Demographic transition in Brazil and the municipal participation fund

A transição demográfica no Brasil e o Fundo de Participação dos Municípios

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Abstract

The main criterion for distributing the Municipal Participation Fund is population. This creates problems due to the absence of factors portraying the need for public spending, as the structural changes in the population caused by demographic transition are not taken into account. Population censuses are an important source for understanding demographic trends and the dynamics of resource distribution to municipalities. Thus, the study analyzes, through a quantitative approach, the variation in population and age structure of municipalities, adopting data from the 2000-2022 Censuses, considering the Fund's distribution parameters and their possible implications. The results show that population decline and aging demand new criteria for distributing the fund's resources.

Keywords*: Municipal Participation Fund; demographic transition; population decline; population aging.*

Resumo

O principal critério na distribuição do Fundo de Participação dos Municípios é a população, acarretando problemáticas pela ausência de fatores para retratar a necessidade de gasto público, principalmente por não considerar as mudanças estruturais na população, provocadas pela transição demográfica. Os censos demográficos são uma importante fonte para compreender o retrato e tendências demográficas, bem como as dinâmicas na distribuição de recursos aos municípios. Assim, a pesquisa analisa, em uma abordagem quantitativa, a variação populacional e da estrutura etária dos municípios, adotando os dados dos Censos do período de 2000-2022, considerando os parâmetros de distribuição do Fundo e suas possíveis implicações. Os resultados demonstram que o decrescimento e o envelhecimento populacional demandam novos critérios para distribuição dos recursos do fundo.

Palavras-chave: Fundo de Participação dos Municípios; transição demográfica; diminuição populacional; envelhecimento populacional.

Introduction

The concept of federalism is inherently linked to the notion of a contractual agreement among political units aimed at achieving common objectives. In the context of Brazilian federalism, the post-colonial period of centralization was followed by a process of territorial power fragmentation (Rocha and Faria, 2010). The 1988 Federal Constitution (CF), enacted during a period of redemocratization, emphasized the establishment of intergovernmental relations to facilitate public administration and address societal demands (Abrucio and Franzese, 2007).

With the 1988 Constitution promoting the decentralization of powers and fiscal responsibilities, the autonomy of subnational entities was significantly enhanced. Consequently, the federal government is tasked with standardizing policy guidelines, thereby setting the framework for subnational administrations, while states and municipalities are empowered to implement strategies and innovations to ensure social protection tailored to local needs (Arretche, 1997).

The effective functioning of federal systems is contingent upon intergovernmental transfers. While revenue collection remains centralized, responsibilities have been decentralized, leading to a "vertical fiscal imbalance." These characteristics are common in federations, where central governments concentrate revenue generation, yet subnational governments are assigned responsibilities that exceed their established taxing capacity (Prado, 2006).

The Municipal Participation Fund (FPM) is notable as Brazil's largest intergovernmental transfer, holding significant economic importance for municipalities (Mendes, Miranda, and Cossio, 2008). However, given that population size is the primary criterion for FPM distribution, several scholars advocate for incorporating sociodemographic indicators into its composition to better align it with social realities (Tomio, 2005; Mendes, Miranda, and Cossio, 2008; Monasterio, 2013; Rocha, 2013; Boueri et al., 2013; Hudzinski, Witt, and Senff, 2019; Ribeiro, 2023). Despite these discussions, there remains an insufficient focus on the changes and challenges posed by the demographic transition.

The regulation of the FPM in 1966, through the National Tax Code, established population size per municipality, categorized into population ranges, as the criterion for distributing the fund's resources, with corresponding participation coefficients. Although subsequent legislation has integrated additional distribution criteria over time, population size unequivocally remains a decisive factor in the amount each municipality receives from the FPM. This factor is particularly significant for smaller municipalities, where population size continues to be the sole determinant.

It is thus evident that, from the legislator's perspective, a more equitable distribution of resources necessitates consideration of each municipality's population size. This viewpoint is likely predicated on the assumption that a larger population correlates with greater demand for public services and infrastructure, thereby rendering population size an indicator of public spending requirements.

However, current discussions surrounding FPM distribution predominantly revolve around the decline in revenue from this type of transfer, a concern amplified by its critical role in municipal management and its substantial share of municipal budgets. This issue is primarily attributed to the decreasing population in Brazilian municipalities.

In light of this, the 2022 Demographic Census has proven to be an invaluable source of information for studies on Brazil's demographic profile and trends, facilitating an understanding of the dynamics and challenges in resource distribution to Brazilian municipalities.

Therefore, this article aims to analyze the variation in population size and age structure of Brazilian municipalities since 2000,[1] in accordance with the distribution parameters of the Municipal Participation Fund and their potential implications.

To achieve this, a quantitative approach was adopted, focusing on statistical aspects and techniques, and classifying the information for analysis. This involved conducting an analysis of population data from the 2000, 2010, and 2022 Demographic Censuses, collected by the Brazilian Institute of Geography and Statistics (IBGE).

The brazilian demographic transition and implications

The concept of demographic transition, initially explored by Thompson (1929), posits a correlation between socioeconomic development and population growth. Specifically, it suggests that more developed spatial areas exhibit lower mortality and fertility rates. Supporting this, Notestein (1945) discussed how urbanization and industrialization processes altered fertility and mortality patterns, consequently modifying overall population dynamics.

Studies on the demographic transition examine the historical process wherein a young population characterized by high fertility and mortality rates evolves into an aging population with low fertility and mortality rates (Foz, 2021). The demographic transition has fundamentally reshaped the global population, initially leading to population growth and an increase in the average age. In more advanced stages, a significant rise in life expectancy is anticipated, culminating in the "inevitable final stage" of the transition: population aging (Lee, 2003).

This process unfolds in four distinct phases: in the first, both rates remain stable at high levels, leading to population growth stagnation; in the second, the population experiences rapid growth as the mortality rate declines while the fertility rate remains elevated; in the third, both mortality and fertility rates continue to decrease, slowing the pace of growth; and in the fourth, fertility and mortality rates stabilize at low levels, resulting once again in slow population growth (Alves, 2002).

While the stages of this process are widely accepted among scholars, the underlying causal factors, pace, and specific manifestations are debated by various authors, who offer economic (Coale, 1979; Lee, 2003) and social (Davis, 1963; Caldwell, 1976) perspectives.

Initially, the demographic transition was understood to conclude when a population reached a stationary state, i.e., when fertility was at replacement level and population growth was zero, thereby achieving equilibrium between birth and death rates. However, from the 1960s onward, this perspective began to be re-evaluated for developed populations, as changes in marriage and fertility behaviors emerged (Lesthaeghe, 2014). Ultimately, what is observed is a stabilization in the age structure, even leading to population decline (Alves, 2002).

In essence, fertility continues its sharp decline, leading to an imbalance between births and deaths, falling below the population replacement level. According to Lesthaeghe (2014), new social and cultural factors, not anticipated in the "first demographic transition,"

have been identified and must be incorporated, necessitating the designation of this process as the "second demographic transition." Furthermore, migration emerges as a crucial factor in understanding population dynamics, particularly as a mechanism to mitigate population aging in more developed nations.

In this context, although the concept of a second demographic transition lacks universal consensus, recent studies integrate an additional phase into the demographic transition process. This incorporates the perspective of regions where fertility rates fall below replacement levels, leading to a tendency towards population decline, into the research agenda (Foz, 2021). An analysis of fertility patterns in several countries, including Portugal, Japan, South Korea, China, and Cuba, reveals a consistent trend of continued decline. Consequently, given the prevailing situation, Brazil is considered to be in the fifth phase of the demographic transition, alongside 34% of other nations (Foz, 2021).

In Brazil, the second stage of the demographic transition initiates in 1950 with a reduction in the mortality rate. Similar to developed countries during this period, the fertility rate remained high, resulting in an annual growth rate of 3.1%, the highest in the nation's history. By 1991, Brazil began to experience a deceleration in population growth due to declining fertility and mortality rates (Vasconcelos and Gomes, 2012).

However, even with the decline in fertility, the number of births remains higher compared to the preceding period. This phenomenon is attributed to the larger number of women in the reproductive age group within the subsequent cohort compared to the previous one, a period termed demographic inertia. It was not until 2010 that the total fertility rate fell below the replacement level, initiating a process of population aging (Vasconcelos and Gomes, 2012). Data from the 2022 Population Census reveal an intensifying population aging process, with Brazil's annual population growth rate reaching its lowest point in the historical series, at 0.52%.

It is evident that the population changes generated by the transition process directly impact intergenerational relationships; notably, the age composition of the population remained virtually stable until the 1970s. Following this period, the Brazilian population exhibited variations in its structure, with the most affected age groups being those under 15, who experienced a loss of representation in the total population, and those over 65, whose proportion continues to increase. These shifts carry significant implications for policies and services targeting different age groups (Carvalho and Wong, 2008; Wong, Carvalho and Perpétuo, 2009; Carvalho and Wong, 2010).

Furthermore, it is crucial to acknowledge the regional disparities in Brazil's demographic transition. The Southeast, South, and Central-West regions have historically driven national indicators, exhibiting signs of demographic change since 1970. Conversely, the North and Northeast regions have experienced a delayed transition, maintaining elevated infant mortality and total fertility rates. As a consequence of this delayed process, these regions still presented higher indicators and younger age structures in 2010 compared to other regions (Brito, 2007; Simões, 2016; Vasconcelos and Gomes, 2012).

Despite the regional discrepancies in the pace of demographic transition, the national reality indicates a decrease in the number of young people and an increase in the elderly population. This scenario demonstrates that Brazil is undergoing an accelerated aging process, which is transforming economic

dynamics, as well as the promotion of social policies and the well-being of the population (Vasconcelos and Gomes, 2012).

For instance, it is estimated that Brazil's aging process will occur three times faster than in Europe (Giacomelli et al., 2016). This renders it an even more sensitive process, particularly given the fragile economies of nations and the escalating inequalities within their territories, thereby necessitating an expansion of public services and resources (Lebrão, 2007).

In this context, Brazil's rapid population aging poses substantial challenges for public policy, as expenditures are projected to outpace revenues due to the needs of the increasingly older population (Wong and Carvalho, 2006). While the population's dependency ratio tends to decrease with a reduction in the number of children, it simultaneously tends to increase with population aging.

One strategy to mitigate intergenerational disparities involves intergenerational transfers, wherein the working-age population transfers income to the dependent population, thereby generating state revenue. During the second and third stages of the demographic transition, revenue increased because the working-age population was proportionally larger than the dependent population (Lee, 2003; Saad, 2004). In other words, as the demographic transition progresses, the population experiences an aging process and a consequent reduction in the representation of working-age individuals in the total population, leading to a projected decline in national revenue.

Examining this scenario from the perspective of economic dependence, which posits that children (0-14 years old) and the elderly (65 years old and older) are financially reliant on the working-age population (15-64 years old), it becomes clear that a society's age composition can influence its economic performance. Thus, populations characterized by a large number of children or elderly individuals tend to consume more than they produce, as these age groups typically do not actively participate in the workforce (Brito, 2007). Consequently, the working-age population faces increased pressure to augment the production of goods and services to meet the needs of dependents (Jesus, Wajnman, and Turra, 2020).

Initially, to address these demands, the economically active population transfers resources to the dependent population through intergenerational transfers (Santos, Turra and Noronha, 2019). However, with the increase in the elderly population and the conclusion of the demographic bonus, the period when the working-age population exceeds the dependent population, these transfers may prove insufficient (Correa, 2023).

This is primarily because aging is associated with a greater demand for health services and an increased burden on the social security system (Veras and Oliveira, 2018). Pressure on the health system is driven by the higher prevalence of chronic diseases and the occurrence of physical limitations, such as reduced muscle strength and mobility, which compromise the functional capacities of older adults (OPS and IDB, 2023).

In this context, the Constitution stipulates that the Unified Health System (SUS), through the federal pact, shall be implemented with joint responsibility among the three federative entities. Thus, municipalities are tasked with guaranteeing primary health care services and providing services in their localities, with technical and financial cooperation from the Union and the State.

It is noteworthy that the SUS is financed by federal transfers, with a modest contribution from the state and an increasing contribution from municipalities, particularly when analyzing the reality of Rio Grande do Norte. However, resources for equipment maintenance are scarce, and municipal entities possess limited autonomy (Leite, Lima, and Vasconcelos, 2012).

Another significant aspect concerning the conclusion of the demographic bonus is the imperative to ensure the sustainability of social security systems (Correa, 2023). Regarding the country's pension systems, municipalities encounter difficulties with their own systems, specifically the federative entity's particular pension scheme. According to Montalvão (2024), the primary cause of imbalance in these specific systems is linked to the implementation of federal programs without adequate resource allocation. In this scenario, municipalities function merely as executors of national policies, which often do not even guarantee the necessary resources for their implementation.

Thus, equity in resource distribution is a fundamental aspect for ensuring the state capacity of Brazilian municipalities. According to Souza and Moraes (2019), capacities bolster the welfare state, which is designed to meet the population's needs and enhance opportunities for societal improvement by defining intervention strategies consistent with their target audience.

Modeling the Municipal Participation Fund

The FPM can be categorized as an unconditional redistributive transfer. It is unconditional because it is not earmarked for specific purposes, and redistributive because it is granted to beneficiaries irrespective of the location where the revenue was collected (Mendes, Miranda, and Cossio, 2008). This type of transfer is distributed based on demographic and socioeconomic data, in accordance with specific legislation, similar to the distribution method of the State Participation Fund (FPE). These funds aim to address both vertical and horizontal fiscal imbalances (Baião, Cunha, and Souza, 2017). Therefore, the FPM seeks to ensure a more balanced redistribution of resources among the country's various regions, solidifying its role as a crucial revenue source for municipalities (Schommer and Silva, 2015).

This assertion is substantiated by the fact that an analysis of data from 5,541 Brazilian municipalities between 2006 and 2016 revealed a positive impact of the FPM on socioeconomic development, demonstrating its capacity to reduce disparities among Brazilian municipalities (Rodrigues et al., 2020). When examining the municipalities of Santa Catarina, Hudzinski, Witt, and Senff (2019) found that the contribution of these resources is essential for the survival of municipalities. However, it was also highlighted that municipalities most dependent on the fund tend to exhibit a poorer quality of public spending.

Mendes, Miranda, and Cossio (2008) contend that nationally collected resources distributed to subnational entities in Brazil possess limited capacity to reduce the fiscal gap. Regarding the FPM, criticisms have centered on the inadequacy of distributed amounts to meet municipal demands for investment and public services (Schommer and Silva, 2015). Another critique is that the Fund contributes minimally to the fiscal equalization of municipalities (Baião, Cunha, and Souza, 2017).

The problem is compounded by the fact that numerous municipalities were established without sufficient fiscal resources to provide essential public services, resulting in inadequate funding to meet social demands (Hudzinski, Witt, and Senff, 2019). In this context, it is crucial to highlight the role of the territorial power fragmentation process that occurred in Brazil. This process was particularly pronounced in the country following the 1988 Constitution, which facilitated the intense emancipation of municipalities (Tomio, 2005).

The minimum value allocated to municipalities in the initial population bracket rendered emancipation advantageous for this group, as the division into two entities would effectively double the locality's revenue, irrespective of its small population (Monasterio, 2013). This understanding is corroborated by the argument that the smaller a municipality's population, the greater the per capita gain in resources (Brandt, 2010).

Furthermore, it is argued that the proliferation of municipalities generates more expenditures for maintaining the public administration than for the actual implementation of public policies (Gomes and Macdowell, 2000). Consequently, emancipation exacerbated distortions in the FPM distribution criteria (Brandt, 2010), in addition to not directly stimulating local economic development (Boueri et al., 2013).

From an alternative perspective, the creation of municipalities is understood to be linked to Brazil's economic development and demographic dynamism (Siqueira, 2003; Baltar and Baltar, 2014). Thus, an analysis of the historical series from 1900 onward suggests that the intense process of municipal creation between 1950 and 1970 was a result of urbanization, rural exodus, and the expansion of agricultural frontiers (Baltar and Baltar, 2014). It is worth noting that this period coincides with the formulation of the FPM, planned in 1965 and initially distributed in 1967.

However, in the case of emancipations in the state of São Paulo, an additional dimension emerges: the political-institutional one. Until the end of the military regime, the creation of municipalities was primarily driven by economic and demographic factors (Siqueira, 2003). In the post-1988 Constitution, in 1989 alone, there were 222 emancipations, led by the states of Rio Grande do Sul, Goiás, Ceará, Pará, Mato Grosso, and Espírito Santo (Rocha, 2013). During the 1990s, the political-institutional dimension became the principal impetus for the creation of municipalities, particularly in areas where development had lagged, possibly due to the "new constitutional context" (Siqueira, 2003).

In the sixty years since the FPM's inclusion in Brazilian regulations, its configuration has undergone numerous modifications, aimed at altering the volume of resources it comprises, the administrative procedures for its management, and the factors shaping its distribution to municipalities. The constitutional provision for adjusting population ranges is noteworthy, rendering the criteria less static. However, it is clear that this criterion solely addresses population size and is tied to new limits proportional to an increase, with an expectation of positive variation (Queiroz, 2024).

However, a new dimension was incorporated throughout the process: the reduction of coefficients due to the decrease in municipal populations. Beginning in 1999, financial reductions were implemented to redistribute FPM resources through a gradual transition of bands (Queiroz, 2024). Consequently,

approximately 31.6% of the 5,507 municipalities nationwide were impacted by these reductions. Notably, the Northeast region was most affected by this measure, with 40.6% of its municipalities impacted, followed by the South (31.7%), Central-West (31.6%), North (30.7%), and Southeast (22.1%) (Bremaeker, 2001).

It is argued that the reductions rectified the disparities caused by the criteria utilized for the 1991 Demographic Census population. Municipalities had their coefficients frozen due to population reduction resulting from exodus and emancipations. Thus, the law promoted correct classification by freezing the population and applying annual reductions to mitigate the financial impact (Santos, 2005). However, an alternative interpretation of the process is plausible, as prior legislation did not enact substantial changes in distribution criteria, and the consequences of this inertia were evident in the census results.

In other words, conducting the demographic census is pivotal for the distribution of FPM resources, given the overarching demographic landscape of Brazil, specifically the number of inhabitants per municipality. Thus, the "statistical blackouts" resulting from the failure to conduct a population count or the postponement of the 2020 Population Census had significant implications for FPM distribution.

Complementary Law n. 165/2019 stipulated that, from January 2019 until the new census update, the 2018 coefficients should be maintained for municipalities that experienced a reduction in their coefficients due to the annual estimates of the Brazilian Institute of Geography and Statistics (IBGE). This regulation was introduced on the grounds that the absence of the intermediate count scheduled for 2015, which was canceled due to budgetary constraints, would create a greater-than-usual discrepancy in population figures and, consequently, financial losses for municipalities.

In June 2023, following the enactment of Complementary Law n. 198/2023, a gradual ten-year transition period was established for municipalities whose FPM distribution coefficients were reduced. The rationale for this proposal is based on the "imminent fiscal risk" faced by municipalities due to coefficient reductions stemming from the official results of the 2022 Population Census. Similarly, "sudden declines" would be averted, ensuring legal certainty in the budget laws approved by municipalities and allowing sufficient time for new financial planning without jeopardizing the provision of public services.

Regarding the current distribution criteria, substantial differences exist. Presently, 10% of the fund's total is reserved for state capitals, while 90% is allocated among the country's other municipalities. Furthermore, 3.6% of this total is specifically reserved for municipalities with a population exceeding 142,633, excluding state capitals (Queiroz, 2024).

Distribution criteria vary according to the type of municipality. For distributing resources among capital cities and from the reserve to the most populous municipalities, state per capita income factors are applied, while population size is applied to all types. Therefore, it is clear that per capita income influences the distribution of resources to capital cities and the 3.6% allocated to municipalities with populations above 142,633, while population is a factor that affects all typologies, although they have specific tables. It is noteworthy, therefore, that municipalities with populations under 142,633 are only affected by the population size factor (Queiroz, 2024).

This is equivalent to stating that 90% of the resources are distributed according to the population range table that defines the coefficients used to calculate FPM transfers. These coefficients vary according to the population size. For municipalities with up to 16,980 inhabitants, the initial coefficient is 0.6 for the first 10,188 inhabitants, increased by 0.2 for every 3,396 inhabitants or excess fraction. In the range from 16,980 to 50,940 inhabitants, the coefficient starts at 1.0 for the first 16,980 inhabitants, adding 0.2 for every 6,792 inhabitants or excess fraction. For municipalities with populations between 50,940 and 101,880 inhabitants, the base coefficient is 2.0 for the first 50,940 inhabitants, increased by 0.2 for every 10,188 inhabitants or excess fraction. In the next range, from 101,880 to 156,216 inhabitants, the initial coefficient is 3.0 for the first 101,880 inhabitants, increased by 0.2 for every 13,584 inhabitants or excess fraction. Finally, municipalities with a population above 156,216 inhabitants receive a fixed coefficient of 4.0.

According to Santos (2005), the 3.6% FPM reserve for the most populous municipalities was designed to address the barrier imposed by the maximum quota allocated within the population band system. This barrier impedes the fulfillment of demands in municipalities that have undergone metropolitanization and possess larger populations.

Given this context, and acknowledging that FPM resources are critical for the sustenance of small municipalities, concerted efforts are required to explore alternative approaches for reformulating the distribution of these resources, taking into account the demographic shifts that have occurred over time. Consequently, public administration must act promptly to ensure access to quality services that meet the needs of an aging population.

In light of Brazil's aging population and decelerating growth, and with the objective of fostering critical thinking regarding FPM distribution, the variation in the population size of Brazilian municipalities from 2000 to 2022 was analyzed.

Demographic changes and the FPM

In Brazil, the rate of population growth has experienced a substantial decrease since 1950. Between 1950 and 1960, the annual geometric growth rate was 2.99%. The results of the 2022 Population Census underscore this issue, as Brazil's annual population growth rate reached its lowest historical level at 0.52% (IBGE, 2023). This situation is projected to worsen, as, according to the Foz Group (2021), IBGE projections indicate a decline in the country's population by approximately 2040.

From this perspective, this analysis aims to elucidate how this growth slowdown has manifested at the municipal level, given the diverse realities across thousands of Brazilian municipalities. Thus, while population decline is not yet a national reality, it presents distinct stages at the municipal level.

Of the 5,570 municipalities enumerated in the 2022 Census, 58 lacked population information in 2000, while five were missing this data in 2010. Due to the impossibility of monitoring population variation for these municipalities, they were excluded from the present study, resulting in a universe of 5,507 municipalities.

For analytical purposes, municipalities exhibiting a population increase during an intercensal period were designated as "winning"

municipalities, whereas those experiencing a population reduction were termed "losing" municipalities.

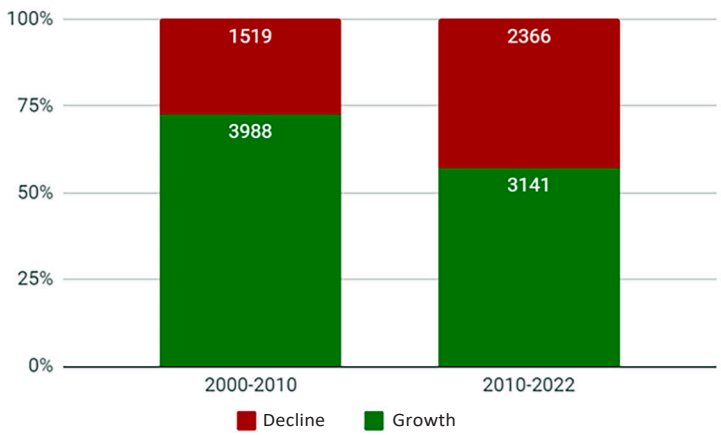
Change in population size

Exploratory analysis reveals an increase in the number of municipalities experiencing population decline compared to the preceding intercensal period. Between 2000 and 2010, 3,988 municipalities recorded population growth, while 1,519 lost inhabitants (27.5% of the total). Between 2010 and 2022, the number of municipalities experiencing population decline totaled 2,366, corresponding to 42.9% of the total (Graph 1).

From a regional perspective, it is important to note that the process of population decline did not occur uniformly, as illustrated in Table 1. For example, when analyzing the proportion of losing municipalities relative to the total number of municipalities in each region, the South region exhibited the highest percentage of losing municipalities (45.8%) in the first intercensal period, followed by the Central-West region (29.6%), Southeast (23.2%), Northeast (21.8%), and North (17.6%).

However, in the subsequent intercensal period, a significant shift in proportions was observed across all regions. Notably, all regions recorded proportions of losing municipalities exceeding 36%, as detailed below: Northeast (49.0%); South (44.1%); North (39.0%); Southeast (38.5%); and Central-West (36.3%).

Graph 1 – Number of municipalities according to the type of population variation. Brazil, 2000-2022



Source: prepared by the author, based on the Population Censuses (2000, 2010 and 2022), in 2024.

Table 1 – Percentage of municipalities "losing population" in relation to the total number of municipalities in the region, by intercensal period

Region	2000-2010 (%)	2010-2022 (%)	Variation (p.p.)
Central-West	29,6	36,3	6,7
Northeast	21,8	49,0	27,2
North	17,6	39,0	21,4
Southeast	23,2	38,5	15,3
South	45,8	44,1	-1,7

Source: prepared by the author, based on the Population Censuses (2000, 2010 and 2022), in 2024.

It is noteworthy that the South was the only region to show a reduction in the proportion of losing municipalities, although its proportions remain high.

Although the South region had the highest proportion in the country between 2000 and 2010 (45.8%), there was a reduction in the subsequent intercensal period (44.1%), while the Northeast region took the lead, increasing from 21.8% to 49.0%. This process aligns with the understanding that the transition unfolds differently depending on the location, with developing regions experiencing a faster transition process (Brito, 2007; Simões, 2016; Vasconcelos and Gomes, 2012; Giacomelli et al. 2016).

Table 2, by narrowing the analysis to the state level, reveals that only the states of Paraná, Roraima, and Santa Catarina experienced a decrease in the percentage of losing municipalities. The most significant increases in the percentage of losing municipalities occurred in the Northeast region, specifically in the states of Alagoas, Maranhão, Pernambuco, and Sergipe.

Regarding the size of municipalities, in accordance with the FPM distribution criteria, the 18 population bands and the separate consideration of capitals were included, given that capitals are governed by a distinct distribution criterion. As demonstrated in Chart 1, 77.4%, 74.9%, and 73.2% of municipalities were concentrated in the first four bands in 2000, 2010, and 2022, respectively.

Table 2 – Percentage of losing municipalities in relation to the total number of municipalities in the state, by intercensal period

State	2000-2010 (%)	2010-2022 (%)	Variation (p.p.)
AC	0,00	4,55	4,55
AL	30,69	63,37	32,67
AM	14,52	22,58	8,06
AP	0,00	25,00	25,00
BA	35,18	55,18	20,00
CE	11,41	38,59	27,17
DF	0,00	0,00	0,00
ES	23,38	31,17	7,79
GO	32,23	37,60	5,37
MA	9,22	52,53	43,32
MG	30,36	46,19	15,83
MS	16,88	29,87	12,99
MT	32,54	38,10	5,56
PA	9,09	31,47	22,38
PB	25,11	45,29	20,18
PE	13,51	49,19	35,68
PI	21,27	45,25	23,98
PR	44,61	43,11	-1,50
RJ	7,69	29,67	21,98
RN	23,49	45,78	22,29
RO	48,08	75,00	26,92
RR	6,67	0,00	-6,67
RS	54,39	57,60	3,21
SC	33,79	23,89	-9,90
SE	6,67	40,00	33,33
SP	15,97	30,54	14,57
TO	22,30	51,80	29,50

Source: prepared by the author, based on the Population Censuses (2000, 2010 and 2022), in 2024.

Chart 1 – Number of municipalities in relation to population range

Range	2000	2010	2022
CAPITAL	27	27	27
I	2672	2474	2460
II	603	628	597
III	427	427	422
IV	559	595	552
V	340	327	357
VI	193	230	234
VII	121	139	142
VIII	74	87	99
IX	88	110	107
X	81	75	72
XI	62	65	70
XII	36	43	39
XIII	28	36	43
XIV	32	44	45
XV	19	26	34
XVI	18	18	26
XVII	11	16	16
XVIII	116	140	165

Source: prepared by the author, based on the Population Censuses (2000, 2010 and 2022), in 2024.

Regarding the FPM distribution bands, it is observed that the capitals presented the greatest variation between the intercensal periods, so that 9 of the 27 capitals are losing municipalities between 2010-2022, as shown in Table 3. Although the capitals do not have the FPM distribution criterion by population bands, it is worth noting that the reduction in population can lead to a reduction in their distribution coefficients, since one of the rules considers the population weight of the capital in relation to the others.

The prominence of capital cities in terms of population loss may be related to the process of change in the types of travel discussed by Cunha (1994), especially in metropolitan areas with greater intermunicipal mobility. Thus, mobility became more intense when urban areas increasingly expanded and individuals began to reside in municipalities other than those in which they work (Ojima, Monteiro and Nascimento, 2015).

Mobility can be understood as a stage in migration, which does not necessarily occur through migration (Zelinsky, 1971). Since 2000, Brazil has experienced a reconfiguration of population flow, with migrants heading to nearby municipalities or the metropolis, rather than long distances or other hubs (Silva, Queiroz and Ojima, 2021).

Specifically regarding population bands, it can be observed that, between 2010 and 2022, the largest proportions of losing municipalities were concentrated in bands I, II, and III, compared to the initial population of that period. Therefore, the situation may be more delicate

Table 3 – Percentage of losing municipalities in relation to the total number of municipalities in the population range, by intercensal period

Range	2000-2010 (%)	2010-2022 (%)	Variation (p.p.)
CAPITAL	0,00	33,33	33,33
I	36,83	51,29	14,47
II	29,52	46,02	16,50
III	23,19	45,90	22,72
IV	20,57	39,50	18,92
V	19,71	38,53	18,83
VI	13,99	33,04	19,05
VII	15,70	36,69	20,99
VIII	4,05	22,99	18,93
IX	7,95	26,36	18,41
X	9,88	22,67	12,79
XI	1,61	12,31	10,69
XII	11,11	9,30	-1,81
XIII	0,00	11,11	11,11
XIV	3,13	9,09	5,97
XV	10,53	19,23	8,70
XVI	0,00	0,00	0,00
XVII	0,00	0,00	0,00
XVIII	3,45	17,14	13,69

Source: prepared by the author, based on the Population Censuses (2000, 2010 and 2022), in 2024.

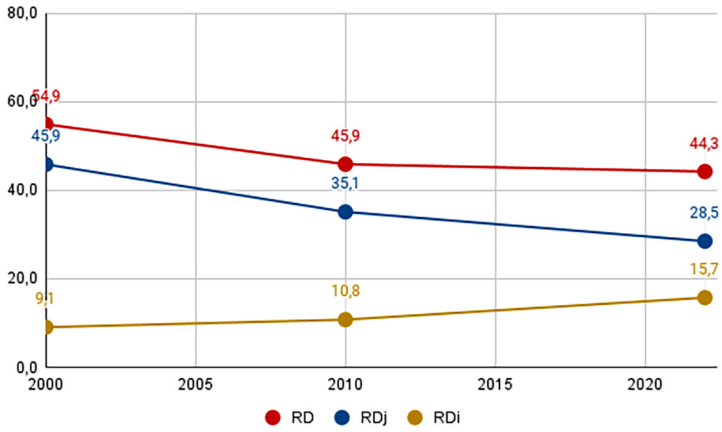
for municipalities in bands II and III, if the population reduction leads to a shift to a lower band. This is especially true for municipalities in band III, given that they experienced the second-largest variation between intercensal periods, expanding 22.7 percentage points.

From another perspective, the scenario of municipal population reduction is aggravated for 1,021 Brazilian municipalities, given that they presented a reduction in population number in both census periods analyzed. It can be seen that the majority of these municipalities are located in the South region (363), followed by the Northeast (268), Southeast (262), Central-West (78) and North (50).

The variation in age structure

Considering another aspect of the demographic transition, population aging, it is necessary to analyze another indicator that clearly reflects the scenario and the changes occurring in the population's age structure. Graph 2 depicts how the demographic transition is altering the country's population patterns, demonstrating that the Dependency Ratio (RD) was decreasing due to a decline in the Young Dependency Ratio (RDj). At the end of this process, the RD typically shows an increase, particularly due to an increase in the Elderly Dependency Ratio (RDi), given that the proportion of

Graph 2 – Total Dependency Ratio, Young and Elderly, Brazil, 2000 to 2022



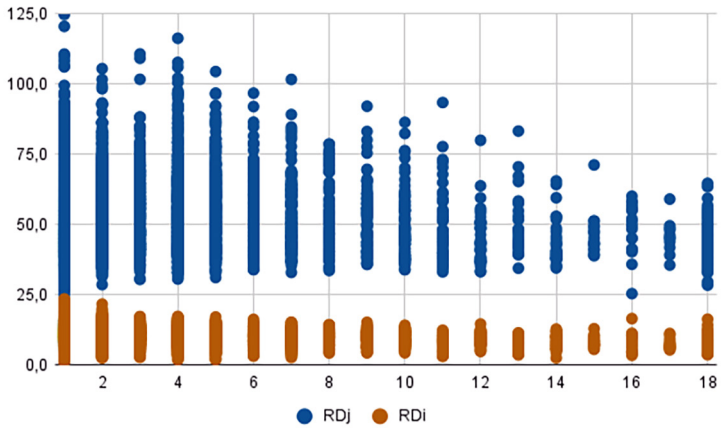
Source: prepared by the author, based on the Population Censuses (2000, 2010 and 2022), in 2024.

elderly individuals relative to the working-age population is expanding due to the falling mortality rate and increased life expectancy.

Graph 2 demonstrates the decline in RD, both total and among young people, and the increase in RDi, which confirms the idea that the demographic transition results in a change in the age structure of the population, transforming the population that was initially made up of young people into a population with signs of aging (Wong and Carvalho, 2006).

When analyzing the age structure of Brazilian municipalities, different realities are observed, mainly in relation to the population size of the municipality, as shown in Graph 3. The population group that presented the highest average RDj was group 5, with an average of 55.8 young people for every 100 people of working age. Meanwhile, group 1 presented the highest average in relation to RDi (with 11.2), followed by group 2 (10.6) and group 3 (10.4), so that it is remarkable that the only bands with municipalities with RDi above 20 are band 1 and band 2.

Graph 3 – Dependency Ratio of Young and Elderly People in Municipalities, by Population Range, 2000

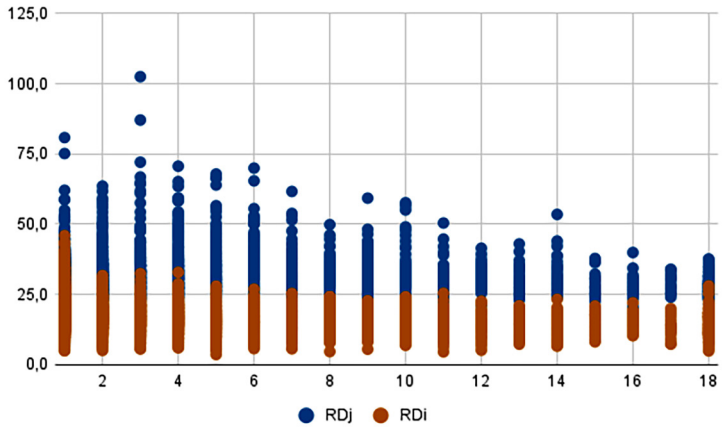


Source: prepared by the author, based on the 2000 Population Census, in 2024.

The scenario observed in 2022 demonstrates a significant change in the age structure of Brazilian municipalities, given the difference in the dependency ratios of young and old people, as shown in Graph 4. It can be seen, then, that most municipalities presented an RDj below 75, while several municipalities increased the RDi above 25, demonstrating a growing population aging.

In relation to population ranges, the average RDj of municipalities is higher in range 6 (with 32.3) and in range 5 (32.2), although the large reduction of this indicator in relation to the 2000 Census is noteworthy. The average RDi continued to be higher in municipalities belonging to the smallest population ranges, being range 1 (20.5), range 2 (17.6) and range 3 (17.2).

Graph 4 – Youth and Elderly Dependency Ratio of municipalities, according to population range, 2022

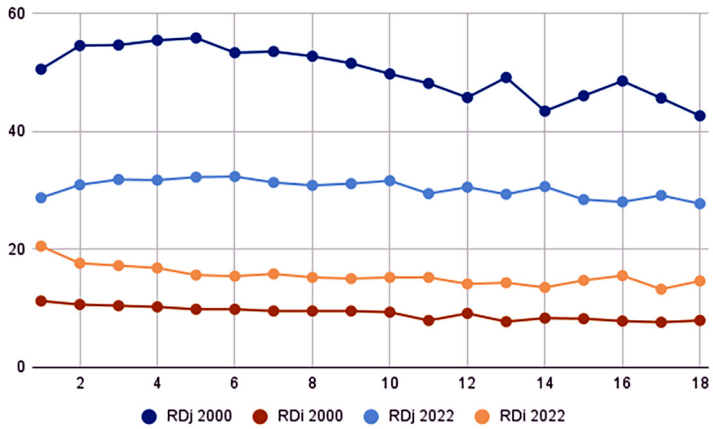


Source: prepared by the author, based on the 2022 Population Census, in 2024.

When comparing the average dependency ratios by band in both periods highlighted, as shown in Graph 5, we observe a large variation in the level and few changes in relation to the standard. The RDi presented similar patterns in both years, although the level increased from one period to the next, especially in band I, which showed the greatest increase.

The RDj in 2000 shows high levels compared to the rates in 2022, a period when there was a substantial decrease in all FPM population groups. It is worth noting that, in 2000, the first group had lower indicators compared to groups II, III, IV, V, and VI, while the following groups showed reductions, with the exception of groups XIII and XVI, which showed peaks. In 2022, the RDj remained at closer levels, with no major variations between the groups.

Graph 5 – Level and pattern of the average Youth and Elderly Dependency Ratio of municipalities, according to population range, 2000 and 2022



Source: prepared by the author, based on the 2000 and 2022 Population Census, in 2024.

Based on the analyses undertaken in this section, it is clear that the country's slowing growth rate and population aging are exacerbated by the distinct circumstances of each municipality, while population losses can lead to reduced revenue and increased demand for public services. This problem becomes more evident due to the increasing number of losing municipalities in municipalities with greater dependence on the FPM, whether due to their region or population size.

From all of the above, it is clear that the demographic transition presents significant changes in the population's age structure, and the slowdown in growth demonstrates signs of significant changes in population size. The second intercensal period analyzed showed an increase in the number of losing municipalities compared to the previous period, while, consequently, the number of gaining municipalities was lower.

Therefore, when analyzing the population variation from 2000 to 2022 on a municipal scale, it was observed that the process of population reduction per municipality indicates a probable destination, in accordance with the theory of the second demographic transition, in relation to population decline and population aging.

Conclusion

The functioning of the Brazilian federal system is linked to agreements between federated entities and the formation of intergovernmental relations. In this context, intergovernmental transfers occur due to the centralized collection of resources by the central government and the decentralized execution of these resources. These transfers enable the provision of public services by subnational entities, most of which are highly financially dependent, especially municipalities (Prado, 2006; Abrucio and Franzese, 2007; Rocha and Faria, 2010).

Despite the progress of the demographic transition, it was not included on the research and government agenda within the FPM. Thus, given the effects of the slowdown in population growth, perceived from the decline in the population of municipalities, palliative measures were adopted that did not stem from a broad understanding of the ongoing transition process (Queiroz, 2024).

An analysis of the population size variation of Brazilian municipalities through 2022 showed that the number of municipalities experiencing population decline is on the rise, driven by the slowing growth rate caused by the demographic transition. Thus, there was a concentration of municipalities that lost population in FPM distribution bands I, II, and III. Thus, the situation may be more difficult for municipalities in bands II and III, as they directly lose revenue if they change bands.

Regarding the changing age structure, the dependency ratio shows an upward trend in the country, mainly due to population aging. By 2022, municipalities in age groups V and VI had a higher youth dependency ratio, while age groups I, II, and III had a higher elderly dependency ratio. Furthermore, there is an aggravating factor: there is no demographic bonus ahead.

Municipalities where population is the sole criterion for allocating FPM resources are expected to be most affected, meaning that band transition regulations, such as the application of speed bumps, will become increasingly common. The demand for these resources is evidenced by the high dependence of these municipalities, which reinforces the need for resources to fund government actions, to the detriment of investments.

The government must initiate a restructuring of its administration, aiming to at least minimize the effects of the demographic transition in a developing nation. Initiatives such as the Statute and the Elderly Fund are essential for a national strategy for this target population, but they need to be strengthened so that municipalities can meet all the demands required to address this structural population change.

Analyzing this issue in the current scenario, we identify the persistence of social disparities, even with an economically active population. Therefore, when estimating a future scenario, it is suggested that the increase in the dependent population will significantly exacerbate social problems. Thus, at the discretion of the municipal manager, he or she is best placed to direct resources toward addressing the most pressing issues in his or her area.

Across the board, municipalities in band I are particularly affected by the demographic transition, as they stand out in terms of population decline and aging. It is worth noting that this band includes micromunicipalities created due to the financial instability of the

first band in an emancipatory process with few technical criteria, as pointed out by Tomio (2005) and Boueri et al. (2013).

Given the above, the need to review the FPM financing model is evident. In particular, municipalities in Tier I, which account for 44% of the national total according to the 2022 Population Census, require further investigation, given their numerical significance and other peculiarities.

The use of sociodemographic indicators that represent the population's age structure is a viable solution for incorporating the structural changes brought about by the demographic transition. The Dependency Ratio, for example, encompasses the resource needs of public authorities to maintain public policies necessary for a more economically dependent population.

Therefore, this study guides the discussion around changing the FPM distribution criteria in line with the concept of demographic transition. Thus, the contributions presented can be used as a basis for formulating new criteria and new representation factors capable of reflecting the demands of the new Brazilian population.

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Note

(1) The ongoing process of municipal emancipation in Brazil precludes a comprehensive tracking of the trajectory of all federative units. Consequently, facing the challenge of monitoring 5,570 municipalities, this study excludes 63 entities created subsequent to the year 2000. The resulting database therefore comprises 5,507 municipalities. From a demographic standpoint, this exclusion represents a minimal loss, corresponding to just 0.28% of Brazil's total population enumerated in 2022.

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João Victor Rocha de Queiroz: project administration; formal analysis; conceptualization; data curation; in-vestigation; methodology; writing–original draft; writing–review & editing; validation; visualization.
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Declaration of conflict of interest

The authors declare that there is no conflict of interest.

Data Availability Statement

All the supporting data for the results of this study is available in "Séries Históricas dos Censos Demográficos" and can be accessed at [https://www.ibge.gov.br/estatisticas/sociais/populacao/22827-censo-demografico-2022.html?=&t=resultados].

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