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Descriptive analysis of intergovernmental contracts in the Brazilian Agriculture Ministry

Análise descritiva dos contratos intergovernamentais no Ministério da Agricultura Brasileiro

Análisis descriptivo de los contratos intergubernamentales en el Ministerio de Agricultura de Brasil

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Abstract

The examination of intergovernmental contracts for acquiring agricultural machinery and equipment is a crucial strategy for comprehending resource distribution and partnerships across different levels of government. This study investigates these intergovernmental

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contracts between the Brazilian Ministry of Agriculture and Livestock (MAPA) and various municipalities, employing descriptive research and analyzing data on financial transfers from MAPA to states grouped by region. Over the period from 2020 to 2022, there was a noticeable increase in voluntary transfers, underscoring the significance of contextualized analyses for more robust inferences within this timeframe. The research employs summary measures such as mean, median, standard deviation, and coefficient of variation, as well as shape measures such as skewness and kurtosis, applied to three quantitative variables. These measures offer an overview of the distribution of financial amounts, revealing central tendencies and dispersions. Bar graphs visually represent the proportions of transfers by state, emphasizing the distribution of transfers across the country's regions. Pearson's linear correlation reveals a moderately strong and positive correlation between the years when intergovernmental contracts were executed and the average normalized transfer amounts. The relatively short timeframe is acknowledged as a limitation of this analysis. Hence, we recommend a more in-depth research agenda to explore intergovernmental contracts in the field of agriculture, considering their socioeconomic implications and impact on public policies.

Keywords: Accountability. Data Analysis. Fund Transfers. Intergovernmental Contracts.

Resumo

A análise dos contratos intergovernamentais para aquisição de máquinas e equipamentos agrícolas é uma estratégia crucial para compreender a distribuição de recursos e as parcerias entre os diferentes níveis de governo. Este estudo investiga esses contratos intergovernamentais entre o Ministério da Agricultura e Pecuária (MAPA) do Brasil e diversos municípios, empregando pesquisa descritiva e analisando dados sobre transferências financeiras do MAPA para estados agrupados por região. Durante o período de 2020 a 2022, houve um aumento notável nas transferências voluntárias, sublinhando a importância das análises contextualizadas para inferências mais robustas dentro deste período de tempo. A pesquisa utiliza medidas resumo como média, mediana, desvio padrão e coeficiente de variação, além de medidas de forma como assimetria e curtose, aplicadas a três variáveis quantitativas. Estas medidas oferecem uma visão geral da distribuição dos montantes financeiros, revelando tendências centrais e dispersões. Os gráficos de barras representam visualmente as proporções das transferências por estado, enfatizando a distribuição das transferências pelas regiões do país. A correlação linear de Pearson revela uma correlação moderadamente forte e positiva entre os anos em que os contratos intergovernamentais foram

executados e os montantes médios de transferência normalizados. O prazo relativamente curto é reconhecido como uma limitação desta análise. Assim, recomendamos uma agenda de investigação mais aprofundada para explorar os contratos intergovernamentais no domínio da agricultura, considerando as suas implicações socioeconómicas e o impacto nas políticas.
Palavras-chave: Análise de Dados. Contratos Intergovernamentais. Responsabilidade. Transferências de Fundos.

Resumen

El análisis de los contratos intergubernamentales para la adquisición de maquinaria y equipo agrícolas es una estrategia crucial para comprender la distribución de los recursos y las asociaciones entre los diferentes niveles de gobierno. Este estudio investiga estos contratos intergubernamentales entre el Ministerio de Agricultura y Ganadería de Brasil (MAPA) y varios municipios, empleando investigación descriptiva y analizando datos sobre transferencias financieras del MAPA a estados agrupados por región. Durante el período 2020-2022, se produjo un aumento notable de las transferencias voluntarias, lo que subraya la importancia de los análisis contextualizados para inferencias más sólidas dentro de este período de tiempo. La investigación utiliza medidas de resumen como media, mediana, desviación estándar y coeficiente de variación, así como medidas como asimetría y curtosis, aplicadas a tres variables cuantitativas. Estas medidas ofrecen una visión general de la distribución de los importes financieros, mostrando las tendencias centrales y las dispersiones. Los gráficos de barras representan visualmente las proporciones de las transferencias por estado, haciendo hincapié en la distribución de las transferencias a través de las regiones del país. La correlación lineal de Pearson revela una correlación moderadamente fuerte y positiva entre los años en que se ejecutaron los contratos intergubernamentales y los importes medios estándar de transferencia. El plazo relativamente corto se considera una limitación de este análisis. Por lo tanto, recomendamos un programa de investigación más profundo para explorar los contratos intergubernamentales en el campo de la agricultura, considerando sus implicaciones socioeconómicas y el impacto en las políticas.
Palabras clave: Análisis de Datos. Contratos Intergubernamentales. Responsabilidad. Transferencias de Fondos.

Introduction

In recent decades, Brazil has been considered an important example of how increasing investment in agribusiness can lead to economic prosperity. In 2020, agribusiness as a whole (including inputs, industry, services, and agricultural production) accounted for 26.7% of Brazil's GDP, while agriculture (the primary sector of rural production) alone contributed approximately 7% to the GDP (Cruz, Medina & Oliveira Júnior, 2022).

The expansion of Brazilian agribusiness results from many factors, including land availability, policies on land use and environmental protection that favor the expansion of agriculture, support from an agricultural policy for the modernization of rural production via subsidized credit, and political support for the sector. However, this favorable environment must be accompanied by a fundamental element: investment (Corcioli, Medina & Arrais, 2022).

Investment plays a fundamental role in explaining the economic miracle experienced by Brazilian agribusiness. Additionally, understanding the arrangements that facilitate continuous investment is essential for envisioning the future of this industry, leading to a more equitable market between large business groups and family farmers. Finally, there is a need to develop policies to promote research, provide access to equipment, and offer subsidies to support small producers (Corcioli, Medina & Arrais, 2022).

In Brazil, the Ministry of Agriculture and Livestock (MAPA) promotes the sustainable development of agribusiness and ensures the safety and competitiveness of agricultural products (Agronet, 2023). Within MAPA's organizational structure, the Secretariat of Innovation, Sustainable Development, Irrigation, and Cooperativism (SDI) plays an active role in improving the innovation environment for the agricultural sector. To fulfill its duties, SDI invests in implementing technological and operational innovations to optimize the workforce and the management of its internal activities (Camargo, 2022).

The intergovernmental contract is one of MAPA's operational instruments. It refers to formal agreements between governmental agencies, nonprofit organizations, and other allied entities to channel financial resources (Controladoria Geral da União [CGU], 2023). This contract regulates the transfer of financial resources from the federal government to state governments (or the government of the federal district) and municipalities. These contracts may involve agencies from the direct or indirect public administration, public consortia, and private nonprofits legally classified as civil society organizations. Intergovernmental contracts

in the field of agriculture aim to facilitate the acquisition of inputs for machinery and equipment. They are established under a regime of mutual cooperation, aiming to meet the common interests of the parties (Brasil, 2016).

Brazil's small farmers, known as "family farmers", face challenges in maintaining market competitiveness against larger agricultural hubs (Frota, Araujo, Barbosa, Tabosa & Almeida, 2019). This struggle is often attributed to a lack of equipment and infrastructure. Intergovernmental contracts can be crucial in supporting these farmers in developing their businesses. Family farming holds significant importance in Brazilian agricultural production, constituting 84.4% (4.4 million properties) of rural communities in the country (Berchin, Nunes, Amorim, Zimmer, Silva, Fornasari, Sima & Guerra, 2019).

In practice, local governments that aim to foster the development of their rural areas and enhance agribusiness actively pursue resources from MAPA through intergovernmental contracts, considering that MAPA shares this same objective. In this sense, these contracts represent a crucial instrument of policy implementation. They are utilized to acquire agricultural equipment, including tractors, seeding machines, and harvesters, which are then made available to local producers, serving the needs of local communities.

Therefore, intergovernmental contracts serve as instruments to enhance the competitiveness of small farmers. However, a comprehensive understanding of the nationwide distribution of resources for the agricultural sector, facilitated by these contracts, is crucial in Brazil. Access to data on these transfers is fundamental for formulating policies and strategically allocating resources to promote the equitable development of agribusiness throughout the territory.

Against this backdrop, this research analyzes the intergovernmental contracts between MAPA and Brazilian municipalities, focusing on those related to the acquisition of agricultural machinery and equipment.

The study is based on data from the SDI and comprises approximately 8,000 observations with 28 variables. Before analysis, the information underwent pre-processing and standardization.

The preliminary analysis focused on the period from 2020 to 2022, providing a two-dimensional view of the regions in Brazil with the highest incidence of voluntary transfers from the federal government through MAPA. Additionally, the continuous variable of transfer amount was discretized to comprehend the behavior of this data and identify frequency patterns. However, the selection of a specific analysis period also represents a limitation of

the study. Therefore, it is recommended that future research be more comprehensive and contextualized to enhance understanding of the socioeconomic implications and the impact of public policies in the agricultural sector.

This study contributes to advancing our understanding of MAPA's voluntary transfer patterns for acquiring agricultural machinery and equipment, offering valuable insights for strategic decision-making and fostering sustainable development across Brazil.

The article is structured into six sections, commencing with this introduction that outlines the research justification and objective. The second and third sections delve into the theoretical framework, covering intergovernmental contracts and the Brazilian agricultural industry. The fourth section outlines the methodology, followed by the fifth section, which presents the analysis and discussions. The sixth and final section brings the study's conclusion, contributions, limitations, and suggestions for future research.

Intergovernmental Contracts in Brazil

The 1988 Brazilian Federal Constitution outlined the attributions of the federal, state (including the Federal District), and local governments. The distribution of these responsibilities ensures that administrators address the interests and needs of the people, encompassing areas such as health, education, and social assistance. The provision of these public services depends on the effective performance of the government at every level-federal, state and local (Brasil, 1988).

Without cooperation with local governments and civil society organizations, the federal government cannot implement public policies benefiting the population directly, reaching all regions of the country, as enshrined in the federal constitution. In this sense, for a country as large as Brazil, it is ineffective to adopt a centralized administration. A joint effort among entities interested in an issue is crucial to meet society's emerging demands.

An intergovernmental contract originates to formalize the federal government's voluntary transfers. These transfers differ from those resulting from constitutional or legal obligations or those directed to fund the national health system (known as SUS), as outlined in Article 25 of the Fiscal Responsibility Law (Brasil, 2000). They refer to resources made available to subnational entities or nonprofit organizations for funding cooperation, assistance, or financial support activities.

These contracts represent agreements between the federal government, subnational

entities (and their agencies), or nonprofit organizations, channeling voluntary transfers toward specific and common purposes, also referred to as the "product". The purpose/product may involve the implementation of projects, activities, services, acquisition of goods, or activities of mutual interest (CGU, 2023).

In the case of the Brazilian Ministry of Agriculture and Livestock (MAPA), the agency's intergovernmental contracts are related to its mission of defining and implementing policies to develop agribusiness, encompassing technological, organizational, and environmental aspects of this market. In this way, MAPA serves Brazilian consumers, enhances food security, generates income and employment, reduces inequality, and promotes social cohesion (Ministério da Agricultura e Pecuária [MAPA], 2023).

Voluntary transfers pose challenges for public administrators concerning transparency and efficiency compared to many other policy implementation instruments used by Brazilian states and municipalities. These transfers from the federal government are part of a cooperation system involving all levels of government and their respective agencies, as well as private nonprofits. The objective is to carry out actions of reciprocal interest funded with resources from the federal budget (Da União, 2018).

Voluntary transfers are governed by Decree 6,170 of July 21, 2007, regulating Article 10 of Decree-Law 200 of February 25, 1967, and Article 116 of Law 8,666 of June 21, 1993. The transfers are further regulated by Interministerial Ordinance 424 of December 30, 2016. Additionally, Constitutional Amendment 86 of March 17, 2015, established the so-called "imposing budget", where Congress designates resources to specific ends through "budget amendments", and the executive must realize the expense. This largely reflects the dynamics of voluntary transfers (Cordeiro, Souza, Limiro & Silva, 2023).

The legislative branch can propose budget amendments, traditionally formalized through treaties, transitional agreements, and provisions in the budget, to be mandatorily executed, amounting to 1.2% of the budget's total net amount. Economic crises and the increased participation of Congress in designating parts of the budget have reduced the financial availability of the federal government. Consequently, the agreements involving funds transfers and contracts resulting from the imposing budget started to be executed via intergovernmental contracts (Tribunal de Contas da União [TCU], 2018).

Brazilian Agriculture Industry

The Brazilian economic policy underwent radical changes in the 1990s, transitioning from a regime of rural-based policy designed for a closed economy with significant state intervention to a new regime adapted to an open economy with a reduced role for the State (Helfand & Rezende, 2004).

In recent decades, significant changes have occurred in the production structure and socioeconomic dynamics of the Brazilian agricultural sector (Frota *et al*., 2019). Furthermore, Brazil is a leading producer (Dias, Hoffmann & Martinez-Fernandez, 2019), and it is well-positioned in a context where global agricultural demand and trade flow are expected to grow by 10% to 50% and 74% to 178%, respectively, by 2050 (Carvalho, Lorandi, Collares, Di Lollo & Moschini, 2021).

Many factors contribute to Brazil's success in the development of the sector. These include the restructuring and mechanization of agriculture for the mass production of commodities, the modernization of production factors, technological improvements, ease of use, and credit availability to producers. On the other hand, small producers are losing market share due to their inability to compete with larger agricultural hubs (Frota *et al*., 2019).

Agricultural modernization is an important economic policy strategy for the sector to realize its full potential for global economic growth and social well-being (Alcântara, Patino, Nascimento & Paseto, 2018).

Brazil has become a leading economy in food production, particularly due to the performance of its agri-food exports. This success results from increasing investments in extensive and large-scale production systems, which represent only 11% of all Brazilian farms. Despite the prosperity of commodity companies, this economic progress has not reached family farmers (Dantas, Martínez-Zarzoso, Santos & Henning, 2023).

Family farming is central in the Brazilian agricultural sector and essential for sustainable rural development strategies. In terms of economic importance, it represents 60% of the food Brazilians consume and almost 40% of the total value of agricultural production. These small farms produce 70% of the legumes used in the country, 84% of cassava, 5.8% of swine production, 54% of dairy cows, 49% of corn, and 40% of poultry products (Santos & Vieira, 2012).

The production of family farms involves over 500 million producers and is recognized worldwide as essential for food security. Family farming encompasses more than 90% of the

world's farms and produces most of the world's food. Challenges and threats imposed on agricultural practices require more adaptation and mitigation actions to increase the resilience of these producers. These challenges mainly relate to a lack of farm equipment, infrastructure, and resources (Berchin *et al*., 2019), as well as barriers to accessing new technologies and market structures (Santos & Vieira, 2012).

Finally, the production capacity of family farming is noteworthy, representing 84.4% of rural properties (4.4 million farms) and 24.3% of the country's rural area (80.1 million hectares). Additionally, it substantially contributes to generating rural jobs, being responsible for 74.4% of the agricultural workforce, amounting to 12.3 million workers (Berchin *et al.*, 2019).

Materials and Methods

This study provides a comprehensive descriptive statistical analysis of the intergovernmental contracts between the Brazilian Ministry of Agriculture and Livestock (MAPA) and local governments. Descriptive statistics offer an overview and a better understanding of the sample characteristics by describing and summarizing the data and presenting them in text, tables and figures. Tables and figures are most valuable when dealing with a large sample size and multiple characteristics under analysis (Fulk, 2023).

Descriptive research refers to the scientific method with no bias and includes the observation and description of the subject. This method facilitates comprehensive data collection by observing and portraying a subject's conduct without influencing them (Okwata, Wasike & Andemariam, 2022). In other words, descriptive research explains, examines, and interprets prevailing practices, existing situations, attitudes, reasons, and ongoing processes (Yusuf, Ahmed, Zhu, Usman, Gajale, Zhang, Jialong, Hussain, Zakari & Yusuf, 2023).

The data used in this study were collected from an internal control database gathered within the MAPA's Secretariat of Innovation, Sustainable Development, Irrigation, and Cooperativism (SDI). The database contains information on voluntary transfers from MAPA to Brazilian local governments. It was accessed for the purpose of this research under the conditions of the agreement Termo de Execução Descentralizada (TED) 939993/2022 signed between SDI/MAPA and the institution the authors are affiliated with.

The database included 7,927 observations and 28 variables. For this research, particular emphasis was placed on the variables "year", "state", "amount of the counterpart

contribution", "global amount", and "transfer amount" to understand the patterns in each of these variables. Additionally, a new variable, "region", was created based on the variable "state", allowing the analysis of patterns considering the five regions of Brazil (North, Northeast, Southeast, South, and Central-West). However, some financial variables had missing data. There were 14 missing entries for the variable "transfer amount" (0.17% of total data), 11 for the variable "global amount" (0.13% of total data), and 152 for the variable "amount of the counterpart contribution" (1.91% of total data). As Kang (2013) notes, "Missing data can reduce the statistical power of a study and can produce biased estimates, leading to invalid conclusions". Thus, the calculations disregarded the missing data to ensure the integrity and reliability of the results.

The descriptive analysis was conducted using the R Studio software, adopting the R programming language. The "tidyverse" package was essential for performing calculations, visualizing the database, and creating graphs. Within the R programming environment, the "tidyverse" ecosystem is a collection of packages built on a common programming style, grammar, and data structures (Li, Deans & Buell, 2023). The information obtained through this package was crucial for understanding the distribution and features of the amounts allocated through intergovernmental contracts in recent years.

The next section presents the results considering statistical measures such as mean, median, standard deviation, coefficient of variation, skewness, and kurtosis. However, emphasis will be placed on the median when the data are distributed asymmetrically, as it is not influenced by outliers (Duquia & Bastos, 2007). At certain times, the coefficient of variation will be presented instead of the standard deviation. According to Akamine and Yamamoto (2013), "the coefficient of variation is a measure that normalizes the standard deviation in relation to the mean. It is dimensionless as it is a quotient of two measurements with the same unit, i.e., it does not have a unit". Furthermore, this coefficient is "a relative measure of dispersion useful for comparing in relative terms the degree of concentration around the average of different series" (Fonseca & Martins, 2012).

Results

5.1 Characterization of Voluntary Transfers

In the MAPA database of voluntary transfers to local governments, the variable "transfer amount" was discretized into 14 classes based on the Sturges Rule for the period between 2008 and 2022. The total range of transfer amount was approximately BRL 95.49 million.

Table 1 describes each class, including their initial and final interval, the absolute frequency, representing the number of occurrences of amounts within each class, the accumulated absolute frequency, the relative frequency, indicating the proportion of the absolute frequency in relation to the total number of occurrences and the accumulated relative frequency, showing the accumulated proportion of the relative frequencies.

Table 1

Frequency distribution of the variable "transfer amount" between 2008 and 2022.

Transfer amount	n_i	N_i	f_i	F_i
15000 ⊢ 6902001	7878	7878	0.99557	0.99557
6902001 ⊢ 13789002	7	7885	0.00088	0.99645
13789002 ⊢ 20676003	8	7893	0.00101	0.99746
20676003 ⊢ 27563004	5	7898	0.00063	0.99809
27563004 ⊢ 34450005	6	7904	0.00076	0.99885
34450005 ⊢ 41337006	3	7907	0.00038	0.99923
41337006 ⊢ 48224007	1	7908	0.00013	0.99936
48224007 ⊢ 55111008	0	7908	0.00000	0.99936
55111008 ⊢ 61998009	2	7910	0.00025	0.99961
61998009 ⊢ 6885010	1	7911	0.00013	0.99974
68885010 ⊢ 75772011	1	7912	0.00013	0.99987
75772011 ⊢ 82659012	0	7912	0.00000	0.99987
82659012 ⊢ 89546013	0	7912	0.00000	0.99987
89546013 ⊢ 96433014	1	7913	0.00013	1.00000
Total	**7913**	**-**	**1.00000**	**-**

n_i = absolute frequency; N_i = accumulated absolute frequency; f_i = relative frequency; F_i = accumulated relative frequency.

The first class is the one with the highest absolute frequency, ranging from BRL 15,000 to BRL 6.9 million, representing approximately 99.56% of the total transfer amounts in the database. The following classes have lower relative frequencies, indicating that the majority of transfer amounts are concentrated in the first class. Subsequent classes present lower absolute and relative frequencies as the transfer amounts increase. Furthermore, some classes have absolute frequencies equal to zero, indicating that there are no occurrences recorded in

these intervals. Table 1 also reveals that transfer amounts are distributed asymmetrically, indicating the existence of outliers.

Therefore, the data show that the majority of voluntary transfers from MAPA to local governments fall within the range of BRL 15,000 to BRL 6.9 million, with a high probability of occurrence in this range. As the amounts increase, the probability of occurrence progressively decreases.

The results in Table 1 suggest that the distribution of resources to encourage investment in agriculture was concentrated in the first class. This indicates that government strategies are leading to a greater distribution of resources, serving a larger number of cities/beneficiaries and distributing resources more equitably among Brazilian municipalities. Amounts larger than those considered in the first class would suggest a concentration of resources in a few cities.

Still adopting the same approach as in the preliminary analysis, we tried to comprehend and describe patterns and relationships between two categories. In this analysis, frequencies, margins, and proportions of the categories were calculated. Additionally, two-dimensional cross-coordinates were explored to investigate the associations between the variables “year” and “state”. The strategy of clustering the occurrences of states into regions was adopted for the period from 2020 to 2022.

The number of intergovernmental contracts found from 2020 to 2022, represents 59.21% of the total number of contracts under analysis. Furthermore, the amount of funds transferred in this period was BRL 2.8 billion, accounting for 72.19% of the total amount transferred from 2008 to 2022.

The results demonstrated that the South is the region with the highest concentration of voluntary transfers, totaling 1,806 intergovernmental contracts from 2020 to 2022, followed by the Southeast with 1,483 contracts. Table 2 presents the number of intergovernmental contracts per region, obtained by clustering the numbers found per state in the database.

Table 2

Number of contracts per region.

Region	Central-West	Northeast	North	Southeast	South	Total
n_i	455	592	349	1483	1806	4685

n_i = absolute frequency.

When associating the number of intergovernmental contracts per year and region from 2020-2022, the data shows a pattern where the South and the Southeast regions obtained the first and second-highest proportion of contracts every year. The highest proportion occurred in 2021, where the South had 15.75%, and the Southeast had 14.5% of the intergovernmental contracts signed within the three years. In 2020, this proportion was 13.8% for the South and 11.6% for the Southeast, whereas 2022 witnessed the lower proportion of contracts, with the South leading with only 9%, followed by the Southeast with 5.6% of the intergovernmental contracts signed between 2020 and 2022 (Table 3).

Table 3

Proportion of contracts per year and region.

Year	Central-West	Northeast	North	Southeast	South	Total
2020	0.0388	0.0335	0.0245	0.1157	0.1379	0.3504
2021	0.0497	0.0681	0.0395	0.1450	0.1575	0.4598
2022	0.0085	0.0248	0.0105	0.0559	0.0901	0.1898
Total	0.0970	0.1264	0.0745	0.3166	0.3855	1.0000

Table 4 presents summary and shape measures for the variables “global amount”, “transfer amount”, and “amount of the counterpart contribution”.

Table 4

Statistical measures of financial variables from 2020 to 2022.

Variable	Mean	Median	Standard deviation	Skewness coefficient	Kurtosis coefficient
Global amount	721880.0	385228.10	3302341.0	19.51	447.00
Transfer amount	603361.4	286500.00	2917345.0	19.97	486.66
Amount of the counterpart contribution	121186.4	40550.61	611882.9	31.27	1138.09

Table 4 reveals that the three variables have skewness greater than zero, indicating a positively skewed distribution. In other words, this suggests that, for the three variables, there are above-average amounts more distant from the mean than the below-average amounts observed.

The medians of the global amount, transfer amount, and the amount of the counterpart contribution are approximately BRL 385,000, BRL 286,500, and BRL 40,500, respectively. These amounts are significantly below the means, suggesting the presence of outliers. This perspective is reinforced by the standard deviations, which are too high for the three variables. Thus, it is possible to say that the amounts of the variables are dispersed in relation to the

means. Furthermore, the kurtosis coefficient indicates that the data curve is classified as leptokurtic, demonstrating that the amounts of the variables are strongly concentrated in the central interval of the distribution.

For the subsequent analysis, the financial values of the variable "transfer amount" were grouped by state, considering the period from 2020 to 2022, and central tendency, dispersion, and shape measures were calculated (Table 5). This procedure sought to compare observations and identify possible disparities in the amounts transferred through the intergovernmental contracts examined in this study.

Table 5

Statistical measures of transfer amounts between 2020 and 2022 for each Brazilian state.

	State	Mean	Median	Coefficient of variation	Skewness Coefficient
AC	Acre	1516242.2	477500.0	3.4265248	8.3144108
AL	Alagoas	2573969.3	620750.0	2.9183780	3.1972839
AM	Amazonas	1069134.9	724500.0	1.1179821	2.9288687
AP	Amapá	689671.4	859500.0	0.5740513	-0.2953232
BA	Bahia	1040397.2	477500.0	3.0574055	6.7764720
CE	Ceará	588870.1	420200.0	1.2557935	4.5533119
DF	Distrito Federal	700808.4	300000.0	1.6560091	2.7911495
ES	Espírito Santo	1050632.5	308465.0	4.2689521	9.6870724
GO	Goiás	445388.9	238750.0	1.4417986	5.1081062
MA	Maranhão	372975.2	257802.2	0.5789451	0.9350732
MG	Minas Gerais	477955.1	286500.0	2.0312495	10.2199081
MS	Mato Grosso do Sul	1202672.6	477500.0	5.8589615	12.7997512
MT	Mato Grosso	1293227.3	477500.0	3.1771445	6.0699549
PA	Pará	524782.7	382000.0	1.0242062	3.1323870
PB	Paraíba	452671.2	238750.0	2.5631736	9.9224063
PE	Pernambuco	765346.8	286500.0	1.5574939	2.8520329
PI	Piauí	546882.3	286500.0	1.2982253	3.2427652
PR	Paraná	447038.4	286500.0	5.1118563	23.4161642
RJ	Rio de Janeiro	635965.8	467950.0	1.0356719	3.4408873
RN	Rio Grande do Norte	407211.6	229200.0	2.5710773	7.4027327
RO	Rondônia	609901.3	305600.0	1.2275718	2.8761975
RR	Roraima	1077683.1	859500.0	0.8782253	1.0941679
RS	Rio Grande do Sul	394722.9	191000.0	6.6178748	20.5645647
SC	Santa Catarina	839116.2	238750.0	6.5735810	11.6412826
SE	Sergipe	860922.7	429750.0	1.3876979	1.8014274
SP	São Paulo	303500.8	238750.0	0.8360699	3.4239065
TO	Tocantins	703743.9	477500.0	1.1928355	3.7583236

The skewness coefficients presented in Table 5 show that all states exhibit skewed distributions. However, only the state of Amapá demonstrates a left-skewed distribution. This implies that there are amounts transferred to Amapá that fall below the average and are relatively farther from the mean compared to amounts above the average. The remaining states exhibit right-skewed distributions.

Due to the skewed distribution of transfer amounts, the study focuses on the median of this variable. Table 5 shows that the states with the lowest medians were, respectively, Rio Grande do Sul, Rio Grande do Norte, Goiás, Paraíba, Santa Catarina, São Paulo, Maranhão, Minas Gerais, Pernambuco, and Piauí. The states with the highest medians were Roraima, Amapá, Amazonas, Alagoas, and Tocantins, respectively.

The results for the coefficient of variation in Table 5 demonstrate that transfer amounts vary significantly in all Brazilian states. The lowest variability was observed in Amapá, Maranhão, São Paulo, and Roraima, with 57.4%, 57.9%, 83.6%, and 87.8% variability in transfer amounts, respectively. Despite being the lowest numbers among Brazilian states, these percentages are still significantly high. The states with the highest variability rates are Rio Grande do Sul, Santa Catarina, Mato Grosso do Sul, and Paraná, with 662%, 657%, 586%, and 511%, respectively.

Seeking a deeper understanding of the management of resources transferred, the data for the states were clustered according to the Brazilian regions. Table 6 presents the statistical measures for the variable transfer amount clustered per region.

Table 6

Statistical measures of transfer amounts clustered by region between 2020 and 2022.

Region	Mean	Median	Coefficient of variation	Skewness
Central-West	927505.1	466040	5.288839	16.61406
Northeast	648795.8	286500	3.086009	10.49840
North	903182.8	477500	2.975565	15.35767
Southeast	576388.2	286500	3.747173	18.59725
South	471014.2	238750	6.521565	19.01540

Table 6 shows that the coefficients of variation for Brazilian regions are also high, revealing significant variability of transfer amounts in relation to the means. For instance, the South and the Central-West have a variability rate of 652% and 529%, respectively. The North has the lowest variability among Brazilian regions, with 297.5%. As for the results for the skewness coefficients, the transfer amounts present a right-skewed distribution. The South has a median of BRL 238,750 in amounts received from intergovernmental contracts, being the region with the lowest median. On the other hand, the North has a median of BRL 477,500, being the region with the highest median.

Table 7

Statistical measures of transfer amounts clustered by year between 2020 and 2022.

Year	Mean	Median	Coefficient of variation	Skewness
2020	489181.4	238750	4.478801	17.528464
2021	587933.1	286500	6.001249	20.084223
2022	851635.8	382000	2.816257	9.838529

Table 7 presents the statistics for transfer amounts per year from 2020 to 2022. The skewness coefficients for each year show a right-skewed distribution. The coefficients of variation show significant variability in the period, with 447.8%, 600.1%, and 281.6% in 2020, 2021, and 2022, respectively. Furthermore, the median over the three years increased substantially: the median for 2021 was 20% higher than that of the previous year, and the median for 2022 increased 33% compared to the median for 2021.

The results reinforce the need for a managerial approach that promotes stability in transfer amounts and resource allocation efficiency. This may include an in-depth analysis of the specific needs of each period and strategic actions to ensure an adequate distribution of financial resources.

The data analyzed offers elements to understand the management of the financial resources related to intergovernmental contracts between MAPA and local governments in the period from 2020 to 2022, grouped per state and region and considering the coefficient of variation and median of the transfer amounts. Evaluating trends and variations in such financial transfers is crucial to subsidize data-driven decisions and optimize resource allocation according to specific circumstances and needs.

5.2 Analysis and Discussion

This subsection presents the analysis of the relationships between the variable “transfer amount” and the variables “state”, “region”, and “year” using graphs. The database allowed us to investigate patterns of transfers across different geographic locations and identify possible outliers and trends from 2020 to 2022. We used bar graphs, box plots, and density plots to examine how transfer amounts vary among the states. This analysis helps to understand resource allocation patterns and their distribution in different states and regions of Brazil, providing essential information for a more efficient and equitable management of financial resources. The graphs present a visual analysis of transfer amounts, and these

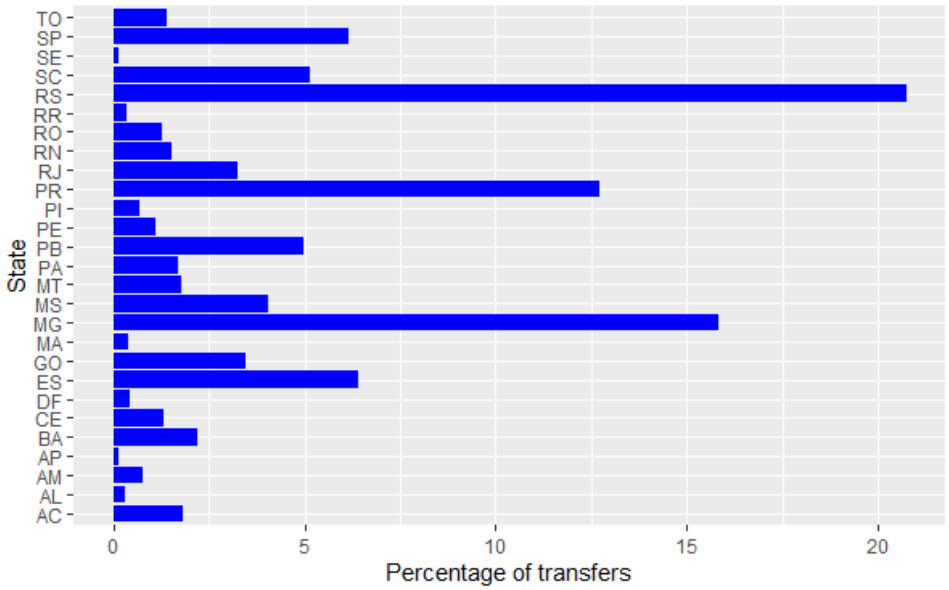
representations allow exploring how the transfer amounts are distributed and how they differ according to geographic locations.

The analysis of the number of transfers per state shown in Figure 1 reveals important patterns. The states of Rio Grande do Sul, Paraná, and Minas Gerais are responsible for the highest percentages of intergovernmental contracts, representing 49.2% of the number of contracts. As observed in Table 2, these numbers highlight the dominance of the South and Southeast regions regarding this topic.

The study by Lui and Miquelino (2023) indicates that the Brazilian National Congress plays a significant role in allocating resources. However, a notable regional disparity in this approach is evident, with a significant concentration of resources in the South and Southeast regions of the country. This suggests that the distribution of intergovernmental contracts related to agriculture in Brazil tends to favor certain policies and geographic areas to the detriment of others. Therefore, it is essential that MAPA establishes effective coordination mechanisms to avoid redundancies in allocating resources in specific regions, prevent gaps in assistance, and ensure that all areas of public policies receive due attention (Lui & Miquelino, 2023).

Figure 1

Percentage of transfers per state between 2020 and 2022.



The study by Chaves, Campelo Filho and Pinto (2022) examined intergovernmental contracts during the period from 2008 to 2016 and highlighted the transfers from the federal government categorized by ministries. Their study showed that Rio Grande do Sul, Paraná, Minas Gerais, and Santa Catarina, the leading states in terms of transfer amounts in this research, received the majority of their revenues from federal transfers from the Ministry of Education, in the case of Rio Grande do Sul; Ministry of Health, in the case of Paraná; and Ministry of Cities, in the case of Minas Gerais and Santa Catarina. Chaves, Campelo Filho and Pinto (2022) observed that the state that received the largest transfer amount from MAPA was Espírito Santo.

Moutinho and Kniess (2017) identified a strong correlation between the amounts of voluntary transfers from the federal government to local governments and the number of mayors politically aligned with the federal government per state, suggesting the existence of party discretion. This may be the case in this study, as states that received the most significant amount of transfers, such as Santa Catarina, Paraná, and Minas Gerais, were aligned with the political coalition governing the country from 2020-2022.

Figure 2

Density plot of financial transfer amounts between 2008 and 2022.

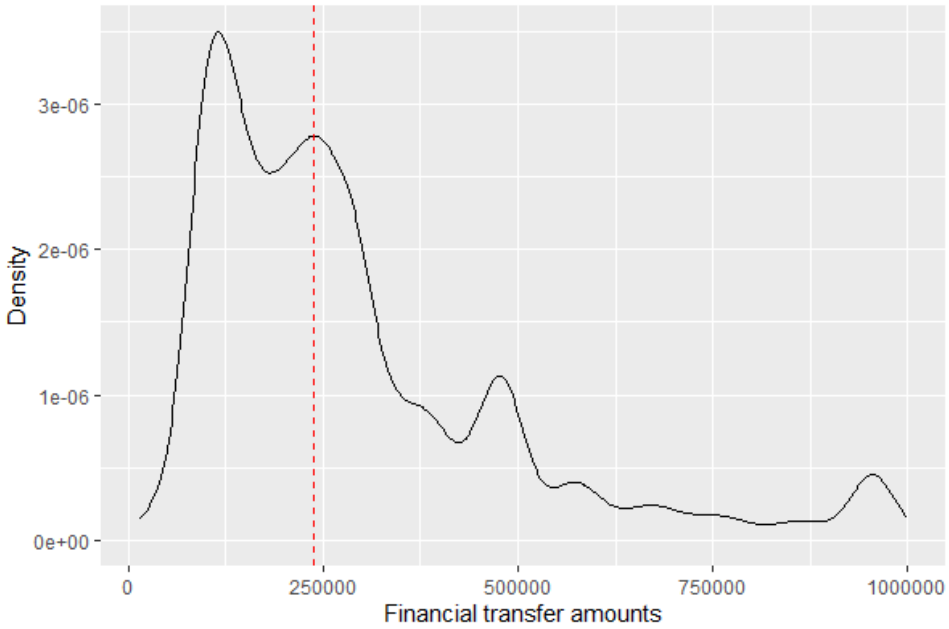


Figure 2 shows that most transfers (95.55%) between 2008 and 2022 ranged from BRL 15,000 to BRL 1,000,000. Therefore, transfers with higher amounts (4.45% of them, see Table

1) were considered unusual and adjusted in the construction of the graph. Another factor to be observed is the decrease in the density curve when the amounts of financial transfers are greater than BRL 239,000 (the median indicated by the dashed line on the graph). This shows that amounts above the median become gradually less frequent.

The study by Knorek, Rocha and Sciminski (2015) illustrates the impact of these transfers on the field. The authors discuss voluntary transfers from the federal government through MAPA, totaling BRL 1,500,000 in 2013. The resources were used in projects to support infrastructure and services in rural territories, to purchase food from family farming, to offer specialized technical assistance for rural women, provide inputs for family farming, promote socio-productive networks of family farming, and the participation of family farming in renewable energy chains, reaching 1,579 families and 50 enterprises.

The funds transferred by MAPA are frequently allocated for the acquisition of agricultural equipment such as 4x4 110hp tractors, bee boxes, crushers, fertilizer machines, furrowers, soil drillers, harrows, harvesters, hoes, milk coolers, planters, plows, power generators, seeders, and water pumps, as illustrated by the study conducted by Cordeiro *et al*. (2023).

Chaves, Campelo Filho and Pinto (2022) identified that MAPA transferred approximately BRL 4.6 billion between 2008 and 2016 through voluntary transfers formalized in 15,063 contracts. These findings align with the data presented in Figure 2, where the average amount per contract was BRL 308,165.

For subsequent analyses, transfer amounts were normalized to facilitate visualization and ensure that the data was on an appropriate scale for statistical analysis.

Figure 3

Scatter plot of transfer amounts between 2008 and 2022.

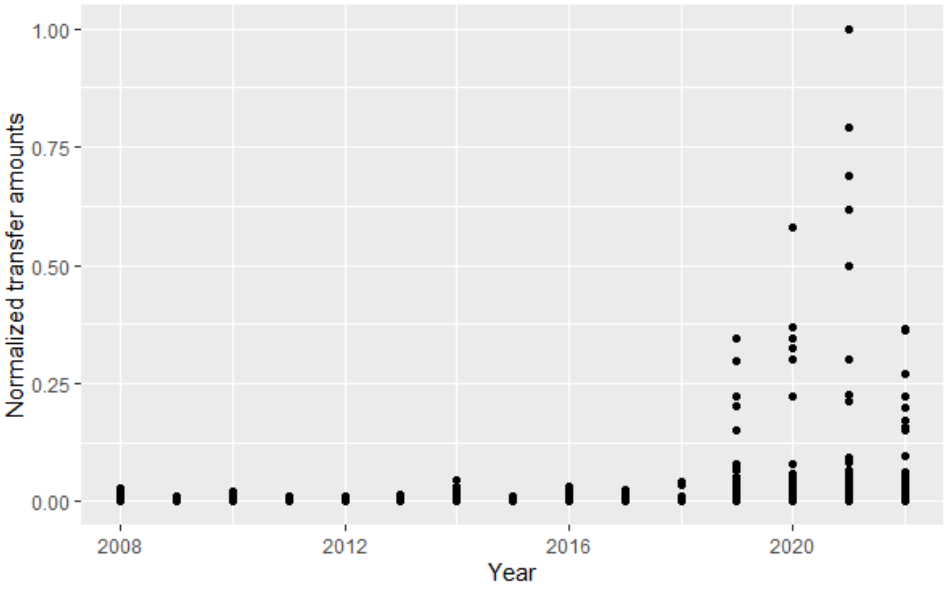


Figure 3 illustrates the distribution of transfer amounts from 2008 to 2022. Notably, outlier amounts began to emerge from 2019 onwards. Between 2020 and 2022, only 456 of these outlier amounts were identified, constituting a mere 5.76% of the total transfers in the database. The exploration of these outlier amounts could be a subject for future research.

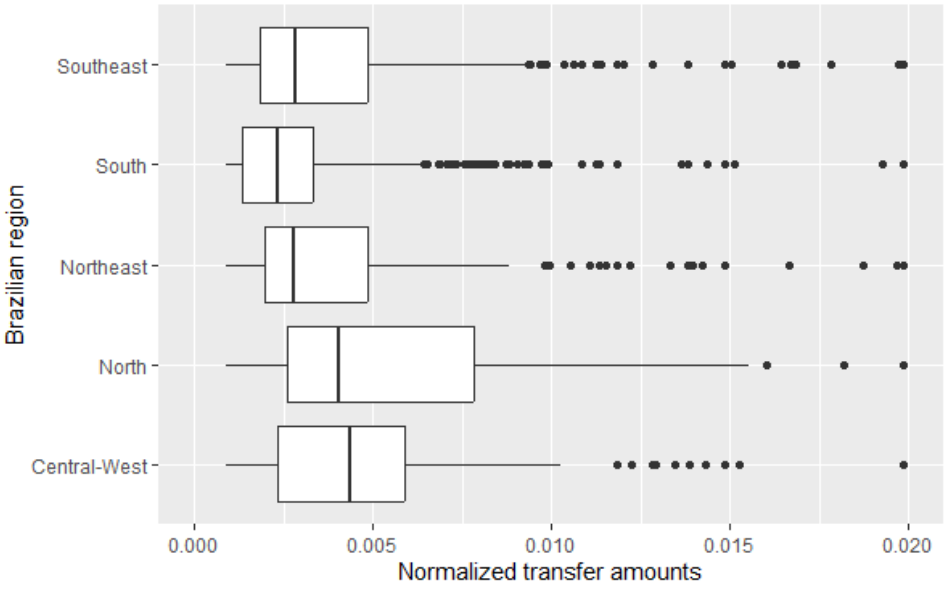
While constructing the box plots for the Brazilian regions and the years 2020 to 2022 separately, the presence of outliers posed challenges to the visualization of results. In Figures 4 and 5, the range of values on the horizontal axis was deliberately reduced to enhance analysis and visualization. It is important to note that although the 112 outlier amounts are not explicitly displayed, they were duly considered in the process of constructing the box plot.

Figure 4 displays box plots for the Brazilian regions, revealing numerous outliers. These outliers underscore the atypical nature of high transfer values in the database. The Central-West, Northeast, North, Southeast, and South regions exhibit 72, 81, 93, 150, and 60 occurrences of exceptional or unusual financial transfer amounts, respectively. These values represent 1.53%, 1.72%, 1.98%, 3.20%, and 1.28% of transfers made between 2020 and 2022 in the Central-West, Northeast, North, Southeast, and South, respectively. An additional observation from Figure 3 is the variability of transfer amounts. The North, Northeast, and Southeast regions show greater variability above the median values, while the Central-West exhibits greater variability below the median values. In contrast, the South region displays

relatively uniform variability both above and below the median, suggesting greater stability in transfer amounts for this region.

Figure 4

Box plot of transfer amounts between 2020 and 2022.



The absence of regulated policies results in significant heterogeneity in per capita spending. The federal government's involvement should introduce dynamics in transfers and regulations, shaping policies to prevent a "race to the bottom". This approach ensures a certain homogeneity in the provision of public goods and services while preserving the autonomy of municipalities in policy implementation (Bijos, 2018). Consequently, the observation of outliers in Figure 4 highlights the non-homogeneous distribution of resources, signaling the need for specific investigations in each case to identify the reasons behind these atypical values.

Chaves, Campelo Filho and Pinto (2022) provide an explanation for the higher amounts, arguing that states with superior economic and social indicators, primarily in the South and Southeast regions, attract a larger share of resources and demonstrate more favorable outcomes in the execution of intergovernmental contracts. São Paulo, Minas Gerais, Rio Grande do Sul, and Paraná are cited as examples supporting this argument.

The data specific to each municipality reveals even more pronounced contrasts than those at the state level. Notably, the diversity in per capita values among the 5,569 Brazilian

municipalities implies an extremely dispersed distribution of resources. The national average of BRL 352,000 per municipality suggests highly fragmented resource allocation. However, this relatively low value may render large investment projects unfeasible. When resource transfers encompass various areas or serve multiple purposes, it is likely that these resources will be directed toward interventions of a more specific and localized nature (Bijos, 2018), thereby generating atypical values.

According to Moutinho and Kniess (2017), it is reasonable to anticipate an increased volume of resources transferred as the Human Development Index (HDI) decreases. This assumption suggests that the HDI could be an effective indicator to determine transfers since voluntary transfers, designed to decentralize resources, should be utilized to mitigate existing disparities between municipalities. However, there is a tendency to perpetuate regional inequalities in Brazil, as both the amount and evolution of resources transferred to subnational entities seem to be determined more by the political influence of these entities than by criteria designed to reduce regional disparities and meet the needs of local populations.

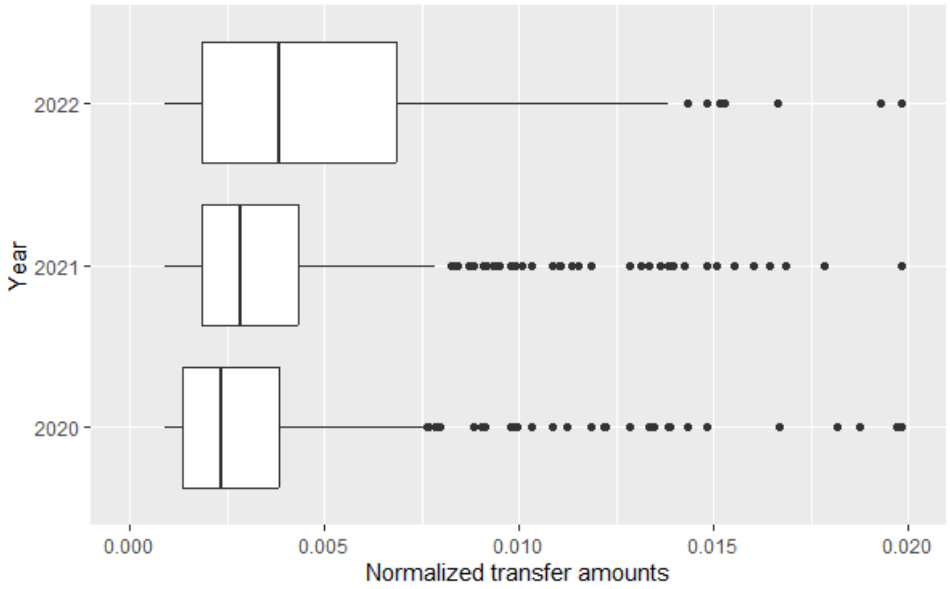
Continuing with Figure 4, regions with larger interquartile ranges and longer whiskers indicate greater variability in transfer values. Notably, the North region has a third quartile that is more distant compared to other regions. Additionally, this region has the largest interquartile range, i.e., the transfer amounts vary more within the region. In other words, this characteristic denotes greater data variability around the center of the transfer amounts in this region, indicating a wider dispersion of values in relation to the median. This suggests that transfer amounts in the North may be more diversified, with the amount of voluntary transfers varying significantly.

Looking at the years 2020 to 2022, Figure 5 shows that the medians of the boxes for each year are relatively close, indicating that the transfer amounts tend to be at similar levels over these three years.

Figure 5 illustrates the variability of transfer amounts from 2020 to 2022. Each year exhibits greater variability for transfer amounts above the median values, with some values significantly deviating from the norm. In 2020, there were 112 outliers (6.82% of the total transfers). In 2021, this number increased by 27.67%, reaching 143 outliers (6.63% of the total transfer amounts). Notably, in 2022, the number of outliers surged by 40.56%, totaling 201 outlier amounts, which represented 40.55% of the total transfer amounts for that year.

Figure 5

Box plot of transfer amounts in each year (2020 to 2022).



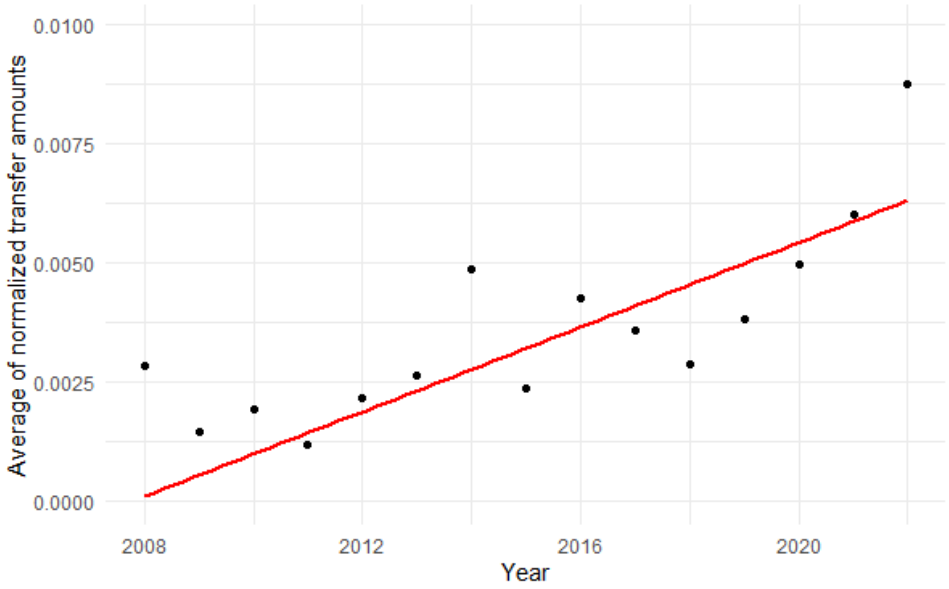
The prevalence of outliers notably increased in 2022, suggesting potential induced cases of transfer that deviate from the typical distribution pattern for that specific year. A detailed analysis of these outliers could yield valuable insights into intentionally atypical transfers or extraordinary events that influenced the transfer dynamics.

The box plot for each year indicates that transfer amounts exhibit similar trends from 2020 to 2022, displaying consistent distributions. However, a thorough examination of outliers, particularly in 2022, is vital for a more comprehensive analysis and a thorough understanding of the prevailing patterns in transfer values during this period. Such insights can be crucial for decision-making and the formulation of public policies concerning the intended transfers from MAPA to municipalities.

The subsequent analyses involved calculating the mean of the normalized transfer amounts for each year. Pearson's linear correlation coefficient was employed to assess the presence of a linear relationship between the variables "year" and "mean of the normalized transfer amounts". According to Costa Neto (2006), "Pearson's linear coefficient possesses crucial properties, being dimensionless and ranging between -1 and +1".

Figure 6

Chart of the dispersion among variables: year and average of normalized transfer amounts.



The calculation yielded $\rho = 0.78$, indicating a moderately strong and positive correlation. Consequently, the mean of the normalized transfer values demonstrates an increasing trend over the years. In Figure 6, the red line depicts the result obtained for Pearson's correlation coefficient. The use of standardized amounts eliminates potential distortions caused by differences in scales among the transfer amounts over the years, facilitating a more precise analysis of the correlation between these two variables.

The scatter plot in Figure 6 showcases the mean of the normalized transfer amounts for each year, emphasizing a discernible growth trend over time. This analysis enhances our understanding of the evolution of intergovernmental contract transfer amounts, indicating a tendency for an increase in the coming years.

Final Considerations

This study provided a statistical analysis of intergovernmental contracts between the Brazilian Ministry of Agriculture and Livestock (MAPA) and local governments, focusing on the acquisition of agricultural machinery and equipment. The findings have practical and theoretical implications for similar intergovernmental contracts in this domain.

The study focused on resource distribution, identifying states that received significant transfer amounts and how these resources were allocated within municipalities. Regional disparities in resource distribution were revealed, highlighting areas requiring attention for agricultural development policies. By identifying the most demanded objects in intergovernmental contracts, the study informs policymakers about specific regional needs, guiding future investments toward relevant sectors and projects.

This article's analysis contributes to assessing equity in resource distribution nationwide and lays the groundwork for predicting factors influencing intergovernmental agreements for public policy promotion. However, it is essential to note the study's limitations, including the time frame (2020-2022) and the absence of a specific theoretical foundation for certain analyses. Future research should aim for a more comprehensive, contextualized, and inferential approach to provide detailed evidence for more robust conclusions.

The findings from this study provide valuable insights into the distribution of financial resources and intergovernmental contracts initiated by MAPA for the acquisition of machinery and equipment, aimed at benefiting municipalities across Brazil. This information is crucial for guiding strategic decision-making in public policies, fostering equitable and sustainable development within the agricultural sector nationwide.

For future research using the same database, potential areas of exploration include analyzing different time frames, identifying regions with increased demand for agricultural machinery and the associated reasons, examining financial disparities among regions in agricultural machinery acquisition, utilizing the least squares method to understand the evolution of financial transfers and/or the number of intergovernmental contracts over time. Additionally, considering the wealth of textual description information in the database, there is an opportunity for qualitative analysis and employing text mining techniques to extract valuable insights.

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