Área 5 – Crescimento econômico e desenvolvimento regional

ECONOMIC GROWTH AND REGIONAL DISPARITIES: A LONG-TERM PERSPECTIVE FOR THE STATE OF SERGIPE

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RESUMO

Este artigo constrói e avalia cenários de longo prazo da economia sergipana, identificando setores com maior capacidade de alavancar o crescimento econômico estadual e mitigar as disparidades regionais. Utiliza-se um modelo de EGC dinâmico, calibrado para o ano de 2015 e com 41 setores. As simulações capturam os efeitos de alocação de investimentos setoriais no estado de Sergipe e exploram seus efeitos diretos e indiretos na economia. Os principais resultados mostram que setores como Agricultura, Transportes, Intermediação Financeira e Serviços Industriais de Utilidade Pública têm simultaneamente impacto acima da média no PIB estadual e contribuem para reduzir as disparidades regionais.

Palavras-chave: Setores dinâmicos; Disparidade regionais; Equilíbrio Geral Computável.

ABSTRACT

This paper aims to build and evaluate long-term scenarios of the Sergipe economy, identifying sectors with greater capacity to leverage the state's economic growth and mitigate regional disparities. We use a dynamic and inter-regional CGE model, calibrated for the year 2015 and 41 sectors. Our simulations capture the effects disentangle by sectorial investment shocks in the state of Sergipe and explores its direct and indirect effects through the economy. The main results show that sectors such as Agriculture, Transport, Financial intermediation, and Public Utility Industrial Services have simultaneously above average impact on state’s GDP and contribute to reduce regional disparities.

Keywords: Dynamic sectors; Regional Disparities; Computable General Equilibrium.

Jel-Codes: C68; R15; R58.

1. Introduction

In 2022, Brazil accounted for over half of the GDP of South America (51.5%) and 31% of the Latin America & Caribbean's GDP (World Bank, 2023). Despite experiencing a significant process of reducing regional disparities throughout the 2000s (Silveira Neto and Azzoni, 2011; 2012), it continues to be one of the most unequal economies in the world (Chancel et al., 2023). This progress has a reversal starting during the national crises of 2014-2016 (Rocha, 2019) and was further exacerbated by the Covid-19 pandemic (Santos et al., 2020; Ribeiro et al., 2023).

The Brazilian Northeast is home to nearly 27% of the national population (IBGE, 2022) and contributes to 14.2% of the national GDP. This share represents an increase of only 1.1% compared to 2002. In 2020, the per capita GDP of São Paulo, the country's wealthiest state, located in the Southeast region, was approximately 3.4 times that of the Northeast' state of Maranhão, the poorest in the nation (IBGE, 2022). In terms of intraregional inequalities, there is also significant regional disparities among its states (Ribeiro et al., 2018) and their respective productive structures (Ribeiro et al., 2019), especially in the Northeast region.

Historically, the smallest Brazilian state, Sergipe, located in the Northeast region, has a poorly diversified economy, whose economic dynamics have been based on low productivity and low value-added sectors. Since 2012, regional inequalities, measured by the Gini Index of household per capita income are higher in Sergipe than Brazil and all the Northeast's states (IBGE, 2023). Additionally, the economic crisis faced by Brazil (2014-2016) impacted Sergipe's economy more intensely than the national and regional economies, which disclose its vulnerability (Ribeiro et al., 2023). On the other hand, during the COVID-19 crisis in 2020, Sergipe's Gross Domestic Product (GDP) showed one of the smallest drops (-1%) among other states and above average, compared to a decrease of -3.9% for Brazil (IBGE, 2022). Notwithstanding, the negative impact raised new concerns for public policymakers, regarding the dependency on specific sectors, such as extractive industries, and the proper allocation of public resources, including its spatial distribution in the state.

In light of this policy context, we propose simulations designed to address questions such as: which sectors hold the greatest potential to drive economic growth in Sergipe and mitigate regional disparities over the long term? Additionally, we seek to identify strategies that could be implemented to avoid entrapment in slow-growth scenarios.

The attraction of industries to the state, following a national tradition, has been based on tax exemptions, which has proven to be an ineffective development policy, and has also contributed to fiscal competition (Lima and Lima, 2010). With the ongoing fiscal reform, states should consider new strategies for selecting sectors or productive chains with the potential to boost their economies and contribute to the process of economic growth, considering the spatial distribution of the economic activities in the state.

This paper aims to build and evaluate long-term scenarios of the Sergipe economy, identifying sectors with greater capacity to leverage the state's economic growth and mitigate regional disparities. To do this, we use a dynamic and inter-regional Computable General Equilibrium (CGE) model, calibrated for the year 2015, with 41 sectors and a top-down specification for all 75 municipalities of Sergipe. Based on this, policymakers will have at their disposal elements that directly contributed to the decision-making process for the allocation of sectoral investments.

2. Model, dataset, and simulations strategy

We begin with the model developed by Porsse et al. (2020). These authors calibrated a TERM model - The Enormous Regional Model (Horridge, 2012) for Brazil, TERM-BR, for the year 2015. The database is based on the most recent official input-output matrix of Brazil, with an openness to 67 sectors and 27 Federative Units, supplemented by information from other surveys and administrative data (PORSSE, *et al.*, 2020).

In this paper, we consider a higher level of sectoral aggregation, with 41 sectors, to highlight the sectors with greater participation in the state's production chain or those which are in the Development Plan of Sergipe. Additionally, we included a top-down module to access results at the municipal level. In this module, we utilized data from the Annual List of Social Information (Ministry of Labor and Employment, 2023) to systematically disaggregate sectoral production information for each municipality – which is originally documented in the System of Regional Accounts for only four distinct sectors by IBGE (2022).

The underlying structure of the model comprises blocks of equations delineating economic agents' behavior. On the production front, firms minimize production costs in a hierarchical production structure. At the primary level, diverse productive inputs from various sources are specified, adhering to a Leontief-type production function. Concerning intermediate inputs, the assumption extends to the purchasing of each input from various sources, encompassing local, interregional within Brazil, and international origins. For primary inputs, the substitution between capital and labor is determined by a constant elasticity of substitution (CES) production function. Reflecting the regional nature of the model, prices exhibit variation among producers in different Brazilian states, with basic prices augmented by trade and transport margins ensuring product delivery across the entire territory. Concurrently, households use a linear expenditure system that combines CES and Klein-Rubin functions. At the national level, equilibrium is achieved by equalizing all offers and demands, clearing all markets (Horridge, 2012).

Essentially, owing to its dynamic nature, the model incorporates a capital accumulation component. This module facilitates the enhancement of sectoral productive capacity through investments, thereby altering supply levels and consequently influencing equilibrium prices. It follows the general proposal described in Dixon and Rimmer (2002).

The TERM model has already been widely used in several countries. For the Brazilian case, it was used to evaluate the impacts of fiscal policies on regional inequality (Ribeiro and Souza, 2019; Cardoso et al., 2022), evaluation of structuring investments in the Northeast region (Ribeiro et al., 2018), impacts of regional funding (Ribeiro et al., 2019), impacts of the oil spill on tourism and fishing (Ribeiro et al., 2020), among others.

For planning purposes, the state of Sergipe is divided into eight planning regions. Table 1 shows the territorial area, population and GDP shares and per capita GDP of the planning regions of Sergipe state in 2020.

Table 1: Socioeconomic characteristics of planning regions, Sergipe state

ID	Planning region	Area (%)	Population (%)	GDP (%)	Per capita GDP (R$)
1	Centro - Sul Sergipano	16.1	10.4	7.9	14,908
2	Agreste Central Sergipano	14.3	11.0	9.5	16,966
3	Sul Sergipano	14.3	11.5	9.5	16,182
4	Grande Aracaju	9.9	46.5	51.7	21,796
5	Leste Sergipano	6.9	4.8	4.3	17,201
6	Baixo São Francisco	8.9	5.7	4.1	14,037
7	Médio Sertão Sergipano	7.2	3.0	2.1	13,888
8	Alto São Sergipano	22.4	7.1	10.9	29,981

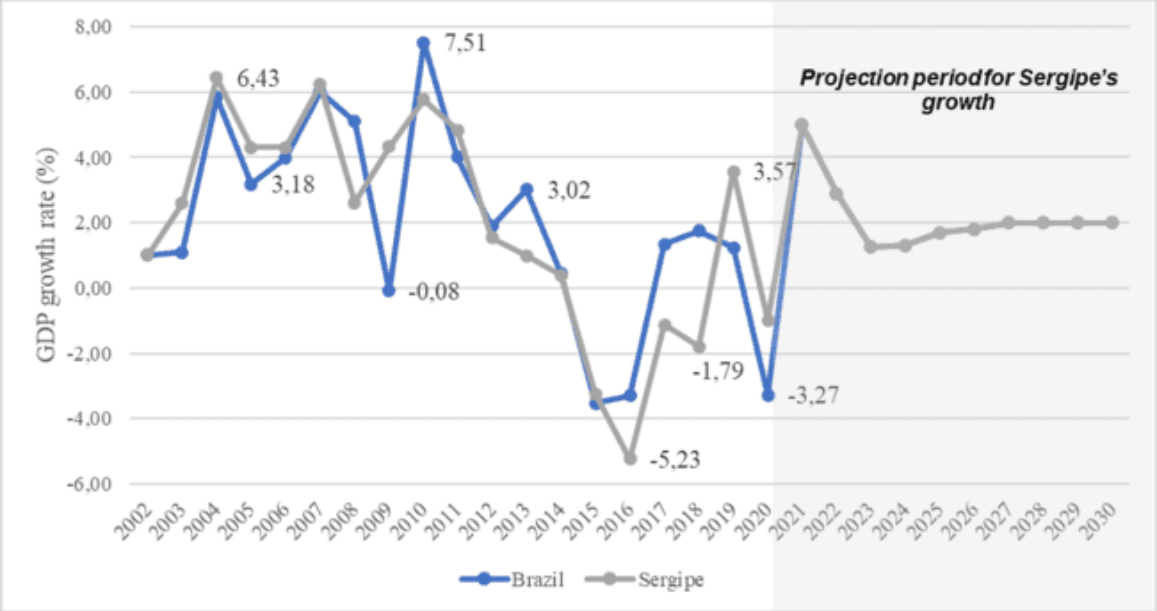
Source: Brazilian Institute of Geography and Statistics (IBGE).

Médio Sertão Sergipano, the poorest region in Sergipe, accounts for 2.1% of the state GDP and 7.2% of territorial area and has a GDP per capita of R$ 13,888. The ratio between the richest region, with GDP per capita of R$ 29,981, and the poorest region in the state is more than 2 times. Grande Aracaju comprises 51.7% of state's GDP and 9.9% of territorial area and has a GDP per capita of R$ 21,796.

2.1 Simulations strategy

In a dynamic CGE model, results from two types of scenarios are obtained: the baseline scenario and the policy scenario. Figure 1 presents the observed growth rate, extracted from the System of National and Regional Accounts of the Brazilian Institute of Geography and Statistics (IBGE), regarding the GDP of Brazil and Sergipe between 2002-2020, and the projected growth between 2023-2026. This data is used to calibrate the economic trajectories of Brazil and Sergipe at the baseline. In the period 2002-2020, the tendency and the average growth rates of the Brazilian and Sergipe economies were similar, with an average rate of approximately 2% for the entire period. Therefore, for the baseline scenario, it is assumed that in the projection period (2021-2030), Sergipe's economy would follow the same growth rate as Brazil.

Figure 1: GDP Growth rates in Brazil and Sergipe (%)



Note: *For the period 2023-2026, the estimates for Brazil correspond to the values projected by the Focus report of the Central Bank of Brazil, while projections for Sergipe (2021-2023) consider that the state maintains growth identical to that of Brazil, according to the average for the period 2002-2020.

Source: Author's own based on System of Regional Accounts, IBGE (2022).

The choice of the simulation period until 2030 is justified by the attempt to align with the Development Plan of the State of Sergipe, settled by the State Legislative Assembly, as this research also aims to provide support to the state government in the formulation of public policies. Furthermore, the model has a top-down specification for all 75 municipalities of Sergipe which it is used to simulate impacts on regional disparities, a fact that cannot be overlooked when it comes to processes of economic growth and development.

All macroeconomic variables used in the baseline scenario are described in Table 2. For the period 2015-2022, we utilized observed macroeconomic variables for the Brazilian economy, along with the observed and projected GDP growth rates for Sergipe.

Table 2: Macroeconomic variables of the baseline scenario (%) – 2015-2022

Period	2015	2016	2017	2018	2019	2020	2021	2022
Real GDP	-3.55	-3.28	1.32	1.78	1.22	-3.28	4.99	2.90
Household consumption	-3.20	-3.77	2.09	2.33	2.62	-4.46	3.69	4.28
Government consumption	-1.44	0.21	-0.67	0.79	-0.49	-3.69	3.46	1.53
Investment	-13.95	-12.13	-2.56	5.23	4.03	-1.75	16.49	0.89
Export	6.82	0.86	4.91	4.05	-2.56	-2.29	5.87	5.54
Sergipe's GDP	-3.24	-5.23	-1.13	-1.79	3.57	-0.98	4.99*	2.90*

*Projections for Sergipe considering that the state maintains growth identical to that of Brazil, according to the average for the period 2002-2020.

Source: Author's own base on System of National Accounts, IBGE.

To design better policies for the State of Sergipe, our prospective policy scenarios are composed by 41 independent simulations of investments shocks in each of the 41 sectors of the State, assuming every sector receives a R$ 10 million investments in 2024. Comparing simulation results we can elect the most effective sector for the allocation of public resources considering

different policy goals, such as GDP growth, employment growth, or regional inequality decrease.

To estimate the effects on regional inequality in Sergipe, as in Ribeiro et al. (2018; 2019), we calculate the ex-ante and ex-post Gini index in the impact analysis for each sector, to assess to what extent an investment in a specific sector changes the distribution structure of the GDP among municipalities in Sergipe. If the variation between these two indexes is negative, it means that the investment allocation in that specific sector contributes to reduce regional inequality.

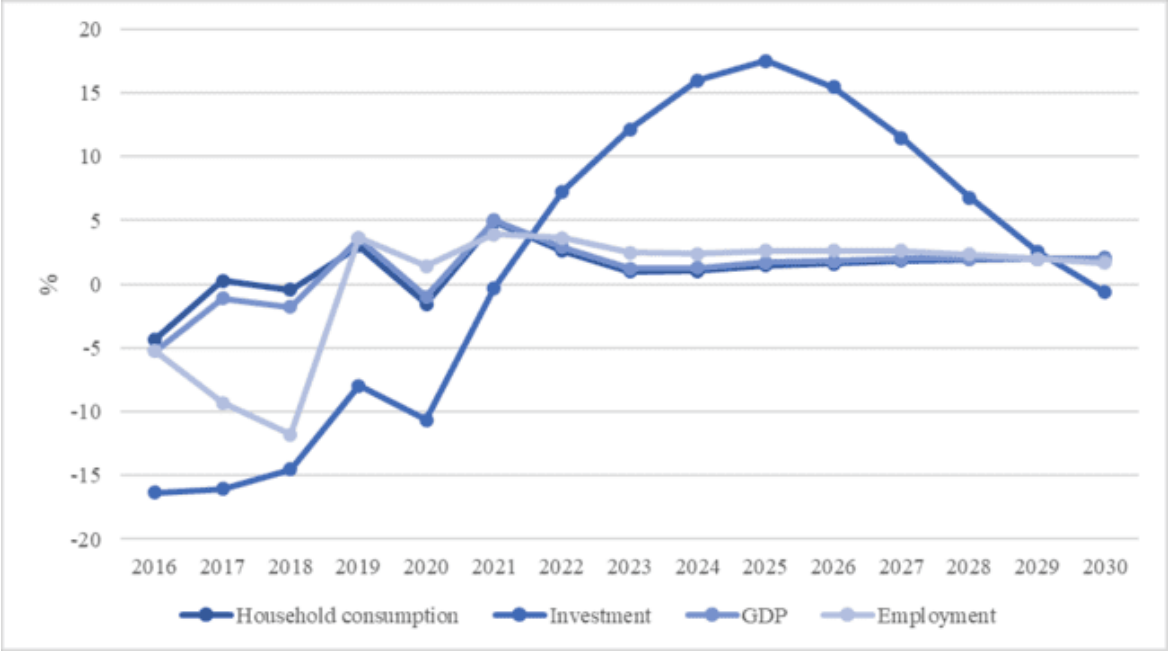
3. Results and discussion

The findings are delineated in two distinct sections. Firstly, we delve into the baseline scenario, providing insights into Sergipe's economic structure and projecting its trajectory based on observed historical growth. Subsequently, we present policy outcomes, elucidating the potential impact of sector-specific investments on altering the baseline projections.

3.1. Baseline Scenario

Initially, Figure 2 illustrates the behavior of the main macroeconomic aggregates in the baseline scenario, i.e., without any exogenous economic policy intervention. More specifically, we observe the results obtained for household consumption, real investment, aggregate employment, and real GDP in Sergipe for the period 2016-2030. Starting in 2027, the uniform behavior of GDP is explained by assuming the hypothesis that during these years, the state experiences a constant growth rate of 2%, matching the national average.

Figure 2: The trend trajectory of macroeconomic variables in Sergipe (%)



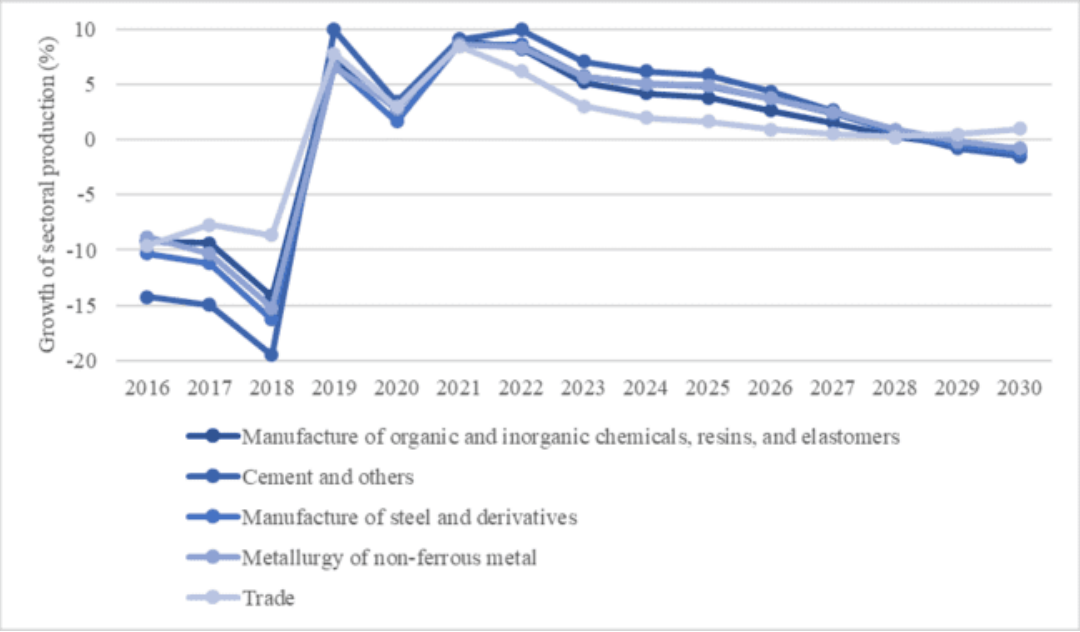
Source: Author's own based on CGE simulations.

Owing to the dynamic nature of the model, the most variable component in the forecast scenario is real investment, displaying a pronounced trend. Between 2020 and 2025, it experiences a robust growth pattern, explained by a recovery period, after COVID-19 pandemic effects (which showed a large decrease in gross fixed capital formation.). After this interval, it

undergoes a deceleration, which is expected in the dynamic simulation strategy where investments tend to return to trend levels after adjustments. Therefore, by 2030, investment returns nearly to the rate it had in 2021. The household consumption, by assumption, follows the behavior of GDP. The employment tends to grow slightly more than the GDP, because of the main economic sectors behaviour, especially related to services and trade.

In terms of productive structure, Figure 3 depicts the trajectory of economic sectors in Sergipe with the highest growth in sectoral production in the baseline scenario. These sectors include: i) Manufacture of organic and inorganic chemicals, resins, and elastomers; ii) Cement and others; iii) Manufacture of steel and derivatives; iv) Metallurgy of non-ferrous metals; and v) Trade. This outcome is a consequence of investment recovery, which is aligning with the trend in Brazil. The main sectors responsible for growth in Sergipe include traditional industries and trade, which has the most persistent growth until the end of the period and is an important sector to create employment.

Figure 3: Trend trajectory of sectoral production, selected activities in Sergipe (%)



Source: Author's own based on CGE simulations.

3.2. Policy Scenarios

As mentioned previously, we conducted 41 simulations, each corresponding to an individual sector within the model. In each simulation, a uniform investment of 10 million reais was allocated to the respective sector.

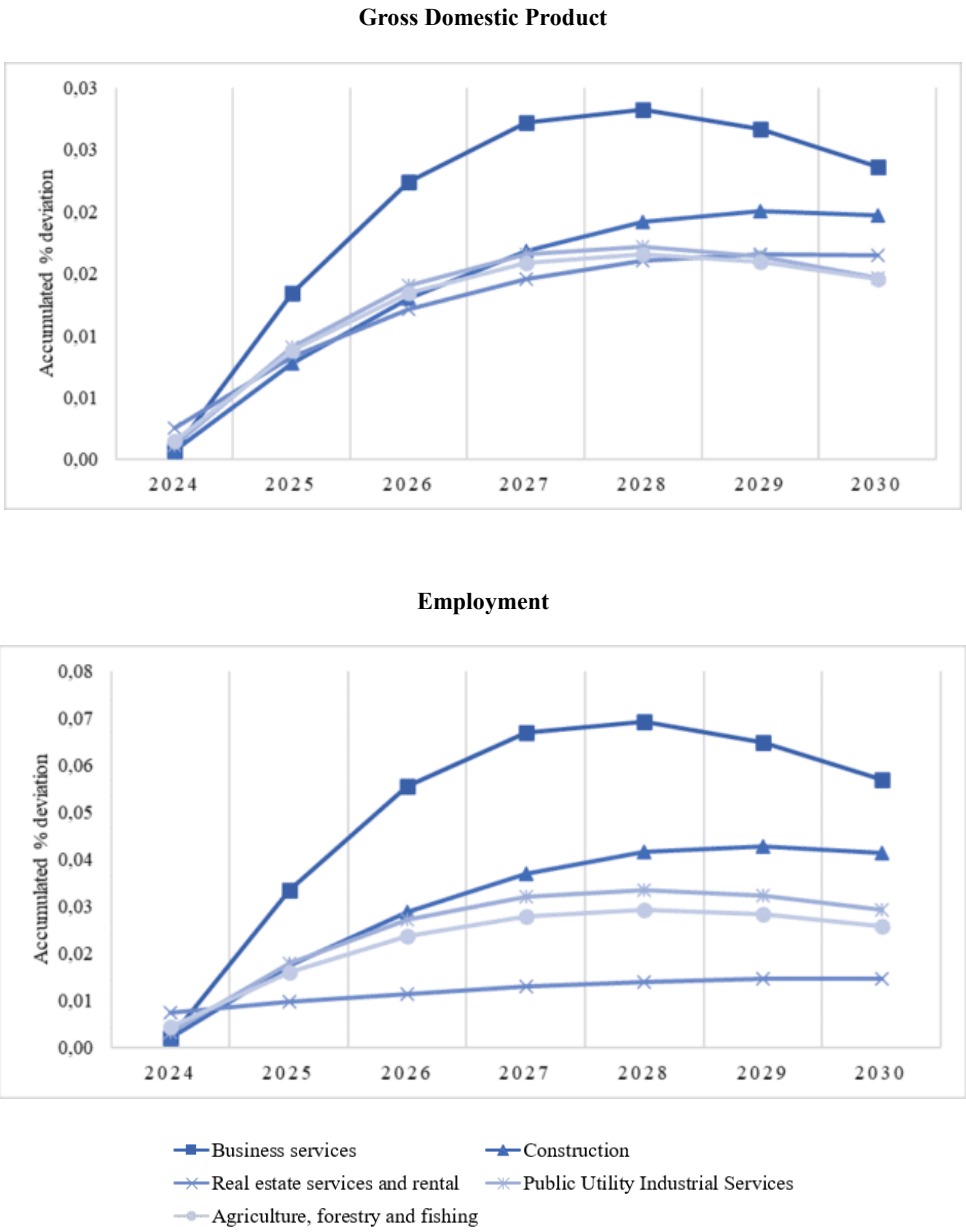
Figure 4 illustrates the trajectory of GDP and employment for the five sectors estimated to generate the greatest effects on the state GDP: i) Business services, ii) Construction, iii) Real Estate Services and rental, iv) Public Utility Industrial Services (SIUP), and v) Agriculture, forestry, and fishing, respectively.

The trajectory of growth of these economic sectors in Sergipe, related mainly to services and agricultural sector, follow the tendency of the Brazilian economy. According to Diniz and Mendes (2021), among the structural changes in Brazil can be mentioned the increase of the importance of services in employment, the infrastructure investments, and the dynamic of the agrobusiness.

Regarding the SIUP sector, it is worth noting that, starting in 2020, the largest natural gas-fired Thermoelectric Power Plant in Latin America began operating in the state of Sergipe. Viera et al. (2021) estimated that their cumulative long-term impact on Sergipe's GDP by 2030 would be 6.55% above the reference scenario.

From a top-down perspective, Figure 5 illustrates the municipal impacts on GDP and employment in the five sectors that would generate the most significant effects on the state GDP: i) Business services, ii) Construction, iii) Real Estate Services and rental, iv) Public Utility Industrial Services (SIUP), and v) Agriculture, forestry, and fishing. In general, the impact of the two variables exhibits spatially similar behaviors, albeit in different magnitudes. Additionally, due to the competitive effect inherent in the CGE models, some municipalities experience a cumulative negative impact by 2030.

Figure 4: Effects on GDP and employment for the for the five sectors with the greatest impact in Sergipe (%)



Source: Author's own based on CGE simulations.

Figure 5A: Business services: Impacts on GDP and Employment, accumulated deviation (%)

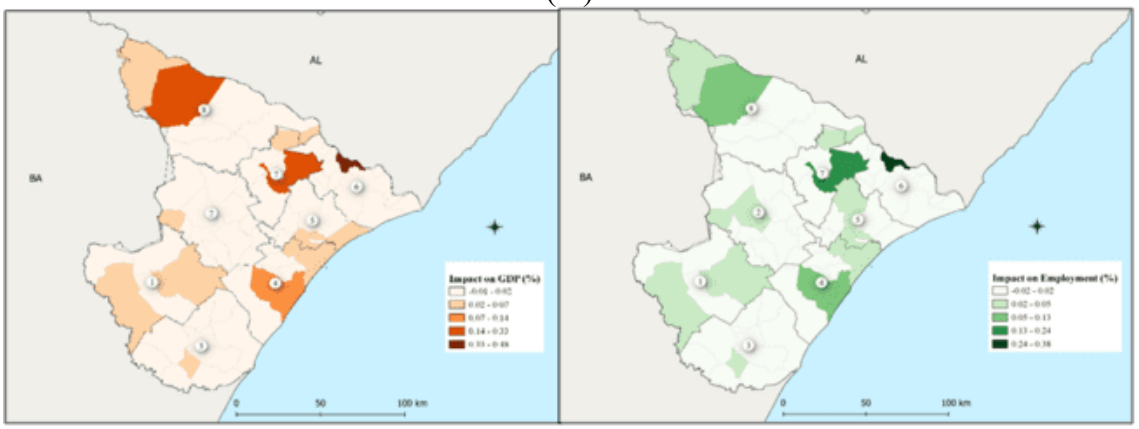


Figure 5B: Construction: Impacts on GDP and Employment, accumulated deviation (%)

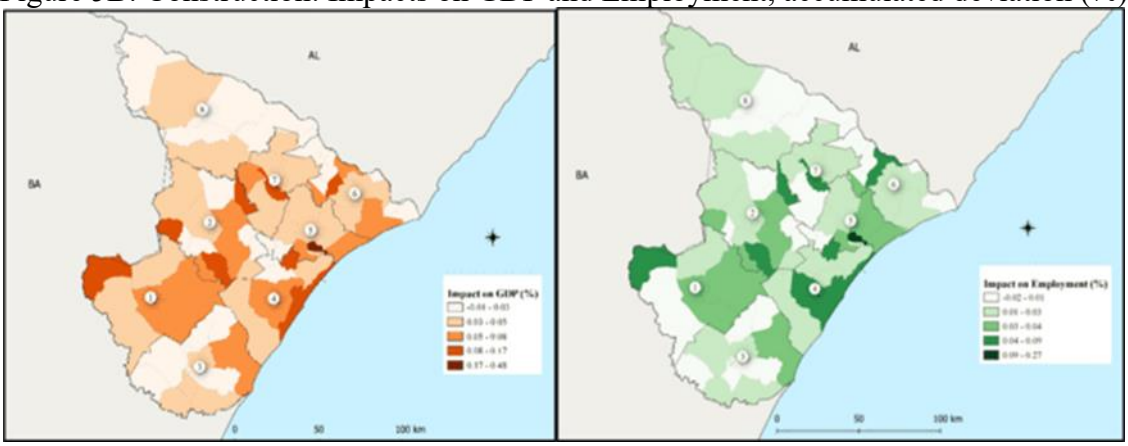


Figure 5C: Real state: Impacts on GDP and Employment, accumulated deviation (%)

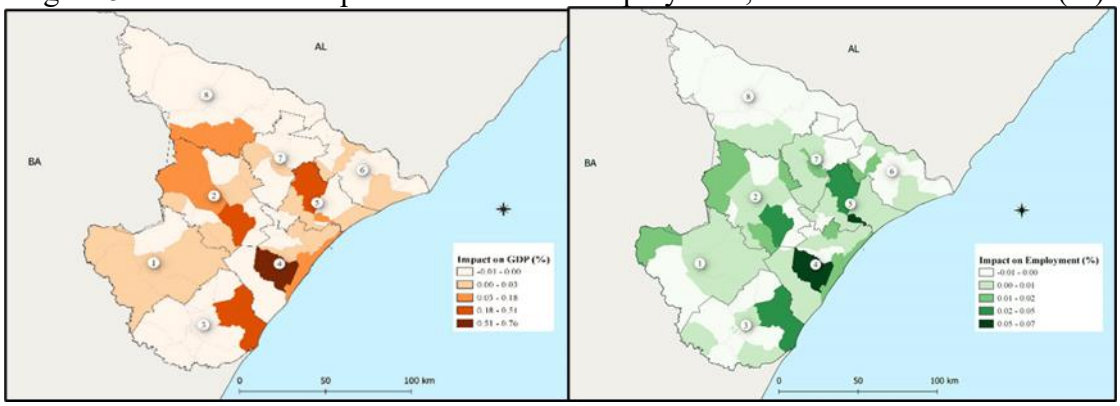


Figure 5D: SIUP: Impacts on GDP and Employment, accumulated deviation (%)

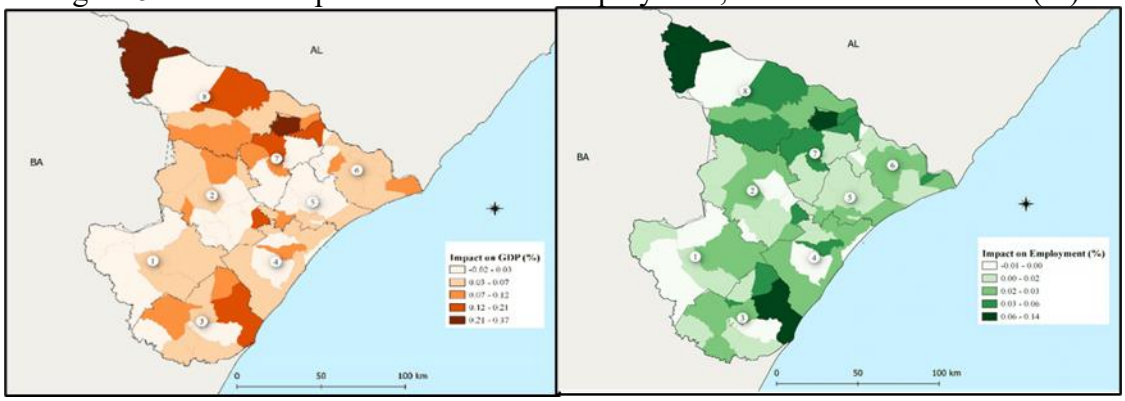
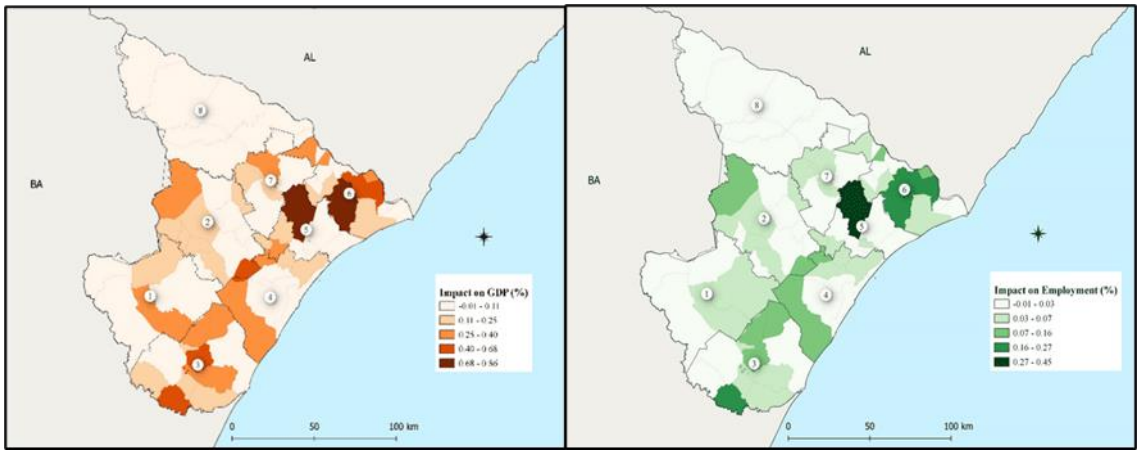


Figure 5E: Agriculture: Impacts on GDP and Employment, accumulated deviation (%)



Source: Author's own based on CGE simulations.

The greatest impacts in Business services (Figure 5A) would be in Propriá, Aquidabã, Cumbe and Poço Redondo with a GDP accumulated variation between 0.19% and 0.48%. Following closely are three municipalities that constitute the Metropolitan region of Aracaju: São Cristóvão (0.14%), Aracaju (0.12%), and Barra dos Coqueiros (0.07%).

In Figure 5B, a greater spread of the economic impact is observed due to investments made in the Construction sector. A highlight can be given to the planning region 5, where occurs the exploration of mineral resources like petroleum and potassium. The cumulative impact on municipal GDP in 2030 would range between -0.01% and 0.48%, while on employment, it would vary between -0.02% and 0.27%.

Figure 5C depicts the greatest impacts in the Real estate sector, with highlighted municipalities located in planning region 4 – Greater Aracaju, which encompasses the Metropolitan region's municipalities. It is worth noting that the three municipalities with the greatest impact on GDP, São Cristóvão, Estância, and Itabaiana, host campuses of the Federal University of Sergipe, which, in part, explain this result. The effects of the university expansion can be direct, by increasing the renting activity, or indirect, by improving the entrepreneurship and the economic activity in the respective cities. Authors like Ndaruhutse and Thompson (2016) and Garcia (2018) bring some of the effects of the university to the regional economy.

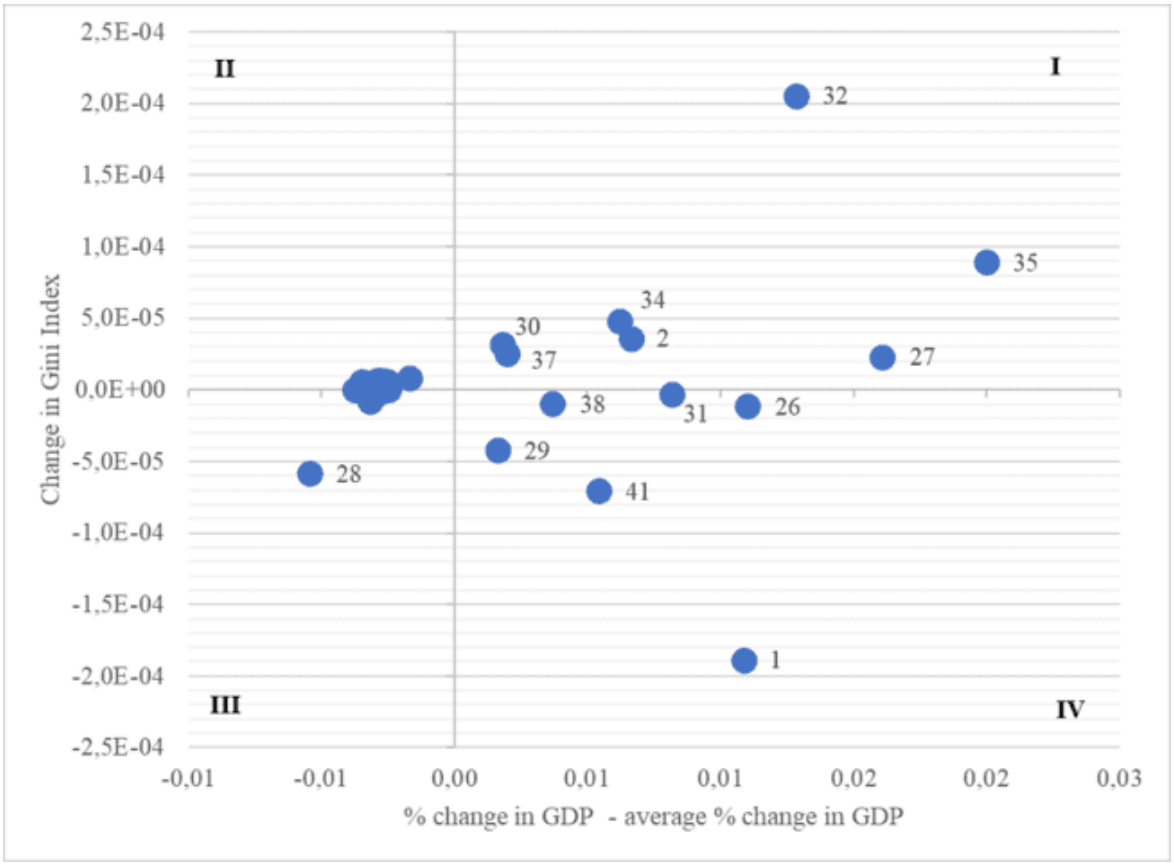
In Figure 5D, the municipality Canindé do São Francisco, located in planning region 8 – Alto Sertão Sergipano presents the highest impacts on GDP and employment. We can interpret this effect as a direct impact, given that the Xingó Hydroelectric Plant is in this municipality. This is the biggest Hydroeletric Plant of the Brazilian Northeast, with a production capacity of 3.162MW. In planning region 3 – Sul Sergipano, 13 municipalities are supplied by Sulgipe, one of the electricity distributors in the state.

The most significant outcomes in Agriculture (Figure 5E) are observed in planning regions 5 – Leste Sergipano and 6 – Baixo São Francisco, with impacts ranging between 0.68% and 0.86% on GDP and 0.27% and 0.45% on employment. The planning region 5 is characterized by a significant cultivation of sugarcane. And in the planning region 6, where is located an important fruit growing hub, stands out the cultivation of pineapple, rice, banana, and coconut, primarily due to irrigated production from São Francisco River. The western part of the state, covered mostly by territory 2 – Agreste Central Sergipano, is notable for corn production, while in the south, orange cultivation is prominent.

Figure 6 illustrates a typical tradeoff between efficiency, measured by real GDP growth, and equity, assessed by the variation in the Gini index. We can group sectors based on characteristics distributed across four quadrants: I) above average impact on GDP and an increase in regional disparity; II) below average impact on GDP and an increase in regional disparity; III) below average impact on GDP and a reduction in regional disparity; and IV) above average impact on GDP and a reduction in regional disparity.

Based on this, in quadrant I, sectors 2 – Oil and gas, 27 - Construction, 30 - Information services, 32 - Real estate services and rental, 34 - Accommodation and food services, 35 - Business services, and 37 - Private health services, despite contributing to the long-term GDP growth of Sergipe, would have an effect of increasing regional disparity. On the other hand, in quadrant IV, sectors 1 - Agriculture, forestry and fishing, 26 - Public Utility Industrial Services, 29 - Transport, storage and mail, 31 - Financial intermediation and insurance, 38 - Other services, and 41 - Public administration and social security, upon receiving investment inflows, would have the potential to stimulate economic growth while simultaneously contributing to the reduction of regional disparities in Sergipe The outcome of sector 28 - Commerce stands out in quadrant III, meaning that once stimulated, its long-term effect on GDP tends to be negative, despite its contribution to reducing regional disparity.

Figure 6: Economic Growth versus Regional Inequality



Source: Author's own based on CGE simulations.

4. Final remarks and policy implications

This paper aimed to build and evaluated long-term scenarios of the Sergipe economy, identifying sectors with greater capacity to leverage the state's economic growth and mitigate regional disparities. Thus, we used a dynamic and inter-regional CGE model with a top-down specification.

Historically, the sectoral allocation of resources is often based on political criteria. In contrast, this article has provided a technical criterion that identifies sectors capable of yielding more efficient long-term results in terms of impacts on GDP and employment, while also mitigating effects on intraregional inequality within the state.

The main findings indicate that Sergipe have lost its industrial dynamics and the sectors related to services and agriculture have increased its economic importance, like occurs in the Brazilian economy. The following sectors would have the greatest impacts in 2030 when receiving the same investment influx: Real estate services and rental, Construction, Financial intermediation and insurance, Business services, Public Utility Industrial Services (SIUP), but only financial intermediation and SIUP also have positive impact on reduce regional disparity.

In the coming years, the oil and gas sector in Sergipe will receive a significant influx of investments due to the exploration of new reserves in deep waters. Therefore, since our results indicate that investments in this sector are likely to increase regional inequality among municipalities in Sergipe, it is crucial that equity policies be implemented concurrently with these investments to counterbalance this effect.

On the other hand, primary limitations are associated with data constraints. The calibration of data utilized the 2015 input-output matrix, as previously indicated. While this matrix represents the most recent official data available, it does not encompass the impacts of the COVID-19 pandemic on the productive structure. Moreover, owing to the absence of inter-regional matrices from Brazilian statistical agencies, we used estimated inter-regional flows. Additionally, the model does not incorporate considerations for technological changes in the production structure.

As step forward, in future research, we can conduct ex-ante evaluations of specific investment project portfolios of the state government of Sergipe, as well as assess policies and/or programs ex-post, with the aim of enhancing their efficiency.

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