Title: The Persistence of Regional Inequality in Brazil: An Interregional Input–Output Approach

Authors: Lúcio Barbosa[1], André Carrascal-Incera, Geoffrey Hewings, Carla Souza[1]

Abstract: Regional inequality is a long-standing feature of the Brazilian economy. The Southeast region, particularly the state of São Paulo, concentrates a large share of national GDP. Minas Gerais, also located in the Southeast, is the country's third-largest economy and acts as a bridge between the wealthier South and the poorer Northeast. Within Brazil, Minas Gerais stands out as one of the states with the highest levels of internal spatial inequality. Persistent interregional disparities arise from the spatial concentration of economic activity and the organization of production in a globalized economy. Using an interregional input–output model, this paper explores the structural roots of regional inequality in Brazil, with a particular focus on Minas Gerais, and provides insights into the sources and persistence of inequality both within and between Brazilian states.

Keywords: regional inequality; Brazil; Minas Gerais.

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1 Introduction

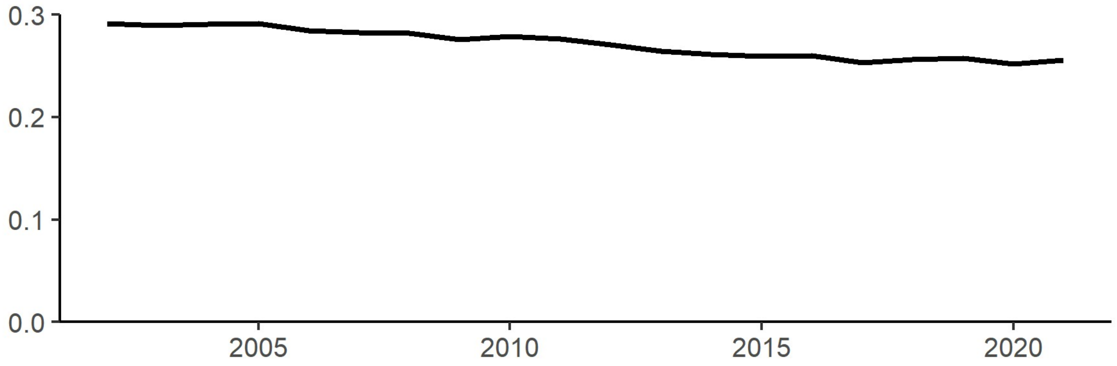
In the last decade, territorial imbalances have attracted growing attention from the research community. The rise of anti-democratic leaders in several countries, along with increasing secessionist movements and territorial tensions, appears to be partly rooted in persistent spatial income disparities. "Left-behind" places are considered to have played a decisive role in both the Brexit vote and the first election of Donald Trump (Rodriguez-Pose, 2018).

Blanchard and Rodrik (2021) attribute the increase in income inequality to the combined effects of globalization, technological change, and institutional transformations, which have strengthened centripetal forces favoring urban and more prosperous regions. Complementing this perspective, Carrascal-Incera and Hewings (2026, 2022) show that income earned and spent in one region induces asymmetric interregional spillovers in European economies, disproportionately benefiting wealthier and more densely populated regions and reinforcing spatial income imbalances. However, it remains unclear whether similar spillover mechanisms operate in large developing economies characterized by structural heterogeneity and simultaneously high interpersonal and regional inequality such as Latin American countries (Ramos et al., 2018; Lessmann and Seidel, 2017;).

Colombia, Chile, and Brazil ranked among the ten most unequal countries in 2024. In Brazil, the richest 10% accounted for 59.1% of pre-tax national income (WID, 2026). Brazil is also one of the largest countries in the world, with a population exceeding 200 million. Its states are comparable in size to several European countries.

Over the last two decades, interstate inequality in Brazil has declined slightly (Figure 1), yet it remains at a concerning level. In 2021, GDP *per capita* (PPP) exceeded US$ 20,000 in the wealthiest states, whereas in the poorest states it remained below US$ 10,000 (PPP).

Figure 1 – Interstate inequality across Brazilian states and the Federal District, 2002-2021, Gini index



Source: Own elaboration based on IBGE and OCDE data

This paper examines whether asymmetric interregional income spillovers reinforce interstate inequality in Brazil. Furthermore, it examines whether these patterns persist at a smaller spatial scale, using the state of Minas Gerais (MG) as a sub-national case study. Specifically, we ask whether the circular flow of income induced by household demand systematically benefits wealthier and more densely urbanized regions, thereby constraining deeper reductions in interregional inequality.

The analysis employs extended inter-regional input–output (IRIO) models (Type II), in which households are endogenized within the production system. We focus on the interregional income multiplier matrix, which captures how income generated in one household group induces additional income in others through successive rounds of production and expenditure. This framework allows us to distinguish between domestic effects, meaning income retained within the region where it is generated, and interregional spillovers, meaning income transmitted to or received from other regions. Since total income generated within the system must be absorbed somewhere, the approach enables the computation of net interregional income balances and the identification of each region's structural position within the national economy. Some regions generate more income for other regions than they receive, while others are net beneficiaries, reflecting differences in productive structure, trade linkages, consumption patterns, and factor income flows.

The empirical application relies on the Brazilian Interstate Input–Output Tables for 2011 and 2019 (Haddad et al., 2017, Haddad et al., 2025) and on the interregional input–output system for the intermediate regions of Minas Gerais for 2019 (FJP, 2025). Together, these datasets allow us to assess spillover patterns at both national and sub-state scales within a highly unequal and spatially heterogeneous economy.

By extending the framework of Carrascal-Incera and Hewings (2026, 2024) to a large developing economy, this paper provides new empirical evidence on the structural mechanisms through which induced household demand shapes regional income inequality in developing economies.

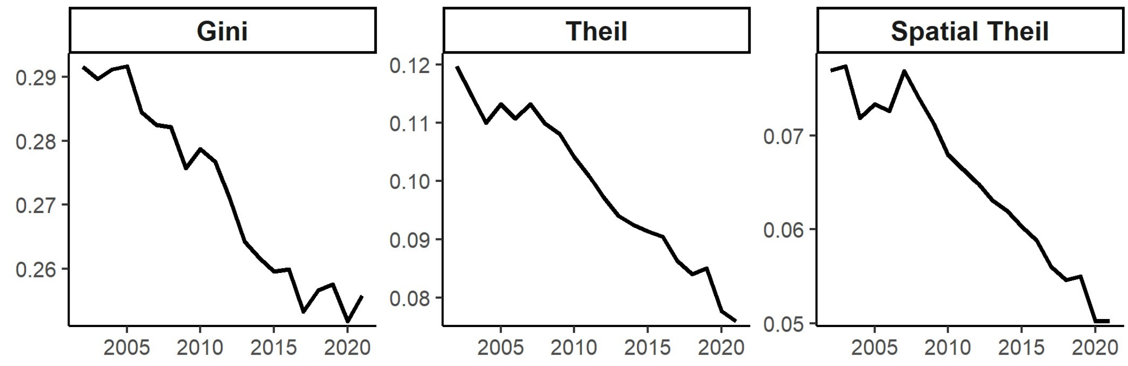
The paper is organized as follows: Section 2 provides an overview of inequality data and synthesizes recent literature on interregional disparities in Brazil; Section 3 describes the methodology; Section 4 outlines the database; Section 5 discusses the results and concludes.

2 Regional inequality in Brazil

Traditional measures of regional inequality in Brazil indicate a slow but persistent decline over time (Figure 2). The spatial Theil index also reveals a downward trend in inequality through 2021, despite a spike in 2007, consistent with a spatial convergence phase[1].

Figure 2 – Interstate inequality across Brazilian states and the Federal District, 2002–2021, Gini index, Theil index, and Spatial Theil index

[1] Theil index was calculated as $heil = \sum_{j=1}^{k} \frac{Y_j}{Y} \ln \frac{y_j/_Y}{n_j/_n}$, where Y represents the GDP and n the population. The spatial theil was defined as $Spatial_{theil} = \sum_{j=1}^{k} \frac{y_j^*}{Y^*} \ln \frac{y_j^*/_{Y^*}}{n_j^*/_{n^*}}$ where y_j^* and n_j^* refers to the spatially weighted averages of the GDP and the population shares of neighboring units, respectively.



Source: Own elaboration based on IBGE data.

Magalhães and Alves (2021) indicate that spatial inequality in Brazil rose during the economic boom between 1920 and 1970, before declining significantly until 2017, the final year of their analysis. This pattern corroborates Williamson's hypothesis, which suggests that spatial inequalities increase during the early stages of development and decrease after reaching a specific threshold.

Silveira Neto and Azzoni (2011) suggest that spatial inequality in the country decreased from 1995 on. Between 1995 and 2005, this decline was primary driving by productivity convergence, alongside non-spatial economic policies. These included monetary stabilization following the Real Plan, the minimum wage policy (the real appreciation of the minimum wage), and the expansion of social transfer programs, most notably the Bolsa Família.

Monteiro Neto (2014) observes that during the 2000s, economic growth shifted toward the North, Northeast, and Central-West, traditionally viewed as Brazil's less dynamic regions. Consequently, their share of the national value added increased from 24.8% in 2000 to 28.7% in 2009. Specifically, the Central-West continued to expand its share in agriculture, consolidating its status as a major hub for the sector.

In 2010s, the Brazilian economy experienced one of the deepest economic downturns in the country's recent history. After achieving an average annual growth rate of 3.4% between 2000 and 2014, the GDP contracted by a cumulative 6.8% during the 2015-2016 period, triggered by a severe institutional and political crisis. Between 2017 and 2019, economic activity showed a sluggish recovery, with an average annual growth rate of 1.4%. Consequently, this period is often labeled the Second Lost Decade[2]. During the economic crisis, more industrialized states entered in recession earlier and remained in that state longer than more agricultural states (Colombo and Lazzari, 2021).

Azzoni and Castro (2025) indicate that periods of high national economic growth are associated with a slower speed of convergence, while periods of sluggish national performance correlate with higher speeds of convergence. This suggests that during upturns, core regions tend to pull ahead. Conversely, during downturns, these same core regions tend to take the initial hit while the remaining regions maintain their performance for a longer duration.

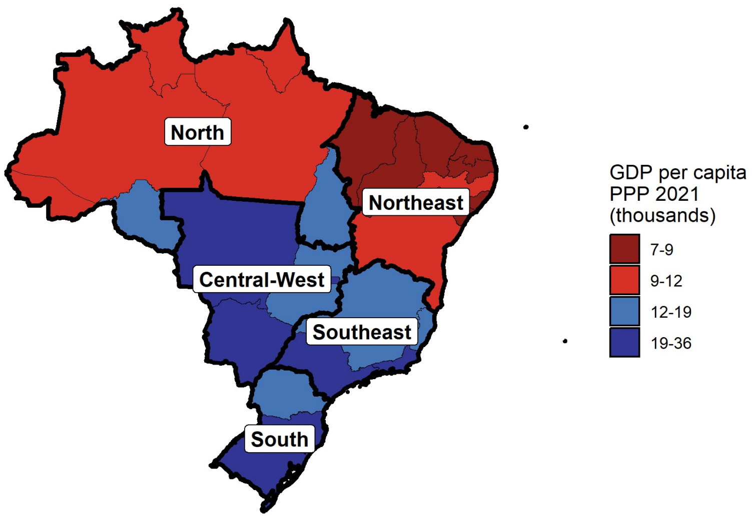
[2] The 1980s in Brazil is known as the "First Lost Decade" characterized by a halted GDP growth along with hiperinflation.

Araújo and Haddad (2025) utilized interregional input-output (IO) analysis to examine the drivers of structural change in Brazil between 2011 and 2019. Their findings suggest that the dominant force underlying modest growth during this period was the expansion of domestic demand, specifically households and government consumption. Notably, they identify a dual effect on regional inequality: while domestic trade reinforced structural disparities by redirecting growth benefits away from less developed regions, increases in consumption levels (income) acted as the primary factor in reducing regional gaps.

In 2020, the economy was again disrupted by the Covid-19 pandemic. This led to a contraction of 3.3% in 2020, which was followed by a rebound of 4.8% in 2021. Over the entire 2000–2021 period, real GDP *per capita* increased by an average of only about 1% per year. As a result, despite the modest decrease in spatial inequality, the overall level remains high.

Manzi et al. (2023) employed club-convergence analysis to confirm the historical socioeconomic divide in Brazil, contrasting the wealthier South and Southeast with the less developed North and Northeast. The Central-West, formerly part of the poorer group, are now converging toward wealthier clusters. These findings suggest the tendency toward the consolidation of a core-periphery pattern within the country, as illustrated by the Figure 3.

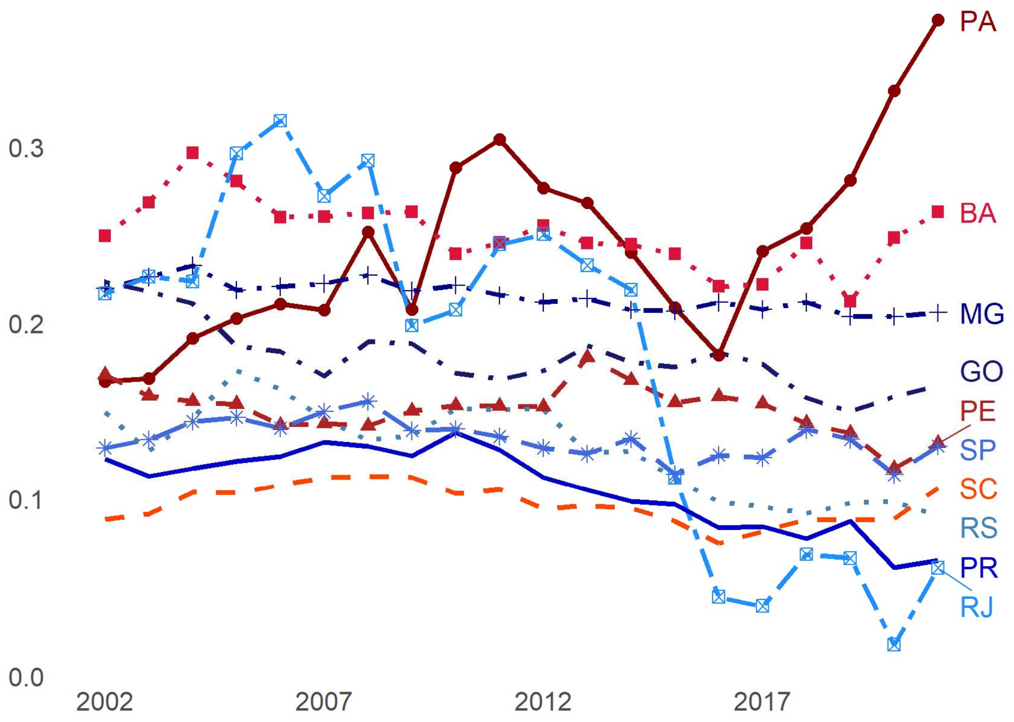
Figure 3 – GDP *per capita*, Brazilian states, US$ 1,000 PPP



Source: Own elaboration based on IBGE data and OECD (PPP for GDP)

Beyond national trends, inequality is also pronounced within individual Brazilian states. Figure 4 illustrates the evolution of spatial inequality at the subnational level, using the Geographical Intermediate Region (RGInt) as a reference. Pará (PA), located in the North of Brazil, exhibits the highest spatial inequality, followed by Bahia (BA) and MG. In PA, this pattern is largely driven by iron ore extraction and related activities in the Marabá RGInt. The cyclical sensitivity of inequality is well-illustrated by the state of Rio de Janeiro (RJ), where spatial disparities are intrinsically linked to commodity price volatility. While spatial inequality in RJ widened during the 2000s, it contracted significantly after 2015. This shift mirrors the trajectory of global oil prices, which surged until 2015 before collapsing, severely curtailing the GDP of the state's primary oil-producing hubs, such as the Campos dos Goytacazes and the Macaé–Rio das Ostras–Cabo Frio.

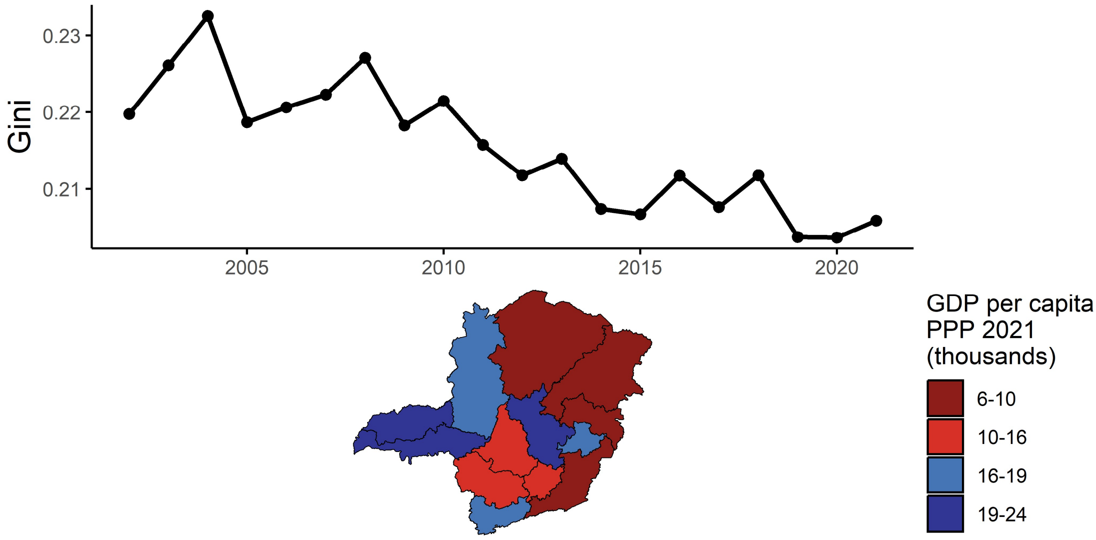
Figure 4 – Evolution of spatial inequality across Intermediate Geographic Regions within the 10 largest Brazilian states, 2002–2021, Gini index



Source: Own elaboration based on IBGE data.

The evolution of spatial inequality in MG shows some similarities with that of Brazil, sharing a downward trend, though with more pronounced fluctuations. Situated in central Brazil, the state bridges the wealthier South and the poorer North. The GDP *per capita* is lower in the Northern region of the state, which connects MG to BA in Brazil's Northeast (Figure 5).

Figure 5 – Interregional inequality in Minas Gerais, 2002-2021, Gini index and GDP *per capita* (US$ 1,000 PPP)



Source: Own elaboration based on IBGE data and OECD (PPP for GDP)

MG is often seen as a reflection of the broader Brazilian context. The state combines affluent southern areas with poorer northern regions, producing socioeconomic indicators close to the national average. It is Brazil's second most populous state and third in GDP. Its terms of size, it is comparable to some larger European countries, such as Spain.

Aguilar et al. (2026) argue that the regions within Minas Gerais exhibit weak economic integration. Trade flows from the Belo Horizonte RGInt, which accounts for more than one-third of the state's GDP, are primarily directed toward other states and international markets. However, as the state's primarily economic hub, it accounts for nearly 20% of the inflows to other internal regions. This relationship is even more pronounced in the Ipatinga RGInt, where steel manufacturing is deeply integrated with the state's central automotive industry. Specifically, the Belo Horizonte RGInt is the source of nearly 30% of all inflows to the Ipatinga region.

Trade flows are also more intense among the RGInts of Uberlândia, Patos de Minas, and Uberaba, indicating a high degree of integration within the agro-industrial supply chain. However, the Uberlândia RGInt acts as a regional hub for the others, serving as their second-largest supplier after the Belo Horizonte RGInt. This position reinforces Uberlândia's role as a dominant economic center within the western part of the state. (Aguilar et al, 2026).

3 Methodology

We employ an extended input-output (IO) framework, also known as Type II multiplier models, to evaluate income formation and distribution within Brazil and Minas Gerais. Unlike the traditional Leontief model, where the household consumption vector is treated as exogenous, Type II models endogenize this component. Consequently, the labor requirements and subsequent labor payments of each sector directly influence the multipliers through induced effects.

To integrate this vector into the technical coefficient matrix, we focus exclusively on labor income. While capital income is a primary driver of inequality (Piketty, 2014), capital payments do not necessarily accrue to domestic households. These flows are particularly difficult to track, especially in a regional context, due to spatial leakages and the complexity of identifying the ultimate recipients of corporate profits (Emonts-Holley et al., 2021).

The expanded input-output system is represented by:

$$\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} A & C \\ V & 0 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} + \begin{bmatrix} f^* \\ g \end{bmatrix} \tag{1}$$

where x represents the gross output vector, y the vector of total income per household group, f^* the vector of final demand excluding household consumption, and g is a vector of exogenous income (if any) for the income groups. A is the matrix of technical coefficients (with dimensions productive sectors by productive sectors, V is the wage income coefficient matrix, and C is the consumption shares matrix (with dimensions productive sectors by households).

In our models, each state is represented by a representative household (yielding 27 household groups in the Brazilian model and 13 for the MG case). Solving for $\begin{bmatrix} x \\ y \end{bmatrix}$, we have:

$$\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} I - A & -C \\ -V & I \end{bmatrix}^{-1} \begin{bmatrix} f^* \\ g \end{bmatrix} \tag{2}$$

Following the Miyazawa decomposition (Miller and Blair, 2009), we define $B = (I - A)^{-1}$, $L = VBC$, and $K = (I - L)^{-1} = (I - VBC)^{-1}$, where VBC represents the interincome group coefficients matrix and K the interrelational multiplier matrix. These modifications result in the following equation:

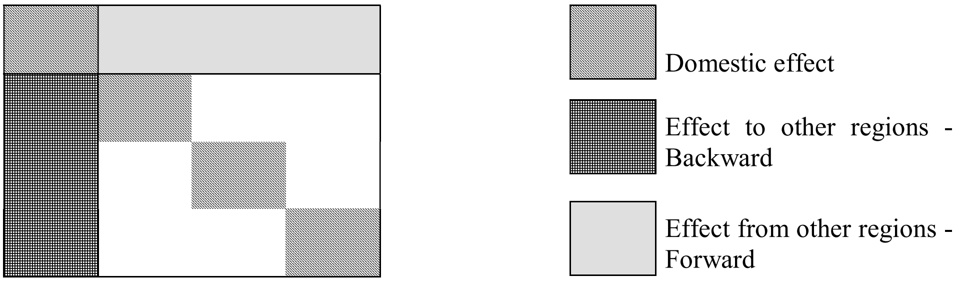
$$\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} B(I + CKVB) & BCK \\ KVB & K \end{bmatrix}^{-1} \begin{bmatrix} f^* \\ g \end{bmatrix} \tag{3}$$

Income formation and distribution are analyzed through the K matrix. The VBC matrix maps household expenditures C, which requires BC in sectoral output; this, in turn, translates into income payments in the amount of VBC. Therefore, the exogenous final demand will generate (through B) direct and indirect changes in production. The product VB provides the direct and indirect income that will be generated and spent by households, and the product VBC tells us how that income is spent. The inverse of $(I - VBC)$ indicates the total increase (direct, indirect and induced) in the income of one household group that results from additional expenditure of an additional unit of income by another household group, i.e., accounts for the subsequent impacts in the economic system (Carrascal-Incera and Hewings, 2026; Miller and Blair, 2009).

Within an interregional framework, the Miyazawa system identifies the extent to which an impact that remains within the originating region (domestic effect), is transmitted to other regions (backward effects), or is received from elsewhere (forward effects). Consequently, it maps the interregional linkages and leakages of an impact initiated in one region as it spreads, both directly and indirectly, through the entire system.

Figure 5 summarizes these effects by showing the composition of the Miyazawa matrix within an IRIO framework. Each row and column represents the households for each region considered in the analysis. The main diagonal provides the internal (domestic) effects, representing the impact within a region from an additional unit of household expenditure in that same region. The remaining entries in the column show the impact of this expenditure on the income of households in other regions (backward effects). Conversely, the remaining entries in the row represent the income received by the first region's households when those in other regions increase their expenditure (forward effects). Therefore, this framework reveals how much income is generated and received by each region.

Figure 5 – Composition of the K matrix and its effects



Source: Carrascal and Hewings (2026)

The total sum by column and by row must be equal, as all generated income must end up somewhere. Hence, we can evaluate the position of each region in the income value chain. Some regions generate more income than they receive and vice-versa, depending on regional trade relationships, the productive structure, consumption patterns, and wage payments.

To perform this analysis, it is necessary to make some assumptions due to limitations of the model and the data. First, we assume that households consume and receive their wages in the same region. Since states in Brazil are large (as are the regions of Minas Gerais) and a significant proportion of income is spent on non-tradable services, this assumption is less restrictive than it seems. Secondly, we only consider wage income due to the difficulty of tracking capital flows. Thirdly, this type of model does not consider income redistribution, only its primary distribution, meaning that government transfers, taxes, and public spending are taken as exogenous. Finally, the analysis is applied to one year (one period), so savings are not considered. This implies that the average propensity to consume is equal to 1 for all regions.

4 Database

We used three different databases. For Brazil, we use the data provided by Haddad, Gonçalves, and Nascimento (2017) for the reference year 2011, and Haddad et al. (2025) for 2019. In both cases, we have interregional IO tables for all 26 Brazilian states and the Federal District (where the Brazilian capital, Brasília, is located), covering 68 sectors and 128 commodities.

The development of these models was based on the Interregional Input-Output Adjustment System (IIOAS) method. This methodology uses official data and non-survey techniques to estimate unavailable information. Particularly, since there is no data for interregional trade flows, it is necessary to estimate them.

In order to do so, the initial assumption is that every economic agent shares the same technology (i.e., input mix) and the same preferences. Therefore, after estimating the regional demand for each region based on these assumptions, it is necessary to calculate the regional supply as the difference between production and exports. The next step estimates the interregional flows, taking into account the shares of intraregional supply vs. intraregional demand (if supply is greater than demand, it is assumed that all domestic demand is satisfied within the region), the tradability of each product (services are regarded as less tradable), and the distances between regions (Haddad, Gonçalves and Nascimento, 2017; Haddad et al., 2025).

The data for MG was sourced from the João Pinheiro Foundation (2025). The interregional IO for MG follows the same methodology as Haddad, Gonçalves, and Nascimento (2017) and Haddad et al. (2025). The base data used to estimate this model were the Supply and Use Tables (SUT) for MG, which cover 57 sectors and 102 products. The interregional IO for MG is more aggregated, covering 42 sectors across the 13 intermediate regions of the state.

The IIOAS method has been applied to a wide range of interregional systems, including countries (Haddad et al., 2023), macro-regions (Haddad et al., 2024), and states (Santana Ribeiro et al., 2024). The system estimated by this methodology is able to retain the specificities present in the productive structure of each region.

5 Results

The results are presented in two blocks. First, we present the findings for the Brazilian economy for both 2011 and 2019. Then, we focus on the results for the Minas Gerais economy for the reference year 2019. In both cases, we explore the Miyazawa matrix (K), reporting forward and backward effects, including and excluding domestic effects, as well as the resulting net balance, GDP *per capita*, and population density for each state or region. At the bottom of the tables, we group the results by wealth and population density levels, adjusting the reference parameters according to the Brazilian and Minas Gerais realities.

Table 1 presents the results for Brazil. The states are ordered according to the magnitude of the net balance effect, from highest to lowest. The forward effects range from 1.105 (0.009 when excluding within effects) to 6.105 (4.623) in 2011, and from 1.170 (0.005) to 6.711 (5.176) in 2019. Over the same period, backward effects vary between 1.254 (0.155) and 1.912 (0.592) in 2011, and between 1.389 (0.234) and 1.930 (0.613) in 2019. In both years, São Paulo (SP) exhibits the highest forward effect, while Roraima (RR) records the lowest. Concerning backward effects, the highest value in 2011 is observed in Paraná (PR) when within effects are excluded (1.912) and in Goiás (GO) when they are included (0.592). In 2019, Espírito Santo (ES) records the highest backward effect both with within effects (1.930) and without within effects (0.613). By contrast, the Distrito Federal (DF) consistently presents the lowest backward effects in both years – 1.254 (0.155) in 2011 and 1.389 (0.234) in 2019.

Table1 - Main Results of the Interrelational Income Multipliers (K matrix) – Brazil

a) 2011

State	Forward effects	Forward effects (excluded within)	Backward effects	Backward effects (excluded within)	Balance	GDP *per capita* (PPP 1,000)	Pop. Dens (people *per* Km2)
SP	6.105	4.623	1.751	0.269	4.354	23.449	167.112
RJ	2.206	0.943	1.557	0.294	0.649	21.602	367.333
MG	2.101	0.794	1.740	0.433	0.361	13.767	33.532
RS	2.037	0.651	1.861	0.475	0.176	16.763	38.055
DF	1.345	0.246	1.254	0.155	0.091	40.199	451.418
PR	1.899	0.568	1.912	0.580	-0.012	16.602	52.633
PE	1.577	0.297	1.625	0.346	-0.048	8.435	90.015
CE	1.554	0.242	1.714	0.402	-0.160	7.138	57.039
RR	1.105	0.009	1.272	0.176	-0.166	10.774	2.048
BA	1.659	0.330	1.828	0.498	-0.168	8.022	24.866
SC	1.699	0.397	1.878	0.576	-0.179	18.704	65.875
AL	1.271	0.077	1.494	0.301	-0.223	6.836	112.419
ES	1.328	0.138	1.554	0.364	-0.226	20.280	76.752
AP	1.140	0.010	1.374	0.244	-0.234	9.333	4.782
RN	1.325	0.090	1.584	0.348	-0.258	8.699	60.300
SE	1.276	0.063	1.551	0.339	-0.276	9.455	94.922
MA	1.272	0.090	1.556	0.373	-0.283	5.326	20.073
PA	1.300	0.105	1.593	0.399	-0.293	8.715	6.144
AC	1.177	0.016	1.474	0.314	-0.297	8.139	4.530
RO	1.235	0.061	1.542	0.368	-0.307	11.873	6.604
GO	1.583	0.277	1.898	0.592	-0.315	13.540	17.812
MT	1.394	0.164	1.713	0.483	-0.319	15.261	3.393
PB	1.298	0.091	1.640	0.433	-0.342	6.644	66.853
PI	1.244	0.043	1.588	0.387	-0.344	5.607	12.421
TO	1.207	0.033	1.572	0.398	-0.365	8.889	5.029
MS	1.341	0.112	1.738	0.509	-0.397	15.105	6.917
AM	1.339	0.175	1.755	0.591	-0.416	13.569	2.259

Income categories (2011)	Balance (mean)	Pop. density categories (2011)	Balance (mean)
Richer states	1.217	High-density states	1.218
Intermediate	-0.157	Intermediate	-0.118
Poorer states	-0.253	Low-density states	-0.314

b) 2019

State	Forward effects	Forward effects (excluded within)	Backward effects	Backward effects (excluded within)	Balance	GDP *per capita* (PPP 1,000)	Pop. Dens (people *per* Km2)
SP	6.711	5.176	1.796	0.261	4.915	22.438	184.519
MG	2.405	1.020	1.837	0.453	0.567	13.511	35.979
RJ	2.242	0.880	1.779	0.418	0.463	19.820	393.602

RS	2.190	0.796	1.810	0.416	0.381	18.606	40.340
PR	2.053	0.717	1.851	0.515	0.202	17.896	57.247
DF	1.539	0.384	1.389	0.234	0.150	39.813	521.513
BA	1.844	0.495	1.764	0.415	0.080	8.650	26.234
PE	1.796	0.487	1.750	0.441	0.046	9.083	97.043
SC	1.823	0.507	1.786	0.470	0.037	19.796	74.715
GO	1.741	0.403	1.876	0.539	-0.136	13.045	20.559
CE	1.700	0.325	1.855	0.480	-0.155	7.859	61.063
AM	1.376	0.185	1.574	0.383	-0.198	11.452	2.647
MT	1.444	0.219	1.756	0.530	-0.312	17.895	3.843
RN	1.400	0.091	1.768	0.458	-0.368	8.925	66.110
MS	1.398	0.162	1.771	0.535	-0.373	16.884	7.759
SE	1.380	0.089	1.758	0.466	-0.377	8.530	104.409
MA	1.325	0.103	1.708	0.486	-0.383	6.036	21.370
PI	1.280	0.052	1.672	0.445	-0.393	7.075	12.946
PB	1.369	0.115	1.771	0.517	-0.402	7.424	70.853
AL	1.391	0.099	1.829	0.536	-0.438	7.752	119.357
RR	1.170	0.009	1.615	0.455	-0.446	10.352	2.697
AP	1.193	0.005	1.650	0.462	-0.457	9.077	5.910
PA	1.365	0.114	1.830	0.578	-0.464	9.097	6.875
ES	1.462	0.145	1.930	0.613	-0.468	14.995	86.957
AC	1.251	0.016	1.727	0.493	-0.477	7.776	5.353
TO	1.236	0.039	1.730	0.533	-0.494	10.978	5.646
RO	1.332	0.096	1.835	0.599	-0.503	11.626	7.445

Income categories (2019)	**Balance (mean)**	**Pop. density categories (2011)**	**Balance (mean)**
Richer states	2.532	High-density states	0.943
Intermediate states	-0.098	Intermediate states	-0.050
Poorer states	-0.316	Low-density states	-0.411

Source: Own elaboration.

Note: AC (Acre), AL (Alagoas), AM (Amazonas), AP (Amapá), BA (Bahia), CE (Ceará), DF (Distrito Federal), ES (Espírito Santo), GO (Goiás), MA (Maranhão), MG (Minas Gerais), MS (Mato Grosso do Sul), MT (Mato Grosso), PA (Pará), PB (Paraíba), PE (Pernambuco), PI (Piauí), PR (Paraná), RJ (Rio de Janeiro), RN (Rio Grande do Norte), RO (Rondônia), RR (Roraima), RS (Rio Grande do Sul), SC (Santa Catarina), SE (Sergipe), SP (São Paulo), TO (Tocantins).

Richer states: GDP per capita > 20 thousands US$ PPP; intermediate: GDP per capita between 10 thousands US$ PPP and 20 thousands US$ PPP; Poorer states: GDP per capita < 10 thousands US$ PPP.

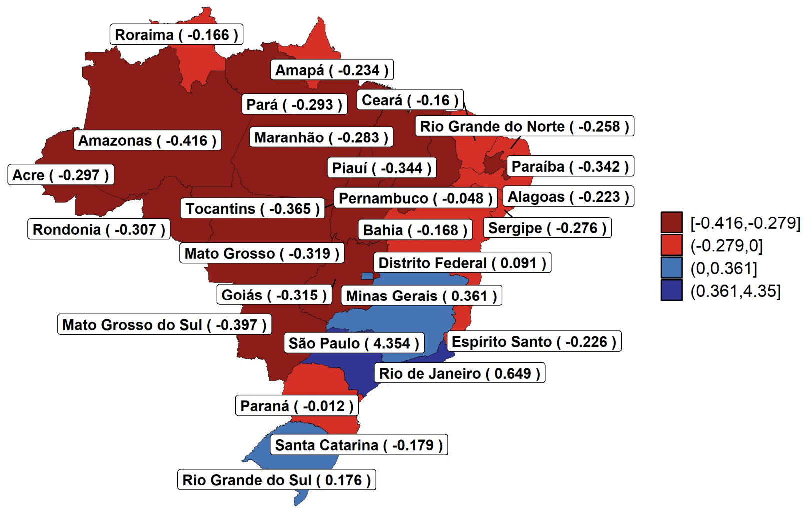
High-density states: Population density > 100 people per km2; intermediate: population density between 20 people per km2 and 100 people per km2; low-density states: population density < 20 people per km.

Regarding the balance between forward and backward effects, SP exhibits the largest positive balance in both years, reaching 4.354 in 2011 and 4.915 in 2019. It is followed by RJ, with balances of 0.649 in 2011 and 0.463 in 2019, and by MG, which records values of 0.361 and 0.567, respectively. In contrast, the most negative balances in 2011 are observed in Amazonas (AM) (–0.416), Mato Grosso do Sul (MS) (–0.397), and Tocantins (TO) (–0.365). In 2019, the lowest balances are recorded in Rondônia (RO) (–0.503), Tocantins (TO) (–0.494), and Acre (AC) (–0.477).

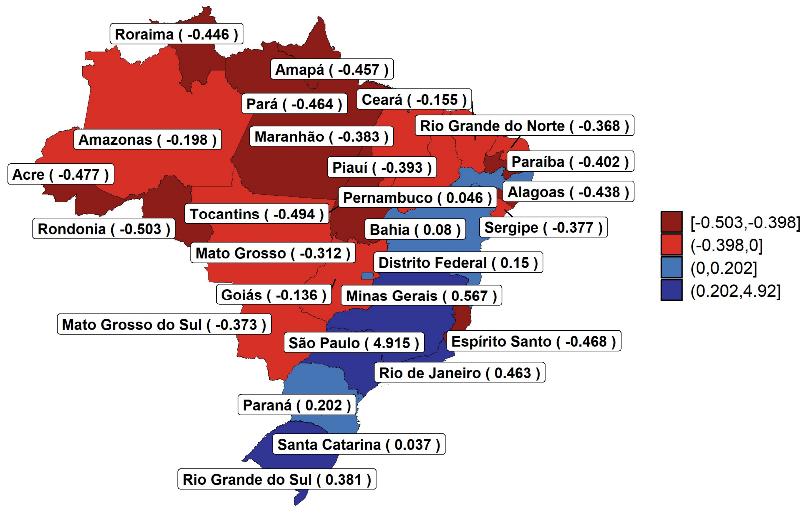
Figure 6 reveals a clear core–periphery pattern: the main economic states in Brazil's Southeast – SP, RJ, and MG – display positive balances, whereas poorer states, predominantly located in the North and Northeast, exhibit negative balances. As summarized in the bottom panel of Table 1, richer and more densely populated states tend to benefit more from interregional linkages.

Figure 6 – Net effect (balance) in the structure of income formation in Brazil, 2011 and 2019

a) 2011



b)



Source: Own elaboration.

Moreover, we can identify that the backward effects vary much less than the forward effects, meaning that the impact of one Real spent in any state is more similar than its spatial distribution. In addition, the results are quite stable over time, even though the Brazilian economy experienced one of its deepest recessions during this period.

It is also important to note that states in the Center-West had negative balances in both years, even though they have a higher GDP *per capita* than the Brazilian average. These states are also characterized by low population density. This was also the case for Espírito Santo (ES) in the Southeast, even though it falls into an intermediate density category. In addition, from 2011 to 2019, Bahia (BA) and Pernambuco (PE) changed from negative to positive balances.

Table 2 summarizes the same results for MG in 2019, ranking the regions according to the magnitude of the balance effect. Belo Horizonte exhibits the highest forward effects both with and without within effects (2.176 and 0.833, respectively), whereas Teófilo Otoni recorded the lowest values (1.251 and 0.028). Regarding backward effects, the highest values are observed in Patos de Minas when within effects are included (1.490) and in Ipatinga when they are excluded (0.248). Conversely, Teófilo Otoni (1.370) and Belo Horizonte (0.100) present the lowest backward effects with and without within effects, respectively.

In net terms, Belo Horizonte registers the highest balance effect (0.743), while Ipatinga shows the lowest (–0.189). Figure 5 further suggests a core–periphery pattern, with Belo Horizonte and the southern regions forming the core and the northern regions constituting the periphery. The bottom panel of Table 2 indicates higher net balance effects in richer and more densely populated regions. Nevertheless, intermediate regions performed worse than poorer ones. This is the case for Ipatinga and Barbacena.

Table 2 – Main Results of the Interrelational Income Multipliers (K matrix) – Minas Gerais – 2019

RGInt	Forward effects	Forward effects (excluded within)	Backward effects	Backward effects (excluded within)	Balance	GDP per capita (PPP 1,000)	Pop. Dens (people per Km2)
Belo Horizonte	2.176	0.833	1.443	0.100	0.734	16.738	153.532
Uberlândia	1.550	0.240	1.443	0.133	0.107	20.634	32.927
Juíz de Fora	1.446	0.165	1.394	0.113	0.052	9.854	60.092
Pouso Alegre	1.436	0.180	1.386	0.130	0.050	16.700	62.448
Varginha	1.417	0.130	1.408	0.121	0.009	11.301	44.446
Governador Valadares	1.313	0.039	1.390	0.116	-0.077	7.441	29.604
Divinópolis	1.342	0.100	1.426	0.184	-0.084	12.670	36.323
Montes Claros	1.289	0.047	1.384	0.142	-0.095	7.083	13.513
Patos de Minas	1.382	0.079	1.490	0.187	-0.108	14.317	9.745
Teófilo Otoni	1.251	0.028	1.370	0.148	-0.120	5.627	15.645
Uberaba	1.354	0.118	1.478	0.242	-0.124	20.644	21.835
Barbacena	1.273	0.041	1.427	0.195	-0.154	11.913	50.751
Ipatinga	1.271	0.059	1.460	0.248	-0.189	13.991	77.479

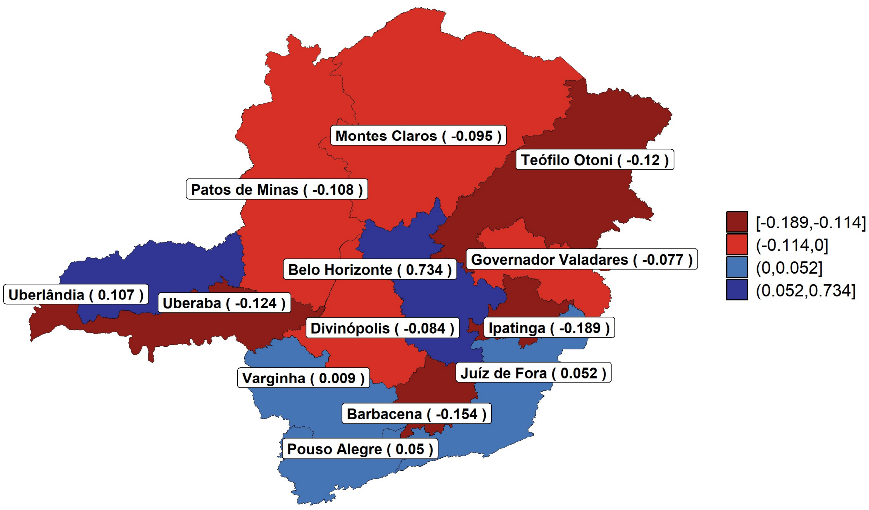
Income categories (2011)	Balance (mean)	Pop. density categories (2011)	Balance (mean)
Richer regions	0.191	High-density regions	0.099
Intermediate	-0.105	Intermediate	-0.034
Poorer regions	-0.060	Low-density	-0.108

Source: Own elaboration.

Note: Richer regions: GDP per capita > 15 thousands US$ PPP; intermediate: GDP per capita between 10 thousands US$ PPP and 15 thousands US$ PPP; Poorer states: GDP per capita < 10 thousands US$ PPP.

High-density states: Population density > 50 people per km2; intermediate: population density between 20 people per km2 and 50 people per km2; low-density states: population density < 20 people per km2.

Figure 7 – Net effect (balance) in the structure of income formation in Minas Gerais, 2019



Source: Own elaboration.

Although Figure 7 suggests a North-South divide, there are other exceptions beyond the regions of Ipatinga and Barbacena. For instance, the GDP *per capita* in the Divinópolis region falls into the intermediate category, while Uberaba records the highest value among all regions. Both are classified within the intermediate density category.

5 Conclusions and Discussion

This paper investigates the causes of the slow decrease in spatial inequality in Brazil and MG over the last twenty years, despite the persistently highly levels of both interpersonal and spatial disparities. To address this issue, we use an extended input-output model (Type II) and explore the results from the Miyazawa multiplier matrix, which allows us to evaluate how much income is generated and received in each state/region. The data used come from Haddad, Gonçalves, and Nascimento (2017) and Haddad et al. (2025) for the Brazilian matrices, and from the João Pinheiro Foundation (2025) for the matrix of Minas Gerais.

The results presented in this paper endorse those found by Carrascal and Hewings (2026, 2022) for European regions and countries. This means that differences in productive structure, trade linkages, consumption patterns, and factor income flows tend to benefit wealthier and highly dense urban places. Therefore, the same reasoning applies in the context of a large middle-income country with high levels of inequality.

The stability of the results during one of the major Brazilian recessions indicates that it is difficult to counteract these forces. Although wealthier states tend to suffer more during recessions (Azzoni and Castro; Colombo and Lazzari, 2021), income flows still benefit them. For instance, the net balance of SP, the main productive powerhouse of Brazil, increased from 4.3 in 2011 to 4.9 in 2019. In addition, even though cash transfer programs to poor families, such as Bolsa Família in the 2000s, seem to contribute to decreasing spatial inequality (Monteiro Neto and Azzoni, 2011), at the same time, this exogenous final demand tends to benefit wealthier and more densely urbanized places more through its direct and indirect impacts on the economic system.

This result also stands within states. In MG, the region of Belo Horizonte, where state production is concentrated, is also the one that benefits most from the chain of income flows. To some extent, this indicates that the North-South (poor vs. rich) divide in Brazil (Manzi et al., 2023) is also verified in Minas Gerais, the state that connects richer states with poorer ones.

Therefore, these results endorse the findings of Araújo and Haddad (2025) that interstate trade reinforces structural disparities by redirecting growth benefits away from less developed regions. The emergence of technology-intensive industries along with the rise of knowledge-intensive services in the Southeast of Brazil, where economic activity historically concentrates, favors the more developed region. In other words, agglomeration effects and modern production seem to be favoring metropolitan areas specialized in high value-added services (financial activities, insurance, real estate, telecommunications, etc.) (Carrascal and Hewings, 2026).

This might explain the results for the Center-West of Brazil. Despite its states having a higher GDP *per capita*, their net balance of income flows is negative. This region's growth has outpaced the Brazilian average, pushed by the extraordinary increase in the agricultural and farming sector. Despite this contributing to *per capita* growth, this sector relies on linkages provided by the Southeast economic system. Nevertheless, it is important to emphasize that these states are much less densely populated, which may hinder the agglomeration effects favoring high-skill industries. In addition, wage income has a lower share in these states, meaning that much of the income generated may not stay within the region; consequently, GDP *per capita* does not necessarily translate into better quality of life for households. The negative balance for the state of ES can also be explained along these lines. The difference here is that the state is more densely populated.

These arguments can also help to explain some results for MG. The sectoral dependence of the region of Uberaba on Uberlândia seems to favor the latter. The same applies between Belo Horizonte, Ipatinga and Barbacena. In this case, the centrality of the automobile industry (Aguilar et al., 2026) in the former may contribute to uneven income flows.

In this scenario, how can we counteract spatial inequality? The answer seems to involve the transformation of the productive structure within the country and its regions, while trying to compensate for the agglomeration effects that reinforce spatial inequality. However, to pursue this, it is important to compare the position and participation in the income value chain vis-à-vis the production value chain (Bolea et al., 2022) to clarify sectoral linkages and leakages.

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