Incidence | Fiscal Autonomy |
|---|---|---|
| | Reduce Form | First Stage |
| Distance | 16778.62 | 27.7616 |
| | (7028.104)** | ( 5.138)*** |
| | (11560.27) | (6.147)*** |
| lnHistHealthExp | 1571.514 | -.040 |
| | (292.358)*** | (.234) |
| | (361.954)*** | (.278) |
| WtdDensity | -2.251 | -.004 |
| | (1.653) | (.001)*** |
| | (2.698) | (.001)** |
| Region | | |
| High and Low Valley | 488.308 | -.304 |
| | (215.086)** | (.193) |
| | (277.622)* | (.240) |
| PopAge1 (0 to 19 years) | .012 | .000 |
| | (.017) | (.000)*** |
| | (.023) | (.000)*** |
| Population Category | | |
| CAT C | -154.078 | .572 |
| | (226.604) | (.206)*** |
| | ( 256.393) | (.223)** |
| Obs | 287 | 287 |
| Province FE | YES | YES |

Notes: Reduce Form and First Stage. Robust standard errors in parentheses (below: clustered by Province, allowing for arbitrary correlations within municipalities). *Significant at 10%; **Significant at 5%; ***Significant at 1%.

Table A4: Fiscal Autonomy and Covid Expenditure: OLS and Instrumental Variable estimates.

| Dep. variable | Covid Expenditure | |
|---|---|---|
| | OLS | IV |
| InfisAutonomy | 0.167 | 0.336 |
| | (0.055)*** | (0.157)** |
| | (0.052)*** | (0.156)** |
| lnHistHealthExp | 0.349 | 0.336 |
| | (0.193)* | (0.199)* |
| | (.186)* | (0.189))* |
| WtdDensity | -0.002 | -0.002 |
| | (0.000)*** | (0.000)*** |
| | (0.000)*** | (0.000)*** |
| Region | | |
| High and Low Valley | -0.338 | -0.321 |
| | (0.162)** | (0.162)** |
| | (0.179)* | (0.183)* |
| PopAge1 (0 to 19 years) | -0.000 | -0.000 |
| | (0.000) | (0.000) |
| | (0.000) | (0.000) |
| Population Category | | |
| CAT C | -0.135 | -0.187 |
| | 0.185) | (0.187) |
| | (0.187) | (0.192) |
| Cons | 1.164 | 2.033 |
| | (1.400) | (1.641) |
| | (1.431) | (1.492) |
| Province FE | YES | YES |
| F statistics | | 20.366 |
| Obs | 235 | 235 |

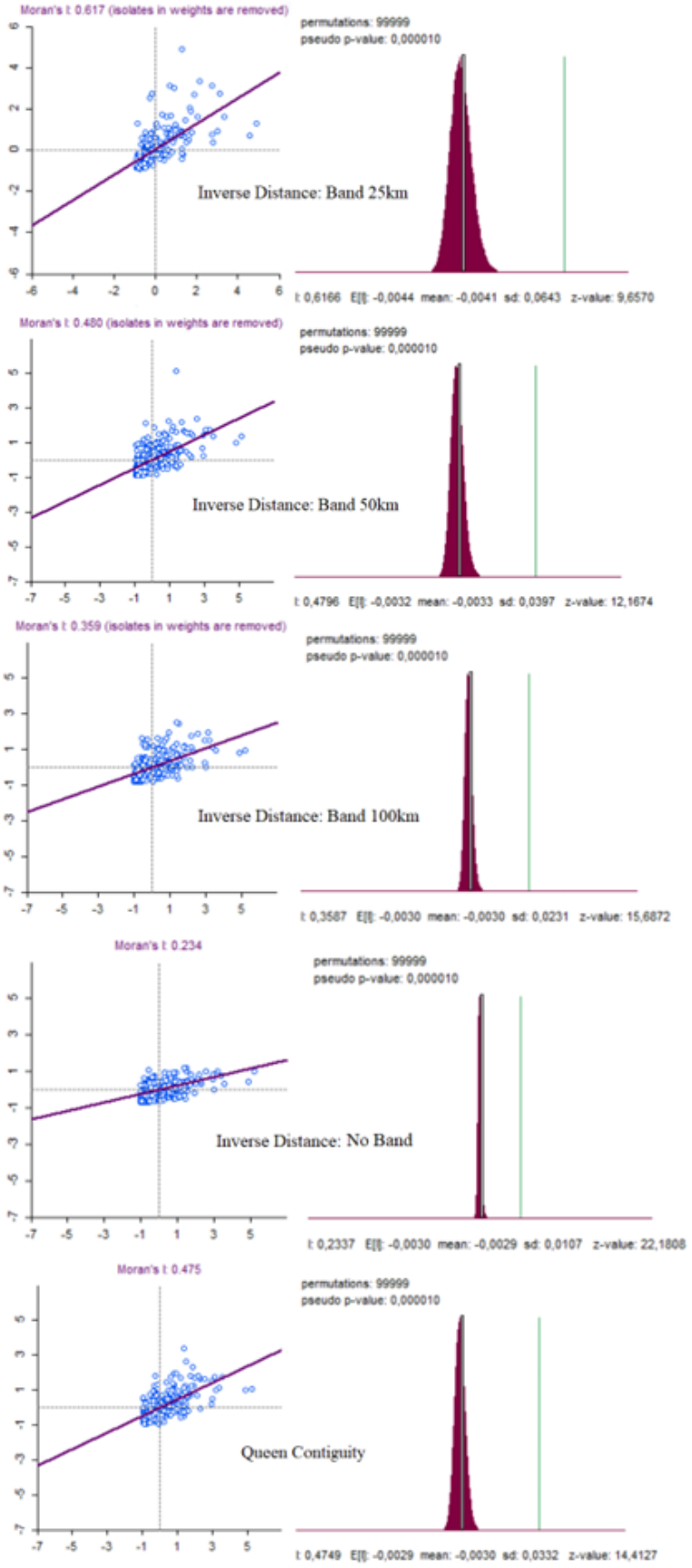
Notes: OLS and Instrumental Variable estimates. Robust standard errors in parentheses (below: clustered by Province, allowing for arbitrary correlations within municipalities). *Significant at 10%; **Significant at 5%; ***Significant at 1%.

Table A5: Fiscal Autonomy and Health Expenditure: OLS and Instrumental Variable estimates.

| Dep. variable | Health Expenditure | |
|---|---|---|
| | OLS | IV |
| InfisAutonomy | 0.042 | 0.063 |
| | (0.015)*** | (0.033)* |
| | (0.052)*** | (0.033)* |
| lnHistHealthExp | 0.482 | 0.481 |
| | (0.055)*** | (0.054)*** |
| | (0.054)*** | (0.053)*** |
| WtdDensity | 0.000 | 0.00 |
| | (0.000) | (0.000) |
| | (0.000) | (0.000) |
| Region | | |
| High and Low Valley | -0.070 | -0.068 |
| | (0.039)* | (0.039)* |
| | (0.041)* | (0.040)* |
| PopAge1 (0 to 19 years) | 0.000 | 0.000 |
| | (0.000) | (0.000) |
| | (0.000) | (0.000) |
| Population Category | | |
| CAT C | 0.010 | -0.001 |
| | (0.037) | (0.037) |
| | (0.034) | (0.034) |
| Cons | 1.810 | 1.927 |
| | (0.412)*** | (0.413)*** |
| | (0.470)*** | (0.449)*** |
| Province FE | YES | YES |
| F statistics | | 23.525 |
| Obs | 276 | 276 |

Notes: OLS and Instrumental Variable estimates. Robust standard errors in parentheses (below: clustered by Province, allowing for arbitrary correlations within municipalities). *Significant at 10%; **Significant at 5%; ***Significant at 1%.

Figure A3: Morant's I Test: Incidence of Covid, 2021



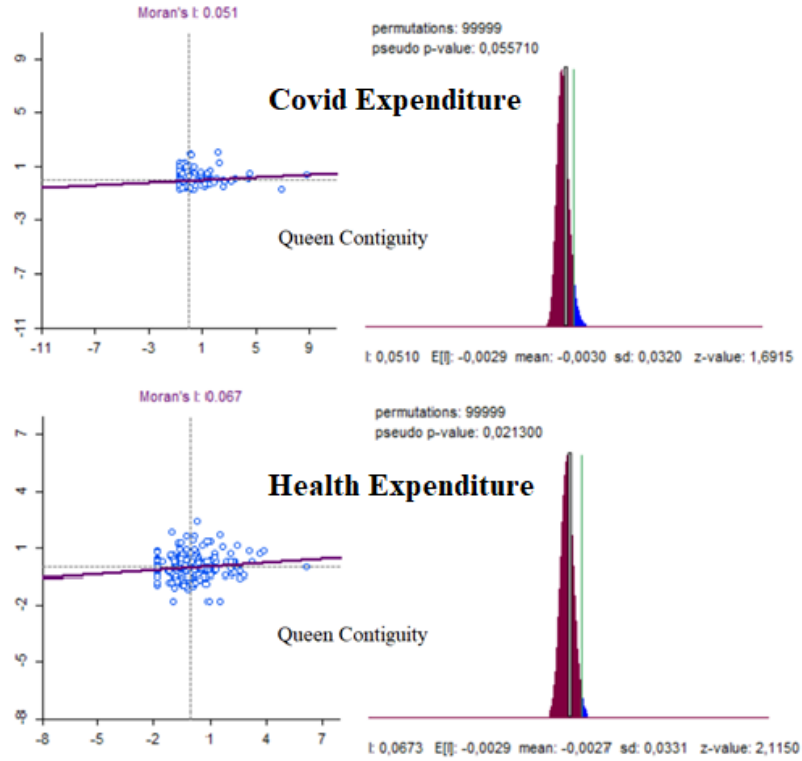

*Source: Own elaboration based from the Ministry of Health of Bolivia, 2021*

Table A6: Fiscal Autonomy and output: Spatial Autoregressive and Spatial Instrumental Variable Regression.

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | Spatial Autoregressive Regression Model (SAR) | | | | | |
| Covid Incidence | | | | | | |
| lnFisAutonomy | 402.334*** | 397.027*** | 397.808*** | 404.546*** | 267.112*** | 322.199*** |
| | (61.953) | (61.967) | (61.605) | (60.880) | (50.111) | (55.244) |
| lnHistHealthExp | 1510.772*** | 1507.648*** | 1515.904*** | 1524.579*** | 835.700*** | 1232.911*** |
| | (248.738) | (248.089) | (247.426) | (247.097) | (209.640) | (226.181) |
| WtdDensity | 0.583 | 0.590 | 0.592 | 0.589 | 0.892 | 0.941 |
| | (1.656) | (1.653) | (1.652) | (1.652) | (1.347) | (1.496) |
| High and Low Valley | 370.926* | 418.919** | 473.045** | 519.267*** | 260.839* | 242.089 |
| | (225.218) | (210.174) | (200.494) | (195.043) | (156.415) | (177.401) |
| Young Population | -0.005 | -0.003 | -0.002 | -0.002 | -0.030 | -0.028 |
| | (0.019) | (0.019) | (0.019) | (0.019) | (0.015) | (0.017) |
| CAT_C | -368.607* | -343.530 | -354.044* | -366.198* | -186.523 | -410.903*** |
| | (210.445) | (210.924) | (210.162) | (209.708) | (171.484) | (189.189) |
| Spatial Term | 0.324** | 0.301** | 0.290*** | 0.294*** | 0.603*** | 0.079*** |
| | (0.138) | (0.117) | (0.109) | (0.110) | (0.051) | (0.010) |
| _cons | -8700.000*** | -8500.000*** | -8600.000*** | -8600.000*** | -3700.000** | -6100.000*** |
| | (1900.386) | (1893.886) | (1892.618) | (1892.433) | (1582.291) | (1723.845) |
| Wald test Chi2(1) p-value | 0.019 | 0.010 | 0.008 | 0.008 | 0.000 | 0.000 |
| | Spatial Instrumental Variable Regression | | | | | |
| Covid Incidence | | | | | | |
| lnFisAutonomy | 812.648*** | 688.742*** | 514.441*** | 378.818* | 368.276*** | 632.519*** |
| | (133.701) | (154.122) | (171.406) | (216.255) | (142.707) | (155.470) |
| lnHistHealthExp | 1651.934*** | 1622.314*** | 1562.542*** | 1518.699*** | 353.070 | 1347.762*** |
| | (269.733) | (261.132) | (252.630) | (252.064) | (249.552) | (246.806) |
| WtdDensity | -0.286 | -0.001 | 0.362 | 0.648 | 0.552 | 0.159 |
| | (1.800) | (1.751) | (1.704) | (1.719) | (1.425) | (1.627) |
| High and Low Valley | 762.226*** | 699.072*** | 575.589*** | 511.356** | 6.800 | 363.054* |
| | (259.352) | (232.272) | (213.347) | (207.472) | (174.829) | (199.235) |
| Young Population | -0.027 | -0.021 | -0.010 | -0.001 | -0.051*** | -0.036* |
| | (0.021) | (0.021) | (0.021) | (0.022) | (0.017) | (0.019) |
| CAT_C | -614.119*** | -545.267*** | -432.809** | -351.450 | -151.371 | -564.497*** |
| | (236.077) | (235.562) | (231.924) | (241.543) | (194.543) | (214.027) |
| Spatial Term | -0.071 | -0.016 | 0.147 | 0.305** | 1.021*** | 0.061*** |
| | (0.176) | (0.148) | (0.138) | (0.154) | (0.113) | (0.015) |
| _cons | -7200.000*** | -7600.000*** | -8200.000*** | -8700.000*** | 435.336 | -5600.000*** |
| | (2087.097) | (2024.413) | (1983.498) | (2023.015) | (1853.663) | (1899.947) |
| Wald test Chi2(1) p-value | 0.685 | 0.913 | 0.288 | 0.047 | 0.000 | 0.0001 |
| Obs | 286 | 286 | 286 | 286 | 286 | 286 |

Notes: Spatial Autoregressive and Spatial Instrumental Variable Regression. *Significant at 10%; **Significant at 5%; ***Significant at 1%. Columns (1), (2), (3), and (4) represent estimates that consider inverse distance weight matrices without a band, and with band of 100km, 50km, and 25km, respectively. Columns (5) and (6) correspond to estimates using contiguity weight matrices, with column (5) using a row-standardized matrix and column (6) using a non-standardized matrix. A low p-value in the Wald test (generally $< 0.05$) indicates that at least one of the spatial terms has a significant effect in the model.

Figure A4: Morant's I Test: Covid Expenditure and Health Expenditure




*Source: Own elaboration based on data from the Ministry of Economy and Public Finance of Bolivia, 2019*