Article

Determinants of irregularities in municipal public management: the case of municipalities in the state of São Paulo

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The municipal external control exercised by the Courts of Accounts reveals the irregularities found in the accounts of municipal governments through the disclosure of audit reports. They have been empirically analyzed from the point of view of their classification in terms of severity, but few studies aim to identify the factors that influence such failures. Having verified this gap, the main objective of this study is to identify factors that may influence lapses in municipal public management pointed out by the audit of the Court of Accounts. This article contributes to further research on this topic and to improving management in municipalities. This is an exploratory analysis based on econometric models for panel data. The sample includes 179 municipalities in São Paulo, with data for 2011, 2013, 2015, 2017, and 2019. The results suggest that the recommendations and determinations of the Court of Accounts and gaps in internal controls influence irregularities in small, medium, and large municipalities. The volume of legal and constitutional transfers received influences small and medium-sized municipalities, while the municipal gross domestic product (GDP) influences medium-sized municipalities.
Keywords: irregularities; public management; counties; panel corrected standard errors.

Determinantes das irregularidades na gestão pública municipal: o caso dos municípios do estado de São Paulo

O controle externo municipal exercido pelos Tribunais de Contas permite, por meio da divulgação dos relatórios de auditoria, conhecer as irregularidades encontradas nas contas dos governos municipais. Elas têm sido analisadas empiricamente, do ponto de vista de sua classificação em termos de gravidade, mas poucos são os estudos que visam identificar os fatores que influenciam tais falhas. Constatada essa lacuna, o principal objetivo deste estudo é identificar fatores que possam influenciar lapsos na gestão pública municipal apontados pela auditoria do Tribunal de Contas. Este artigo contribui para aprofundar a pesquisa em torno desse tema e para a melhoria da gestão nos municípios. Trata-se de uma análise exploratória, baseada em modelos econométricos para dados em painel. A amostra inclui 179 municípios paulistas, com dados relativos aos anos de 2011, 2013, 2015, 2017 e 2019. Os resultados sugerem que as recomendações e as determinações do Tribunal de Contas, bem como lacunas

nos controles internos, influenciam irregularidades em municípios pequenos, médios e grandes. O volume de transferências legais e constitucionais recebidas influenciam os municípios pequenos e médios, ao passo que o produto interno bruto (PIB) municipal tem influência nos municípios médios.

Palavras-chave: irregularidades; gestão pública; municípios; *panel corrected standard errors.*

Determinantes de las irregularidades en la gestión pública municipal: el caso de los municipios del estado de São Paulo

El control municipal externo que ejercen los Tribunales de Cuentas permite, a través de la divulgación de informes de auditoría, conocer las irregularidades encontradas en las cuentas de los gobiernos municipales. Estas han sido analizadas empíricamente, desde el punto de vista de su clasificación en términos de gravedad, pero existen pocos estudios que tengan como objetivo identificar los factores que influyen en tales fallas. Verificada esta brecha, el objetivo principal de este estudio es identificar factores que puedan influir en las fallas en la gestión pública municipal señalados por la auditoría del Tribunal de Cuentas. Este artículo contribuye a profundizar en la investigación sobre este tema y a mejorar la gestión en los municipios. Se trata de un análisis exploratorio, basado en modelos econométricos para datos de panel. La muestra incluye 179 municipios de São Paulo, con datos de los años 2011, 2013, 2015, 2017 y 2019. Los resultados sugieren que las recomendaciones y determinaciones del Tribunal de Cuentas, así como las lagunas en los controles internos, influyen en las irregularidades en los municipios, pequeños, medianos y grandes. El volumen de transferencias legales y constitucionales recibidas influye en los municipios pequeños y medianos, mientras que el producto interno bruto (PIB) municipal influye en los municipios medianos.

Palabras clave: irregularidades; gestión pública; municipios; errores estándar corregidos por el panel.

1. INTRODUCTION

The 1988 Constitution of the Federative Republic of Brazil (Constituição da República Federativa do Brasil de 1988) states that the external control of municipalities will be exercised by the Legislative Power with the help of the Federal Court of Accounts (TCU), with the goal of verifying the legality of acts in the public administration, detecting irregularities, ordering them to be corrected, imposing fines and denouncing improbities. In addition, art. 71, § II, of the Magna Carta (Constituição da República Federativa do Brasil de 1988), states that the Court of Accounts must "assess the accounts rendered annually by the manager, issue a preliminary opinion, judge the accounts, carry out inspections, and audits of an accounting, financial, operational and patrimonial nature". Therefore, it is important to point out that the audits carried out point out flaws in several areas of municipal public management: planning, infrastructure, health, education, internal control, transportation, etc.

Previous studies have detected abnormalities in external audits in two regards: as a proxy for municipal corruption (Albuquerque & Ramos, 2006; Batista, Rocha, & Santos, 2020; Caldas, Costa, & Pagliarussi, 2016; Campos, Castelar, & Soares, 2018; Ferraz, Finan, & Moreira, 2012; Paiva, L. L. Ribeiro, & Gomes, 2021) or as poor management (Olivieri, Martinelli, Massucatto, & Silva, 2018). Such studies point to ways of reducing shortcomings in municipal public management, with a view to the efficiency and effectiveness of the services offered to society. This discussion can be based on the New Public Management ("NGP") model, which aims to strengthen public administration through reforms that will introduce management tools used in the business sector and which, it is believed, will provide greater transparency, availability of information and control, as well as less bureaucratization and, consequently, improvement in the manager's decision-making process (Marques, 2020).

Several studies have pointed the way to greater control of irregularities in municipal public management. At this point, they concluded that the efficiency of the internal control system is linked

to the ability to detect suspicious activities and reduce the risk of deviations in local governments (Atmadja & Saputra, 2017; Mulyani, Munir, Akbar, Yoseph, & Sudrajat, 2020; Peterson, 2018; Salle, Falah, & Wonar, 2020). Qazi and Syed (2021) concluded that internal financial auditing has a significant role to play in detecting errors in private institutions. In the public sector, Ismajli, Aliu, Sahiti, and Lutolli (2017) concluded that internal auditing is a starting point in detecting fraud and irregularities in financial reporting. The problem encountered by external audits revolves around important issues, such as the study and classification of abnormalities, their causes and their determinants.

In the Brazilian context, considering that the Courts of Accounts publish the results of their audits of municipal accounts on their official websites, the identification of factors that influence deviations in the management of municipalities is an opportunity for research and seeks to fill a gap in the literature. Based on this, this essay poses the following question: which factors influence irregularities in public management pointed out by the Court of Accounts' municipal auditing?

To answer this question, this study examines the effect made by five variables: total recommendations issued by the Courts of Accounts, total constitutional transfers received by municipalities, gross domestic product (GDP) per capita, the Court's summary decision on municipal accounts, and total internal control irregularities. With this, it seeks to identify possible factors that influence failures in municipal public management.

The econometric models used were robust estimations in the Panel Corrected Standard Errors (PCSE). The first step was to collect the irregularities. To do so, the reports available on the websites of the Court of Accounts of the State of São Paulo (TCESP) and the Court of Accounts of the Municipality of São Paulo (TCMSP) were downloaded. 895 reports were collected from 179 municipalities in the years 2011, 2013, 2015, 2017 and 2019. The analysis identified 30,594 errors.

This study provides some contributions to the literature on public management and municipal external auditing, contributing to the study of irregularities pointed out by external audits by the Court of Accounts and the identification of factors that may have an impact on the number of shortcomings detected. Besides this, it is a pioneer in the use of PCSE. Overall, this research adds to the theoretical framework on the factors that may be related to deviations pointed out by audits by the Courts of Accounts. Through this type of analysis, it is possible to mitigate other biased results.

The article has been divided into five sections. This introduction is followed by the literature review and the research hypotheses. Then the used methodology is explained. Section 4 shows the results and their practical implications for municipal management. Finally, the conclusions, limitations, and prospects for future research are presented.

2. LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

2.1 Irregularities in municipal accounts

The determinants of fraud and irregularities have been increasingly investigated in public and private institutions, mainly due to the financial and economic implications they can cause (Amiram et al., 2018; Donelson et al., 2021). Despite having different meanings, the term "fraud" is used in a similar way to "irregularity" (Qazi & Syed, 2021). The Statement on Auditing Standards, in its publication number 53, which deals with the auditor's responsibility to detect deviations, defines irregularities as

"intentional misstatements or omissions". According to Young (2002), they differ from errors by the intentionality of the individual. In other words, errors are accidental; irregularities are not. They can also include intentional manipulation, falsification, misrepresentation, or omission of transactions and information, as well as incorrect application of accounting principles.

The term "irregularity" appears only a few times in the 1988 Constitution of the Federative Republic of Brazil (Constituição da República Federativa do Brasil de 1988). First, it is mentioned in sections II, VIII, and IX of art. 71, when it talks about the powers of external control. Then, in §1 of art. 74, the terms "irregularity" and "illegality" are presented as the responsibility of internal control to bring complaints before the courts of accounts. Paragraph 2 of Article 74 states that any citizen can report "irregularities and illegalities" to the Court of Accounts.

They can also be associated with the concept of "administrative improbity" (Sousa & Araújo, 2015). According to Law No. 8.429, of 1992 (Lei nº 8.429, de 2 de junho de 1992), administrative improbity refers to acts against the public administration that provide illicit enrichment through a willful act, causing damage to the treasury or violating the principles of public administration.

The public administration's control is the control that the political-administrative system exercises over itself. For Meirelles (2015), in public administration, control is the power of surveillance, correction, and guidance that one power, body, or authority exercises over the conduct of another. In Brazil, Law No. 4.320, of 1964 (Lei nº 4.320, de 17 de março de 1964), was responsible for inserting the terms "internal control" and "external control", the internal being that which each body exercises over its own acts and agents. In other words, it is the process in which an organization manages its activities effectively and efficiently in order to fulfill its mission (International Organization of Supreme Audit Institutions [INTOSAI], 2004). External control, on the other hand, is the control exercised by an autonomous and independent body or entity, with the aim of overseeing the financial activity of the state (Pascoal, 2019).

Thus, the inspection of municipal management can be observed from two different angles: external control, represented by the municipal council, with the help of the state and/or municipal Courts of Accounts, and the internal control system of each administrative unit.

In the Brazilian context, irregularities in the municipal accounts are pointed out by external audits by the Court of Accounts, the body responsible for external municipal control, and by audits by the Office of the Comptroller General (CGU), the government's internal control body which, since 2003, has been overseeing the use of federal funds in the municipalities through the Program for the Inspection of Federative Entities. Some authors have tried to classify irregularities according to their seriousness. Azambuja, Teixeira, and Nossa (2018) classified them as very severe, serious or moderate. For example, according to them, the misappropriation of funds or the non-application of resources established by law is very serious. Araújo (2018) developed a taxonomy to classify the failures detected by the Courts of Accounts in Brazil, considering those that cause damage to the public purse to be very serious.

These studies have contributed to the identification and classification of irregularities, providing knowledge about their type and severity. However, they do not provide knowledge about the factors that can determine greater or lesser quantities. R. R. M. Ribeiro, Rosa, Mattiello, Borges, and Soares (2019) studied the relationship between the human development index (HDI) and the accounts disapproved by the Court of Accounts of the State of Paraná (TCE-PR) - their disapproval means that there are many problems - and concluded, although no statistical techniques were used, that there is no significant relationship between them and the HDI.

Krüger, Kronbauer, and Souza (2012) examined the factors associated with the shortcomings pointed out by the TCE RS in the management of municipal accounts, and the results showed that municipal GDP per capita and the degree of municipal education are inversely proportional to this quantity. The results of the study conducted by Kronbauer, Krüger, Ott, and C. Nascimento (2011) indicated that the municipalities with the most problems are those with the highest GDP, highest population, and highest net current revenue. They also conclude that abnormalities in internal control systems are greater in municipalities with more irregularities in management. Also regarding GDP, the results of Andrade's study (2018) show that municipalities with lower GDP per capita are more vulnerable to these problems.

Batista et al. (2020) have analyzed the impact of municipal transparency in CGU reports and concluded that it does not reduce local management problems, corruption, or mismanagement. Campos et al. (2018) estimated the likelihood of a given Brazilian municipality committing irregularities in the management of federal funds transferred through agreements, transfer contracts, and legal transfers, and the results showed that they tend to increase when municipalities receive more funds from the federal government.

Another perspective is the analysis of "accounting irregularities" as a form of earnings management. Rahmawati and Kassim (2020) argue that institutions can engage in accounting misconduct in order to present a more attractive financial statement. At this point, they can be understood as an intentional distortion or omission of information. Soepriyanto, Tjokroaminoto, and Zudana (2021) advocate that such irregularities are practices that do not comply with accounting standards and are always linked to negativity.

2.2. Development of hypotheses

Maama and Marimuthu (2020) analyzed the recommendations issued by the external audit regarding the accountability of local governments in Ghana, revealing that these were responses to issues raised by the audit regarding financial and operational irregularities. The recommendations and determinations issued by the Courts of Accounts are instruments of control and represent acts of command, allowing the court to issue general guidelines to managers and other responsible parties, and monitoring the degree of compliance of municipalities on an annual basis. The recommendations are collaborative, proposed to the manager to improve their management and, according to Resolution No. 265, of 2014 (Resolução nº 265, de 9 de dezembro de 2014), art. 6, they should be issued "when opportunities for performance improvement have been verified".

Unlike the recommendations, the determination is a coercive instrument, so compliance is mandatory and those responsible could face sanctions. In this way, the Court of Accounts, in compliance with article 71, VIII, of the 1988 Constitution of the Federative Republic of Brazil (Constituição da República Federativa do Brasil de 1988), may "apply, in the event of illegal expenditure or irregularity of accounts, the sanctions provided for by law". It is therefore expected that recommendations and determinations will have an influence on irregularities. The following hypothesis is therefore proposed: "The recommendations and determinations issued by the Court of Accounts influence irregularities in municipal management" (H1).

Municipal GDP per capita is a standardized measurement that can be used to compare municipalities and is an indicator used as an economic thermometer of the region, quality of life, and income, even though it is not an indicator of each citizen's personal income. The results of the study by Kronbauer et al. (2011) suggested that municipalities with the most problems identified by the

TCE RS are those with the highest municipal GDP, while Albuquerque and Ramos (2006) pointed to a negative relationship between the municipality's GDP and irregularities, suggesting that an increase in *per capita* income reduces them.

Krüger et al. (2012) suggested that municipal GDP per capita is inversely linked to lapses in municipal management. The results of the study conducted by Rodrigues (2019) have shown a positive relationship between municipal GDP per capita and the quality of municipal information, suggesting that the higher the municipal GDP per capita, the lower the number of irregularities pointed out by the Court of Accounts. It can be seen from the results presented that they are contradictory, which justifies further investigation. Thus, another hypothesis is suggested: "Municipal GDP per capita has a negative influence on irregularities in municipal management" (H2).

Intergovernmental transfers are portions of federal revenue that are passed on by the federal government to states and municipalities, which are important for reducing regional inequalities and enabling economic balance. They often account for the majority of municipalities' revenue and are the main source of resources. They can be voluntary or constitutional. Bremaeker (2020) has analyzed the importance of transfers in Brazilian municipalities in 2019. The author points out that, in 2019, these transfers accounted for around two-thirds of municipal resources.

Baião and Couto (2017) also investigated the transfer of resources to municipalities, indicating that not all transfers function as fiscal equalization. The fact is that they are important in the execution of programs and in the fiscal balance of municipal governments. Among the main transfers are: the Municipal Participation Fund (FPM), Cide-Combustíveis, the Fund for the Maintenance and Development of Basic Education and Valorization of Education Professionals (Fundeb), royalties, and the Tax on Rural Territorial Property (ITR).

Caldas et al. (2016) and Campos et al. (2018) analyzed the effect of transfers received by municipalities on municipal irregularities pointed out by the CGU audit. The results indicated that there is an increase in irregularities in municipalities with more resources received. Therefore, hypothesis 3 seeks to analyze the effect of legal and constitutional transfers on municipal irregularities: "The total transfers received by the municipality positively influences irregularities in municipal management" (H3).

The nature of a prior opinion was analyzed by Azambuja et al. (2018) and Kruger et al. (2012). The Court of Accounts' decision on the annual rendering of accounts can be distinguished into regular accounts, regular accounts with reservations, or irregular accounts. The accounts are judged "regular" when there is conformity and accuracy in the accounting statements, legality, and legitimacy of the management acts. When improprieties or other faults that do not cause damage to the treasury are identified, the accounts are judged to be "regular with reservations", and the Court of Accounts is responsible for determining the necessary measures to correct them. The accounts are judged "irregular" when illegal practices, damage to the treasury, embezzlement, and other public assets are detected (Dutra, 2012). Therefore, this study seeks to analyze whether the nature of the prior opinion issued by the Court of Accounts corresponds to a greater number of irregularities in municipal management, from which another hypothesis arises: "The issuance of a prior opinion unfavorable to approval, issued by the Court of Accounts, influences irregularities in municipal management" (H4).

3. RESEARCH METHODOLOGY

3.1. Selection of sample

According to the Brazilian Institute of Geography and Statistics (IBGE), Brazil has an estimated population of approximately 211 million people in 2020. The state of São Paulo, located in the Southeast region, has the second highest HDI in the country and has 645 municipalities, which corresponds to approximately 11.5% of the total number of municipalities in Brazil. Furthermore, it has a population of around 46 million inhabitants, which represents 22% of the Brazilian population. In terms of wealth, the state was responsible for 31.4% of Brazil's GDP in 2018 and has a municipal GDP per capita 44% higher than that of the country.

The size of São Paulo's municipalities is diverse. Based on the number of students enrolled in primary and secondary schools, published by the 2020 School Census, a separation into three groups is proposed: municipalities with less than 1,000 students, municipalities with between 1,001 and 10,000 students enrolled, and municipalities with more than 10,000 enrolments. Of the 645 municipalities in São Paulo, 264 have between 0 and 1,000 pupils in nursery and elementary school, 300 have between 1,000 and 10,000 and 81 have more than 10,000.

It was decided to carry out the study with a stratified sample, given the large number of municipalities in the state. According to Fortin, Côté, and Filion (2009), the advantage of this sample is that it ensures that a portion of the population is represented from relatively homogeneous strata. Thus, 179 municipalities were randomly selected with a 95% confidence level (see Table 1).

TABLE 1   SAMPLE SELECTION

	Population stratum	Population	Sample
G1 – Small	Municipalities with up to 1,000 students enrolled	254	73
G2 – Medium-sized	Municipalities with between 1,001 and 10,000 students enrolled	300	83
G3 – Large	Municipalities with over 10,000 students enrolled	81	23
	Total	**645**	**179**

Source: Elaborated by the authors.

3.2. Data collection

The irregularities were collected from the audit reports and preliminary opinions for the years 2011, 2013, 2015, 2017, and 2019. They were downloaded from the official websites of TCESP and the São Paulo Municipal Audit Court (TCMSP). Municipalities whose accounts for those years had not been judged, or whose opinion was not available for download, were excluded from the sample and replaced. The search for reports took place between September 2020 and June 2021.

Considering that this research analyzes factors that influence irregularities in municipal management, the total amount found was the dependent variable used. The remaining information, such as internal control irregularities, recommendations, and determinations, as well as the summary decision, were considered independent variables (see Figure 1).

FIGURE 1   COLLECTION OF DATA IN THE REPORTS ISSUED BY EXTERNAL CONTROL
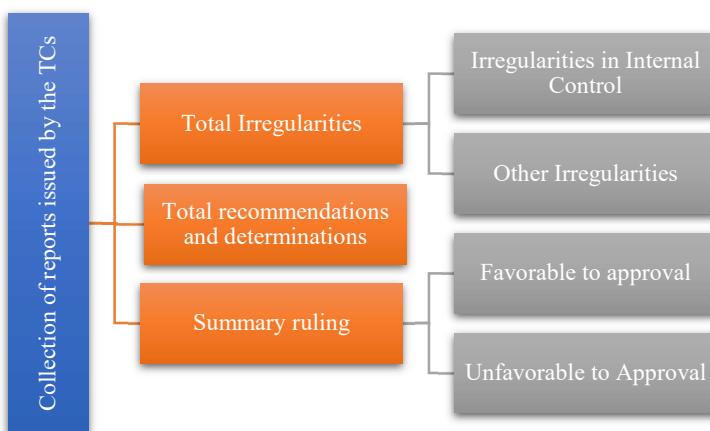
Source: Elaborated by the authors.

The variables were chosen as a result of noticing a gap in the literature when looking at research involving the analysis of irregularities pointed out in audits. In addition, studies are limited in the number of cross-sections and the number of reports. For example, R. R. M. Ribeiro et al. (2019) analyzed the accounts of 20 municipalities for 5 years, totaling 100 reports, and used a documentary and bibliographic technical procedure. Azambuja et al. (2018) analyzed 706 reports from 141 municipalities, using irregularities to assess whether they interfere with the judgment of accounts. Feitosa, Oliveira, Lins, and Silva (2013), R. R. M. Ribeiro et al. (2019), and Sousa and Araújo (2015) carried out a descriptive analysis of irregularities. Only Kronbauer et al. (2011) and Krüger et al. (2012) analyzed the factors associated with irregularities. Even so, Krüger et al. (2012) analyzed 30 municipalities and a total of 180 reports.

As presented, this research aims to expand the study of irregularities pointed out by external audits by the Courts of Accounts. To this end, 179 municipalities were analyzed over 5 years, totaling 895 reports. The "total number of irregularities" was used as the dependent variable and 4 explanatory variables: total number of recommendations, municipal GDP *per capita*, legal transfers, and summarized decision (Box 1). In addition, the total number of internal control irregularities was considered a variable.

BOX 1   DESCRIPTION OF THE VARIABLES USED

Dependent variable	Name	Description		Source of data
$Irreg_{it}$	Irregularities	Total irregularities found in municipal public management		Court of Accounts report

Independent variable	Name	Description	Expected signal	Source of data
$Recom_{it}$	Recommendations	Total recommendations and determinations	+	Court of Accounts report
$PIBper$	GDP *per capita*	GDP/estimated population	-	IBGE website
$TransL_{it}$	Legal transfers	Total legal transfers received	+	Siconfi
$DecR_{it}$	Summary decision	*Dummy* variable: 1, if the decision is to approve the accounts; 0, if the decision is not in favor of approval.	+	Court of Accounts report

Control variable	Name	Description	Expected signal	Source of data
$IrregC_{it}$	Irregularities in internal control	Total irregularities identified in internal control.	+	Court of Accounts report

Source: Elaborated by the authors.

The municipal internal control is an important variable in this study. Studies presented before have shown that efficient internal controls help prevent fraud and irregularities (Atmadja & Saputra, 2017; Mulyani et al., 2020; Salle et al., 2020). According to TCESP, when assessing the annual accounts of the municipal executive, many problems could be avoided if there were an effective internal control system. To demonstrate this, TCESP presents a list of irregularities pointed out by the auditors that might not exist if there were an efficient internal control structure.

Box 2 summarizes the hypotheses and the studies that helped define them.

BOX 2   **HYPOTHESES ATTRIBUTED TO THE ANALYZED VARIABLES**

Hypothesis	Variable	*Proxy*	Other studies
H_1	$Recom_{it}$	Total recommendations and determinations	Maama and Marimuthu (2020).
H_2	$PIBper$	Municipal GDP *per capita*	Albuquerque and Ramos (2006); Kronbauer et al. (2011); Kruger et al. (2012); A. Nascimento (2021); Rodrigues (2019).
H_3	$TransL_{it}$	Total legal and constitutional transfers received	Caldas et al. (2016); Campos et al. (2018); Kruger et al. (2012).
H_4	$DecR_{it}$	Nature of prior opinion	Azambuja et al. (2018); Kruger et al. (2012).

Source: Elaborated by the authors.

3.3. Econometric approach

According to Fávero (2013), panel data studies are important and are increasingly being used as they involve longitudinal data, that is, several cross-sections, in which there is a spatial and temporal dimension. Gujarati (2006) states that, in panel data studies, "the same cross-sectional unit is studied over time".

When working with cross-sectional data, however, errors and disturbances are more likely to appear, which is why other models are considered, such as the Feasible Generalized Least Square (FGLS) and Panel Corrected Standard Errors (PCSE), which take into account the problems of heteroscedasticity, autocorrelation, and contemporaneous correlation. To find out which model is more appropriate, diagnostic tests are applied which can identify these problems. Therefore, we will first present the diagnostic tests used in this study and then present the PCSE and FGLS models.

The problem of heteroscedasticity is analyzed using the Modified Wald Test for panel data, presented by Greene (2002). The objective is to verify the presence of heteroscedasticity. The null hypothesis associated with this test is that the error variance is homoscedastic. It therefore introduces a χ2 distribution and tests the null hypothesis of σ2i = σ2, for i = 1, ···, n.

The Wooldridge test (2006) analyzes autocorrelation. According to Gujarati and Porter (2011), autocorrelation is the correlation between individuals, the main consequence of which is the inefficiency of the MQO estimators. For results under 5%, the Wooldridge (2006) test rejects the null hypothesis that there is no first-order serial correlation in the error terms - in other words, first-order autoregressive effects AR (1) must be considered in the error terms. Lastly, the contemporaneous correlation analysis was carried out. To test cross-sectional dependence in panels where T < N, the tests proposed by Frees (1995) and Pesaran (2004) are used, which assess cross-sectional independence, in other words, the correlation between the panels; therefore, the non-existence of contemporaneous correlation. Thus, the null hypothesis tests cross-sectional independence, while rejection of this hypothesis means that there is cross-sectional dependence.

Unobservable common factors can cause cross-sectional dependence, affecting the error, which may be correlated with the regressors. In this way, conventional fixed and random effects models can

be consistent, but not efficient, considering that the independent variables are not correlated with the unobservable common factors. Therefore, the standard errors must be adjusted. In order to correct for this, Parks (1967) proposed the FGLS, an estimation based on generalized least squares (GLS), but Beck and Katz (1995) proposed the PCSE, correcting for autocorrelation, contemporaneous correlation, and heteroscedasticity between groups. PCSE and FGLS follow different estimation methods. The latter may be unsuitable for medium panels, that is, when the time dimension (T) is smaller than its cross-sectional dimension, that is, smaller than the cross-section observations (N), while the PCSE is better suited to finite samples.

PCSE takes into account the information available in the panel data, that is, it considers all the component periods of the residual in each cross-section in order to estimate the variance of the error term. Thus, for the correlation between cross-sections, PCSE estimations are considered robust, as the covariance is estimated between the units.

In order to obtain efficient results, the econometric method is chosen according to the sample, which in this study, is made up of a set of 179 municipalities, divided into three groups in the years 2011, 2013, 2015, 2017, and 2019. To this end, the next section will present the results of the Frees (1995) and Pesaran (2004) tests to analyze cross-sectional dependence; the modified Wald test to evaluate heteroscedasticity; and the Wooldridge (2006) test, which analyzes autocorrelation. Based on the results, the most appropriate model can be chosen.

Regarding the PCSE specifications, the following methods were considered: CORR (IND), which starts from the premise that there is no autocorrelation; AR (1), which considers that, within the panels, there is first-order autocorrelation and that the coefficient is common to all panels; PSAR (1), which considers first-order autocorrelation within panels, but with the coefficient of the AR (1) process specific to each panel; HET-AR (1), which considers heteroscedasticity at panel level, with first-order correlation common to all panels; and HET, which considers heteroscedasticity options. The estimations were carried out using the Stata software, and the results were presented in the next section.

The regression model's dependent variable is the total number of irregularities (IrregT) and considers the period 2011, 2013, 2015, 2017, and 2019:

$$IrregT_{it} = \beta_0 + \beta_1 Recom_{it} + \beta_2 PIBper_{it} + \beta_3 TransL_{it} + \beta_4\ IrregC_{it} + \beta_5\ DecR_{it} + \varepsilon_{it}$$

In the equation shown above, $IrregT_{it}$ represents the total number of irregularities pointed out by the Court of Accounts auditing from the municipality i at time t; $Recom_{it}$, the total number of recommendations and determinations made by municipality i at time t; $PIBper_{it}$, the GDP per capita of municipality i at time t; $TransL_{it}$, the total number of legal transfers received by municipality i at time t; $IrregC_{it}$, the total number of irregularities in the internal control of municipality i at time t; β (1. ..n), the parameters for each explanatory variable; and ε_{it}, the error term.

4. RESULTS

4.1. Descriptive statistics

In total, 30,594 irregularities were collected in the reports made available by the Courts of Accounts during the analysis period, 926 irregularities in municipal internal controls, 8,088 recommendations and determinations made to the municipalities, of which 634 were favorable decisions - 70.8% of the opinions analyzed were in favor of approving the municipal accounts - and 261 were against approving the municipal accounts. Table 2 shows the detailed descriptive statistics: mean, minimum, and maximum values, median, and standard deviation of the variables used for the total sample and for each substrate. The results showed an overall average of 34.2 irregularities per year of analysis, with a standard deviation of 31.7, with only group 1 below this average.

TABLE 2   DESCRIPTIVE STATISTICS OF THE VARIABLES, FOR THE TOTAL SAMPLE AND BY GROUP

Total sample	Mean	Median	Standard deviation	Minimum	Maximum
$Irreg_{it}$		26	31.7	0	421
$Recom_{it}$	9.0	8	8.8	0	143
$IrregC_{it}$	0.90	1	1.3	0	15
$PIBper$	31,560.1	24,401.6	29,655.35	6,712.5	9,206.4
$TransL_{it}$	41,093,840	10,531,745	299,261,087	4,674,695	5,49e+09
Group 1 – Small municipalities					
$Irreg_{it}$	28.04	24	24.5	0	243
$Recom_{it}$	8.31	8	5.32	0	143
$IrregC_{it}$	0.90	1	0.95	0	6
$PIBper$	27,982.7	18,956	28,608.27	6,712.5	245,702,6
$TransL_{it}$	6,674,761	2,680,978	1,602,514	4,674,695	1,65e+07415
Group 2 – Medium-sized municipalities					
$Irreg_{it}$	35.73	27	34.9	0	421
$Recom_{it}$	8.74	9	5.87	0	31
$IrregC_{it}$	1.06	1	1.31	0	11
$PIBper$	30,896.1	26,206	27,544.6	7,461.2	428,020.2
$TransL_{it}$	2,14e+07	16,582,801	4,45e+07	4,920,537	7,39e+08
Group 3 – Large municipalities					
$Irreg_{it}$	48.06	40	34.6	0	156
$Recom_{it}$	12.42	9	19.5	0	143
$IrregC_{it}$	1.35	1	1.97	0	15
$PIBper$	46,364.7	40,068	34,723.2	9,206.4	192,647.6
$TransL_{it}$	2,21e+08	63,254,397	8,11e+08	2,96e+07	5,49e+09

Source: Data from the research.

Also based on what has been presented in Table 2, it can be seen that, on average, large municipalities have the highest average number of recommendations and determinations, irregularities in internal controls, legal transfers received, and GDP per capita, while small municipalities have the lowest average number of irregularities.

4.2. Econometric analysis

In this section the results were presented for the panel data econometric models for group 1, small municipalities; group 2, medium-sized municipalities; and group 3, large municipalities. Cross-sectional dependence, heteroscedasticity, and correlation were analyzed. The diagnostic tests to check for common problems in estimating the models are shown in Table 3. Regarding the Hausman test, it can be concluded for group 1 that the null hypothesis was not rejected, so the individual unobservable effects are correlated with the explanatory variables in the model for both equations. Thus, the model adopted for the diagnostic tests was that of random effects.

The Wooldridge test (2006) analyzes whether there is first-order serial correlation in the error terms, meaning that it was used to detect autocorrelation. The results indicated that the null hypothesis was not rejected for groups 1 and 2, so there was no first-order correlation at the 5% significance level. For group 3, the null hypothesis is rejected, showing that there is first-order autocorrelation.

The results of the Pesaran (2004) test for groups 1, 2 and 3 allow us to reject the null hypothesis that there is no correlation between the cross-sections, at a significance level of 5% - there is cross-dependence. In this case, it is possible to consider heteroscedastic error, in other words, there is a correlation between the panels. The Frees (1995) test showed evidence of rejection of the null hypothesis for the groups, showing that there is a contemporaneou correlation between the municipalities. Confirming heteroscedasticity using the modified Wald test, it is possible to reject the null hypothesis for all groups. Therefore, the data is heteroscedastic.

TABLE 3   DIAGNOSTIC TESTING

	Pesaran Test	Frees Test	Modified Wald Test (χ^2)	Wooldridge Test	Abstract
Total sample					
First equation	Rejection of the null hypothesis	Rejection of the null hypothesis	Rejection of the null hypothesis	Non-rejection of the null hypothesis	Cross-section dependence; Heteroscedasticity; No first-order autocorrelation
Group 1					
First equation	Rejection of the null hypothesis	Rejection of the null hypothesis	Rejection of the null hypothesis	Non-rejection of the null hypothesis	Cross-section dependence; Heteroscedasticity; No first-order autocorrelation

Continue

	Pesaran Test	Frees Test	Modified Wald Test (χ^2)	Wooldridge Test	Abstract
Group 2					
First equation	Rejection of the null hypothesis	Rejection of the null hypothesis	Rejection of the null hypothesis	Non-rejection of the null hypothesis	Cross-section dependence; Heteroscedasticity; No first-order autocorrelation
Group 3					
First equation	Rejection of the null hypothesis	Rejection of the null hypothesis	Rejection of the null hypothesis	Non-rejection of the null hypothesis	Cross-section dependence; Heteroscedasticity; No first-order autocorrelation

Note: The test results are in the Appendix. The significance level adopted for the decision to reject or not reject the null hypothesis was 5%.
Source: Elaborated by the authors.

The study compared the results of the FGLS and PCSE methods. In general, the first differs from the results of the second, which are usually more robust. The assumptions analyzed for PCSE were: Corr (IND), which considers that there is no autocorrelation; AR (1), which considers that, within panels, there is first-order autocorrelation and that the coefficient is common to all panels. Unlike the previous model, PSAR (1) considers there to be first-order autocorrelation within panels, but the coefficient of the AR (1) process is specific to each panel. Finally, HET-AR (1) considers heteroscedasticity at the panel level with first-order correlation common to all panels.

The data in the panel showed both cross-sectional and contemporaneous dependence between the municipalities, as well as group heteroscedasticity of the error term. When there is evidence of first-order autocorrelation, the best option for controlling autocorrelation is the PSAR (1) or AR (1) model since the estimates of the PCSE assume that the disturbances have contemporaneous correlation between the panels and are heteroscedastic. However, it was observed that the panel data for groups 1, 2, and 3 did not show evidence of first-order autocorrelation of the disturbance term; therefore, the CORR(IND) option would be the most appropriate for the data in these groups of municipalities.

The use of the FGLS model is not the most appropriate for this study since, considering that the time dimension T = 5 is smaller than the cross-sectional dimension N = 179, this could lead to inaccurate results. The HET - AR (1) model controls for heteroscedasticity and first-order correlation.

Based on the above, the interpretation of the results will therefore take into account the estimation of the CORR(IND) model for the panel of both groups and for the total sample, the results of which are shown in Table 4.

The first equation in this study analyzed the effect of recommendations, constitutional transfers, internal control irregularities, and the Court of Accounts' decision on the total number of irregularities in municipal management. The results of the CORR(IND) model for group 3 showed that the *Recomit* and *IrregCi*t variables were statistically significant and had a positive effect on irregularities in municipal management. The results for the panels of groups 1 and 2 showed that all the variables were statistically significant, with a significance level of 1%, with the exception of *DecRit*.

Therefore, unlike the results from the group 3 data panel, the recommendations issued by the Courts of Accounts, the legal and constitutional transfers received by the municipalities, as well as irregularities in municipal internal control, have a positive effect on the total number of irregularities in municipal public management.

TABLE 4   PCSE AND FGLS RESULTS FOR THE FIRST EQUATION

Variables	CORR (IND)	FGLS	PSAR (1)	HET	HET − AR (1)
	Total sample				
	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient
$Recom_{it}$	1.3777***	-.63373	1.3808***	1.3777***	1.259***
	(0.000)	(0.678)	(0.000)	(0.000)	(0.000)
$PIBpercap.$	-8.36e-06	-.0002523**	-7.49e-06	-8.36e-03	-8.40e-06
	(0.231)	(0.043)	(0.249)	(0.172)	(0.222)
$TransL_{it}$	-1.82e-08**	-2.85e-06**	-1.91e-08***	-1.82e-08**	-1.76e-08**
	(0.012)	(0.048)	(0.002)	(0.015)	(0.033)
$DecR_{it}$	-3.6771	-10.8582	2.7332***	-3.6771*	-2.5874
	(0.128)	(0.569)	(0.000)	(0.082)	(0.225)
$IrregC_{it}$	10.9857***	24.7400***	10.5905***	10.9857***	10.6889***
	(0.000)	(0.002)	(0.000)	(0.000)	(0.000)
Constant	14.3856	111.0325***	15.0366	14.3856***	15.2984***
	(0.128)	(0.002)	(0.415906)	(0.000)	(0.000)
R2	0.3636		0.5027	0.3636	0.3279
Observations	895	895	895	895	895
	Group 1				
	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient
$Recom_{it}$	1.4727***	-0.0473	1.6491***	1.4727***	1.3573***
	(0.000)	(0.963)	(0.000)	(0.000)	(0.000)
$PIBpercap.$	-5.14e-06	-0.0000	-7.00e-06*	- 5.14e-06	-5.50e-06
	(0.263)	(0.737)	(0.067)	(0.423)	(0.437)
$TransL_{it}$	2.51e-06***	4.17e-06**	2.64e-06***	2.51e-06***	2.34e-06***
	(0.002)	(0.032)	(0.001)	(0.002)	(0.005)
$DecR_{it}$	-1.2323	-9.6308	-0.4075	-1.2323	-0.9628
	(0.257)	(0.362)	(0.392)	(0.652)	(0.738)
$IrregC_{it}$	6.0659***	-1.3916	5.2289***	6.0659***	6.1188***
	(0.000)	(0.746)	(0.000)	(0.000)	(0.000)

Variables	CORR (IND)	FGLS	PSAR (1)	HET	HET – AR (1)
Constant	-4.7229 (0.441)	31.5794* (0.059)	-5.1626 (0.399)	-4.7229 (0.410)	-3.2933 (0.589)
R^2	0.2845		0.4757	0.2845	0.2484
Observations	365	365	365	365	365
Group 2					
	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient
$Recom_{it}$	1.5918*** (0.000)	0.9478 (0.375)	1.5283*** (0.000)	1.5918*** (0.000)	1.5727*** (0.000)
$PIBpercap.$	-0.0002*** (0.000)	-0.0012* (0.089)	-0.0002*** (0.000)	-0.0002*** (0.002)	0.0002*** (0.003)
$TransL_{it}$	2.72e-07*** (0.000)	1.49e-06 (0.171)	2.72e-07*** (0.000)	2.72e-07*** (0.000)	2.74e-07*** (0.000)
$DecR_{it}$	-1.434287 (0.588)	17.4311 (0.306)	-0.8176 (0.761)	-1.4342 (0.628)	-1.1843 (0.688)
$IrregC_{it}$	13.8147*** (0.000)	17.9519*** (0.000)	13.4835*** (0.000)	13.8147*** (0.000)	13.6880*** (0.000)
Constant	9.2595* (0.058)	7.3949 (0.771)	9.2411** (0.032)	9.2595** (0.021)	9.5854 (0.016)
R^2	0.4972		0.5920	0.4972	0.4869
Observations	415	415	415	415	415
Group 3					
$Recom_{it}$	1.0430* (0.059)	0.5937 (0.253)	0.7879* (0.082)	1.0430** (0.032)	0.7564* (0.084)
$PIBpercap.$	-0.0000 (0.222)	0.0000 (0.844)	-0.0000 (0.526)	-0.0000 (0.211)	-0.0000 (0.380)
$TransL_{it}$	-1.63e-08 (0.203)	-5.37e-09 (0.645)	-1.07e-08 (0.312)	-1.63e-08 (0.182)	-1.20e-08 (0.308)
$IrregC_{it}$	8.0691*** (0.000)	14.3642* (0.067)	7.7782*** (0.000)	8.0691*** (0.000)	8.0063*** (0.000)
$DecR_{it}$	-5.3530 (0.341)	0.2958 (0.983)	-0.2529 (0.960)	-5.3530 (0.376)	-3.6091 (0.553)
Constant	35.4482*** (0.000)	25.0504 (0.145)	33.2199*** (0.000)	35.4482*** (0.000)	36.7004*** (0.000)
R^2	0.3402		0.4120	0.3402	0.2682
Observations	115	115	115	115	115

Note: *, **, *** represent that the values are statistically significant at 10%, 5% and 1%, respectively. The values in brackets refer to the p-value.
Source: Elaborated by the authors.

Overall, the results revealed, as expected, that the recommendations and determinations of the Courts of Accounts are significant and follow the increase in irregularities in municipal public management, at a significance level of 1% in groups 1 and 2, and 10% and 5% in group 3, in all the estimates made, with the exception of the FGLS model, which did not show a statistically significant result. Therefore, the recommendations and determinations issued by the Courts of Accounts have a positive and significant relationship with the number of irregularities in all the groups of municipalities analyzed, confirming H1. This means that the number of recommendations and determinations that the Courts of Accounts issue to municipal managers is directly related to the number of irregularities identified in the municipalities.

This result supports the assumption that a greater number of irregularities implies a greater number of recommendations and determinations, considering that the institutional duty of the Court of Accounts is to detect irregularities and have them corrected.

Kruger et al. (2012) have concluded that the citizen's income level arouses greater interest in social monitoring since the results showed that the higher the GDP per capita, the lower the number of irregularities detected in municipal management. In line with this result, GDP per capita (*GDPper*) was found to have a negative influence on the total number of irregularities in all municipalities, but only in the medium-sized municipalities (group 2) was this result significant, confirming H2.

On the other hand, legal and constitutional transfers (*TransLit*) made by the federal government to municipalities have a positive and statistically significant relationship with the occurrence of irregularities in small and medium-sized municipalities, confirming H3, which suggests that small and medium-sized municipalities with a larger volume of funds received from the federal government have more irregularities.

This result corroborates the findings of Campos et al. (2018), that the resources received by municipalities through federal transfers are directly associated with a greater number of irregularities, which was also found in the research by Caldas et al. (2016), who analyzed the relationship between corruption - measured by the irregularities pointed out by the CGU's external audit - and transfers, coming to the conclusion that the increase in corruption is positively associated with federal transfers in the social assistance, education and health functions. On the other hand, Kruger et al. (2012) showed that federal transfers are a factor in reducing irregularities in municipal management.

As for the nature of the preliminary opinion, represented by the variable "summary decision" (*DecRit*), the results showed that it was not statistically significant for irregularities in municipal management in any of the panels analyzed, although it was assumed that opinions unfavorable to the approval of municipal accounts corresponded to a greater number of deviations in management.

It was expected that the nature of the preliminary report issued by the Court of Accounts would be related to a greater number of irregularities, as was the case in the work by Kruger et al. (2012). However, the results showed that there is no significant relationship, which leads us to reflect on why some municipalities have many irregularities, sometimes many recommendations and determinations, and yet the Court of Accounts decides to approve their accounts.

Azambuja et al. (2018) analyzed the dynamics of the votes of the Court of Accounts' rapporteurs and advisors and the influence on the number of irregularities, highlighting indications that the rapporteur does not take into account the very serious irregularities pointed out by the technical audit, which raises the discussion about the political interference of the advisors of the Courts of Accounts when assessing municipal accounts.

The internal municipal control should ensure greater efficiency and a lower number of irregularities in municipal management, in line with what was presented in the literature review. The results showed that the variable "irregularities in internal control" (*IrregCit*) had the highest β *Coefficient* and statistical significance at 1% in all the groups analyzed; therefore, it is understood that it has a direct influence on the irregularities pointed out by the external audit. Therefore, irregularities in internal controls have an influence on the total number of deviations in municipal management. Thus, it can be inferred that municipalities with weaker internal controls are more susceptible to an increase in management lapses.

Finally, in terms of the hypotheses of this study, Box 3 presents a summary of the related statistical confirmations. Only the nature of the prior opinion showed no statistically significant relationship with the dependent variable.

BOX 3 STATISTICAL CONFIRMATION OF HYPOTHESES

Hypothesis		Statistical confirmation		
		Small municipalities	Medium municipalities	Large municipalities
H_1	Recommendations and determinations by the Court of Accounts influence irregularities in municipal management	Validated	Validated	Validated
H_2	Municipal GDP per capita has a negative influence on irregularities in municipal management	Rejected	Validated	Rejected
H_3	The total amount of transfers received by the municipality influences irregularities in municipal management.	Validated	Validated	Rejected
H_4	The nature of the prior opinion issued by the Court of Accounts influences irregularities in municipal public management.	Rejected	Rejected	Rejected

Source: Data from the reserach.

According to the abovementioned results, the recommendations issued by the Courts of Accounts, the transfers received by the municipalities, and the municipal GDP per capita influence the total number of irregularities in the municipalities, as well as those in municipal internal control.

5. CONCLUSION

The detection of irregularities in municipal management, which comes from the external audit work of the Courts of Accounts, is important for understanding how public management works. In addition, identifying possible factors that may be related to the number of irregularities in municipal management is an opportunity to resolve practices of mismanagement or corruption. The results of the survey indicated that the number of irregularities pointed out by the external audit is growing, with 8,820 identified in 2019, an average of 49.3 irregularities per municipality, which is almost double the number found in 2011.

This research aimed to analyze the determining factors of irregularities in municipal management. Therefore, responding to the proposed question, the study concludes that the recommendations issued by the Audit Courts, the irregularities in municipal internal controls, the municipal GDP *per capita* and the legal and constitutional transfers received by the municipalities are decisive for the irregularities in public management highlighted by the municipal audit of the Court of Auditors.

There is an influence on the total of recommendations and determinations on the total of irregularities in all the groups analyzed. Cunha (2020) highlighted that recommendations represent an operational optimization command for public managers, while determinations represent commands to comply with legal rules. This result corroborates the assumption that a greater number of irregularities implies more recommendations and determinations, considering the Court of Accounts' institutional duty to detect irregularities and have them corrected. It is vital for future work to analyze the degree to which municipal managers comply with the recommendations and determinations of the Courts of Accounts, which could result in an improvement in municipal management and a reduction in irregularities in the long term.

The volume of legal and constitutional transfers received by municipalities has proven to be a positive and a significant factor in the occurrence of irregularities in small and medium-sized municipalities, confirming the findings of Campos et al. (2018) and Caldas et al. (2016). Based on this, it can be inferred that small and medium-sized municipalities do not have a governance structure capable of managing the federal funds they receive, which allows for an increase in irregularities, creating opportunities for deviations, errors, or mismanagement. However, a reduction in legal and constitutional transfers to municipalities is not expected as a measure to reduce irregularities in municipal management. On the contrary, it is necessary to strengthen internal controls and governance in municipal management, so that these resources can be applied to the development of the municipality and are not a factor in encouraging irregularities in municipal management.

In line with this idea, in the larger municipalities, where a better governance structure and a greater volume of transfers received from the federal government were expected, no significant relationship was found between federal transfers and irregularities. It is therefore understood that in these municipalities the receipt of federal funds does not create room for an increase in irregularities.

GDP *per capita* proved to be a factor in the reduction of irregularities in medium-sized municipalities. The population's income generates greater politicization of society and, consequently, better social controls, reflecting on the municipality's government management. In a more detailed analysis, it was found that the nature of the prior opinion issued by the Court of Accounts, defined as 0 for disapproved accounts and 1 for approved and approved with reservations opinions, did not obtain a significant result, which implies that the prior opinions favorable or unfavorable to approval, issued by the Courts of Accounts, did not influence the number of irregularities in municipal management. This result differs from the findings of Kruger et al. (2012) that the issuance of an unfavorable prior opinion implied a greater number of irregularities.

This research also examined municipal internal control and, as expected, the results showed that, despite the size of the municipality, irregularities in internal controls are directly related to the total number of irregularities pointed out in municipal management. This means that it is possible to eradicate practices that lead to fraud, corruption, and irregularities in management through efficient

internal control, as pointed out in the studies by Atmadja and Saputra (2017), Kronbauer et al. (2011) and Mulyani et al. (2020).

Such a conclusion is important to reinforce the role of internal control in municipal management. Since the internal control system should guarantee an improvement in municipal management, as and when there are inconsistencies in internal controls, there is an increase in irregularities. It is not intended to state that the problems in municipal management will be solved with the implementation and efficiency of internal control, but its full operation can provide better guidance in the application of resources, as well as the development of plans and measures according to the needs of each municipality, with a consequent reduction in irregularities.

These findings are important for municipal public management and for future research in this area, especially from two points of view: external control and internal control. Inspections carried out by external control - in this case, the Courts of Accounts - have great potential for the development of research. The study of irregularities pointed out by external control allows us to understand how the management of small, medium, and large municipalities operates, so that it is possible to see how external factors, such as transfers or municipal GDP per capita, affect the effectiveness of municipal management. On the other hand, the study suggests that internal control is an important management tool, and neglecting it leads to problems in several areas since irregularities in municipal internal controls influence the increase in irregularities in public management.

Finally, this research contributes to the study of municipal audits carried out by the Court of Accounts - in particular, it expands knowledge about irregularities in municipal public management. Measures to improve public governance, including strengthening internal controls, are necessary to reduce irregularities and, consequently, improve municipal public management, as well as efficient management of the resources received, such as legal and constitutional transfers. Furthermore, it is important that other studies are developed to improve governance in municipal public management, so that it is possible to identify factors that contribute to reducing irregularities in Brazilian municipalities.

The results from this study are limited to the variables chosen, so it is recommended that other variables be included in the analysis of the determining factors of irregularities in municipal management. In addition, future research should expand the database and analyze these factors in other contexts, including in municipalities where the geographical, financial, economic, and social conditions are different from those in the state of São Paulo. It is therefore suggested that future research analyze a larger number of municipalities in different regions, adding new economic and social factors.

A number of authors have investigated the role of internal auditing in detecting and preventing fraud and irregularities in public and private institutions (Bonrath & Eulerich, 2021; Qazi & Syed, 2021). In the public sector, Ismajli et al. (2017) stated that internal auditing serves as a starting point for the prevention of irregularities. Notwithstanding the results already found in the literature on the role of internal auditing, future research should investigate how external audits are contributing to improving municipal public management and influencing the effectiveness of management procedures. Furthermore, they need to deepen the investigation into irregularities, proposing the study of specific areas, such as education, health, internal control, etc.

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Augusta da Conceição Santos Ferreira: Supervision (Lead); Validation (Lead); Visualization (Lead); Writing - review & editing.

Victor Ferreira Moutinho: Methodology (Lead); Software (Lead); Validation (Lead).

DATA AVAILABILITY

The dataset supporting the results of this study is not publicly available.

ANNEX

TABLE A   DIAGNOSTIC TESTS

	Pooled	Fixed effects	Random effects
Total sample			
Pesaran Test		17.957***	18.854***
Frees Test		1.444***	1.195***
Modified Wald test (χ^2)		1.1e+05***	
Wooldridge Test		0.024	0.024
Sample G1			
Pesaran Test		6.483***	7.830***
Frees Test		1.064***	1.156***
Modified Wald test (χ^2)		2.8e+05***	
Wooldridge Test		3.051*	3.051*
Sample G2			
Pesaran Test		4.274***	4.586***
Frees Test		1.186***	1.154***
Modified Wald test (χ^2)		30263.96***	
Wooldridge Test		1.243	1.243
Sample G3			
Pesaran Test		0.775	4.211***
Frees Test		-0.056	-0.031
Modified Wald test (χ^2)		511.09***	
Wooldridge Test		3.552	3.552

Note: *, **, *** represent that the values are statistically significant at 10%, 5% and 1%, respectively.
Source: Elaborated by the authors.

TABLE B   ROBUST FIXED AND RANDOM EFFECTS RESULTS

Variables	Total sample	Group 1	Group 2	Group 3
	Fixed effects			
	Coeff.	*Coeff.*	*Coeff.*	*Coeff.*
$Recom_{it}$	1.276545***	1.271092***	1.484385***	.9926976**
$PIBpercap.$	0.0000128	-.0000152	-.0001135	.0008032**
$TransL_{it}$	-3.74e-08***	2.40e-06***	2.64e-07***	-3.56e-08**
$IrregC_{it}$	10.6298***	6.450724***	13.49809***	6.983558***
$DecR_{it}$	.6652342	-.394607	2.219973	3.290401
Constante	11.71555***	-1.898424	4.781054	-5.4922216
R^2	0.3119	0,2794	0,4869	0,0154
Constant	895	365	415	115
	Random effects			
$Recom_{it}$	1.332302***	1.44333***	1.571654***	1.022921***
$PIBpercap.$	-6.35e-06	-5.84e-06	-.0002138**	-0.0000793
$TransL_{it}$	-1.92e-08***	2.48e-06***	2.75e-07***	-1.63e08*
$IrregC_{it}$	10.92672***	6.127885***	13.7698***	8.052341***
$DecR_{it}$	-2.663214	-1.13244	-.4960082	-4.841694
Constant	14.01663***	-4.32133	8.404362**	35.19769***
R^2	0.3631	0.2845	0,4969	0,3400
Observations	895	365	415	115

Note: *, **, *** represent that the values are statistically significant at 10%, 5% and 1%, respectively.
Source: Elaborated by the authors.

TABLE C   **RESULTS OF FIXED EFFECTS AND CONVENTIONAL RANDOM EFFECTS**

Variables	Amostral total	Grupo 1	Grupo 2	Grupo 3
Fixed effects				
	Coeff.	*Coeff.*	*Coeff.*	*Coeff.*
$Recom_{it}$	1.276545***	1.271092***	1.484385***	.9926976**
PIBpercap.	0.0000128	-.0000152	-.0001135	.0008032**
$TransL_{it}$	-3.74e-08***	2.40e-06***	2.64e-07***	-3.56e-08**
$IrregC_{it}$	10.6298***	6.450724***	13.49809***	6.983558***
$DecR_{it}$	.6652342	-.394607	2.219973	3.290401
Constant	11.71555***	-1.898424	4.781054	-5.4922216
R^2	0.3119	0,2794	0,4869	0,0154
Observations	895	365	415	115
Random effects				
$Recom_{it}$	1.332302***	1.44333***	1.571654***	1.022921***
PIBpercap.	-6.35e-06	-5.84e-06	-.0002138**	-0.0000793
$TransL_{it}$	-1.92e-08***	2.48e-06***	2.75e-07***	-1.63e08*
$IrregC_{it}$	10.92672***	6.127885***	13.7698***	8.052341***
$DecR_{it}$	-2.663214	-1.13244	-.4960082	-4.841694
Constant	14.01663***	-4.32133	8.404362**	35.19769***
R^2	0.3631	0.2845	0,4969	0,3400
Observations	895	365	415	115

Note: *, **, *** represent that the values are statistically significant from the p-value at 10%, 5% and 1%, respectively.
Source: Elaborated by the authors.