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# ANALYSIS OF THE SUSTAINABILITY AND MACROECONOMIC IMPACTS OF THE INVESTMENT POLICY OF THE GOVERNMENT OF THE STATE OF CEARÁ

**James Ferreira**

SEFAZ

**Paulo Matos**

CAEN/UFC

**Cristiano da Silva**

CAEN/UFC

**Fabrizio Gomes**

SEFAZ

## Abstract

This paper consists of the most extensive and recent study on the investment policy of the Government of the State of Ceará, a leading national (state) federative entity since 2016. It addresses a context about public investments associated with the fiscal situation of the government in question, from two fundamental reflections. The first is about the management of public accounts, which includes flow and stock variables, of revenues, expenses and debt, so that one can infer about sustainability, i.e., the robust and resilient continuity of the conduction of public investments. The second about the need to promote an evaluation practice of public policies aimed at investments, to be conducted ex ante, during and ex post the investment itself, which suggests measuring the isolated impacts of these investments on socioeconomic indicators over time.

**Keywords:** Public Investments; Primary Current Surplus; Debt; Socioeconomic Indicators; Subnational Federative Entities.

**JEL:** H61, H63 and H74

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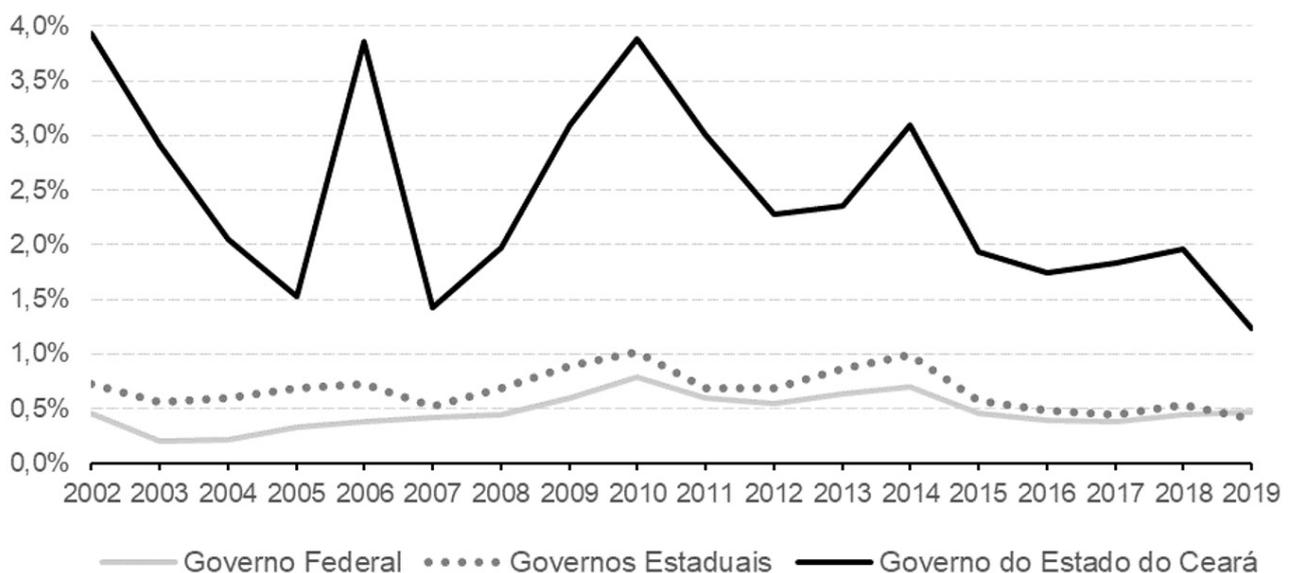
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## 1. Introduction

The subnational federative entities in Brazil are seen by society as providers of essential services, especially in the areas of health, education, public security and social security, if we consider their respective representativity in the total current expenditure committed.

There is, however, another function of the state also seen by society as essential: the state as public investor. According to Bonomo, Frischtak and Ribeiro (2021), about 2/3 of public investments (excluding state-owned companies) are made by subnational governments, that is, by the 26 states, the Federal District and 5,570 municipalities. Since these entities are facing a fiscal crisis, with difficulty in paying their short-term liabilities, there is evidence of a consistent reduction in public investments. Chart 1 reports the investment data as a ratio of the respective Gross Domestic Products (GDP) of the Federal Government, aggregating the State Governments and the State Government of Ceará, from 2002 to 2019.

**Chart 1.** public sector investment (% of GDP)



Source: Own preparation, based on data reported in Bonomo, Frischtak, and Ribeiro (2021).

The trajectory of the Union's investment presents a cyclical behavior, with an average distance between the five-year peaks, around an average investment of 0.5% of the GDP. As far as the State Governments are concerned, less persistent and more volatile cycles are observed, with the investment rate oscillating between 0.5% and 1% of the GDP. It is worth noting that only in the last period of the sample, the investment rate of the State Governments was relatively lower than that of the Union, indicating a more severe retraction in public investments made by the Federal Units as of the 2014 fiscal crisis. The State of Ceará presented an investment rate (% GDP) higher than the State Governments and the Federal Government throughout the sample period. In specific terms, the public investment of this Government oscillated between 1.2% (2019) and 3.94% (2002), presenting similar cyclical phases

as the other entities as of 2006, but with greater amplitude in its oscillations. A downward trend in investments is observed as of 2012.

Finally, despite the adverse scenario experienced by all entities of the federation since the fiscal crisis of 2014, it is important to highlight that Ceará is the state with the highest ratio between investments and Net Current Revenue (RCL) since the year 2016, with the public investment policy consolidating itself as one of the vectors for the development of the state. For the year 2020, the state government recorded R\$ 2.48 billion in committed investments, or 11.3% of the RCL.

This context about public investments associated with the fiscal situation of the government in question suggests two essential and fundamental reflections. The first would be about the management of public accounts, which includes flow and stock variables, of revenues, expenses, and indebtedness, so that one can infer about sustainability, that is, the robust and resilient continuity of the conduction of public investments. The second would be about the need to promote an evaluation practice of public policies aimed at investments, to be conducted *ex ante*, during and *ex post* the investment itself, which suggests measuring the isolated impacts of these investments on socioeconomic indicators over time, if possible, with different frequencies.

Beginning with the fiscal aspect, it is understood that the debt management of a federal entity needs to stick to the legal and operational aspects. However, in states with an unbalanced fiscal situation and whose inequality and poverty indicators suggest concern, it seems equally fundamental that debt management be based on 7 economic pillars: i) solvency, ii) scenario-based forecasting, iii) modeling of determinants, iv) resilience, v) transparency, vi) risk management, and vii) relationship with economic growth.

The reason for this is the foundation that suggests that the long-term consequences on economic growth are positive, based on an austere state public policy, whose credit operations are aimed at specific strategic public investments that complete the market. Based on the premise that the counterpart of public investment also lies in obtaining alternative sources of revenue from domestic and foreign credit operations, domestic and foreign debt management and its relation with economic growth really needs to be the object of study. This context imposes not only on the managers of the state executive branch, but also on the external control organs an indispensable challenge to make allocational efforts of resources and human capital to both monitor and predict fiscal imbalances of the jurisdictions.

Still in this initial context of fiscal management, in addition to the management of the internal and external debt of a federal entity, the monitoring of the relationship between the current primary surplus and the flow of investments is equally important. It is necessary to emphasize that the state can conduct its investment policy from alternative sources of revenue and with its own resources, i.e., its current savings. On this question, little explored in the literature of public finances of the states in Brazil, there is a classical theoretical reference in Barro (1990), who constructs a growth model

including public services and investments as a productive input for private producers. On the other hand, there is a literature that suggests the possible existence of “misallocation” of public investments when made with own resources (primary current surplus), or with alternative sources of resources (credit operations).

Adding to this theoretical and empirical discussion, a recent study applied to Brazil stands out. Based on a panel of data between 2013 and 2017 for subnational federative entities, Matos and dos Santos (2020) highlight that the estimates of the full model suggest that capital and current spending are relevant and different drivers of growth across states in Brazil. Importantly, the elasticities of government capital and current spending to GDP growth, 1.01 and -1.75, respectively, stand out. According to the joint Wald test, these impacts are statistically different. Still with regard to capital expenditures, even though there is no consensus on causality between infrastructure and economic growth, according to Amann et al. (2014), a 1% increase in investment spending in Brazilian states generates a 0.072% increase in the corresponding GDP per capita.

However, this capital expenditure, i.e., investments, must be accompanied by private investment, since the negative role played by government credit in relation to GDP is also evident, due to the significant elasticity of -0.87. In other words, it is necessary that the public sector creates the initial conditions for the private sector to leverage investments, bringing about economic development.

In this scenario, this work adds to the public finance literature applied to Ceará, with emphasis on Simonassi et al (2013), Aguiar (2017), Matos and Santos (2021 a, b) and Matos (2021), as well as, to the instruments produced by the Finance Department of Ceará and the Audit Court of the State of Ceará, by proposing a statistical and mathematical study on the investments of the Ceará State Government over almost two decades, addressing the sustainability of the conduct of this investment flow and its relationship with social and economic variables, such as economic activity, tax collection, and formal job generation.

The reason for this study lies in the fact that the management of public accounts is a relevant vector in generating social welfare and improving socioeconomic indicators. The analysis suggested here, starting from the ambience evidenced in Ceará in relation to the other federal entities with emphasis on the fiscal side, is important specifically for the state in question, due to its persistent uncomfortable situation in socioeconomic indicators. Based on the Gini income inequality coefficient series, from 2009 to 2016, the state oscillated in position, going from a worrisome 6th place in 2010 to a comfortable 21st place in 2015. On average, the state is 12th, and 9th if only the year 2016, the last available in the National Household Sample Survey (PNAD), is considered.

Besides being very unequal, the percentage of the population that is poor based on caloric needs, according to IPEADATA, is also very worrying. Ceará was already the 9th poorest state in 2009, with 36.4% of the population in this situation, and in 2014 it was the 6th, with 24.9%. In other words, the state, sometimes in partnership with the union, has been conducting public policies that manage

to reduce a little the Gini and more markedly poverty, but at a pace that does not seem to be enough to make the state's ambience interesting in relation to the southern and southeastern states, which either had better values before or evolved even more than Ceará. The analysis of GDP or per capita income show that despite the evolution in terms of "market share" in terms of the country's GDP, from 1.3% (1970s) to 2.23% (2018), there is a picture of persistence in the state's ranking. Based on GDP per capita, for example, despite the growth rate being higher than that of the country, since 2014 the state oscillates between 21st and 23rd in the ranking.

According to 2018 data from the Brazilian Institute of Geography and Statistics (IBGE), in absolute terms, Ceará had a GDP of R\$156 billion, the 12th highest in the country. In per capita terms, Ceará's GDP was nearly R\$17,400, while Brazil's was approximately R\$34,000. Based on this per capita GDP, Ceará ranks 23rd out of 27 states, including the Federal District. The other 4 states behind Ceará are all northeastern states. Also in 2018, according to the International Monetary Fund (IMF), Brazil ranked 63rd in a ranking with 176 countries, considering GDP per capita in dollars, controlled by purchasing power parity. If Ceará were a country, in this ranking of GDP per capita it would be between Paraguay and Iran, exactly in the 95th position.

Given this scenario, it is appropriate to analyze the recent empirical literature on the determinants of some of these indicators from modeling applied in the panel or cross-state dimension. In this discussion, Matos (2020) stands out, suggesting the modeling of three classic social and economic indicators, following a common premise: the insertion of efficiency and austerity as additional explanatory variables to the original panel models. Thus, for each variable to be explained, an approach considered classical and well accepted in the literature is used, and to this specific modeling, the insertion of the two variables is suggested. In summary, this recent empirical exercise suggests that the short-term GDP growth of Brazilian states from 2009 to 2014 seems to be the consequence of a non-austerity and inefficient fiscal policy.

In social terms, we suggest modeling both poverty and inequality by adding austerity and efficiency to the frameworks originally developed. Observing the more social indicators, both the reduction of poverty and income inequality have been promoted at a fiscal cost, characterized here by the worsening of the fiscal conditions of the states. On the other hand, a public policy that focuses on the efficient use of financial resources is statistically relevant to reduce both social indicators, with greater impact on combating inequality measured by the Gini.

It is appropriate to analyze these results with great caution, understanding it to be a short-term effect based on an empirical study whose time sample goes from 2009 to 2014. In other words, the intuition and conviction that the state should remain with its strategy of austerity and efficiency should override the evidence that other states have grown at the expense of an explosive debt, for example, because this is not the choice to be made by Ceará.

The summary of Ceará's scenario and context in relation to the others is that the state persistently ranks among those with the worst social and macroeconomic indicators, its favorable ambience being characterized by being a state that invests and prioritizes education, fundamental pillars in growth models.

In this context, it is possible to summarize some of the main results obtained in this work. Initially, regarding the analysis of the sustainability of investments, based on the solvency of the external and internal debts, it is possible to infer that in the very short-term, that is, with lags of 1 to 2 bimesters, there was a sign of solvency of the external debt in 2019, given that there is a cyclical influence of this debt on the surplus, with a reaction whose parameter was around 0.16. In the medium-term, a new solvency signal is observed during the years 2016 to 2017, with a new cyclical commotion determined by the external debt, but now with a lower frequency, with a discrete reaction (approximately 0.02) of the surplus about 2 years later. This evidence of external debt solvency, even if for some periods, corroborates in part the previous evidence reported in Matos (2021).

Another very relevant and totally innovative evidence, which suggests there is a robust and continuous long-term relationship from 2014 to 2017, characterized by the dominance of the surplus cycles, which strongly influenced in a phasic way (parameter with value greater than 1.0) the external debt cycles with a lag that can reach up to 5 years. Finally, between the end of 2012 and 2013 there are in the short-term antiphasic movements of the cycles of domestic debt and surplus, not being possible to identify a dominance by one of the variables. From 2016 to the beginning of 2018, there are cycles that start to move in the same direction with a frequency of two years, and again without any determined dominance. This result does not corroborate the evidence of domestic debt insolvency reported in Matos (2021). The only relationship where dominance can be asserted is evidenced during the period and 2014 to 2017. It is a long-term relationship, as well as the one reported for external debt, also with influence of surplus cycles at the 5-year frequency, however, with opposite directions and with very strong intensity, since the parameter assumed values greater than 2.5.

In other words, the period from 2014 to 2017 is characterized by the dominance of the primary current surplus, whose long-term cycles have determined the external debt cycles in the same direction and the domestic debt cycles in the opposite direction.

With respect to the impact of the State Government of Ceará's investment policy on selected macroeconomic variables, the influence of investments in construction/facilities on the volume of retail sales between the second semester of 2012 and the first semester of 2013 was identified. The impact is at a frequency of 3 years, denoting the maturity period of the structural investment policy, with low elasticity of impact.

Regarding the industrial sector, it can be denoted that the indicator of activity of the industry (PIM/PF-IBGE) influenced the cycles of state public investment in permanent equipment/material

in the short-term, between 2006 and 2009, and in the medium-term, between 2009 and 2012. Along this line, we conjecture the possible existence of a pressure from the secondary sector in the demand for public goods at the end of the decade of 2000, influencing the expansion phase of the investment cycle until the advent of the international crisis of 2008. In the second stage, the retraction in industrial activity observed post - subprime crisis contributed to an inversion in public investment in the medium-term cycle (3 years duration). Investment in works/facilities had a phasic influence on industrial activity only in the period from 2009 to 2010. However, it should be noted that the sensitivity of industrial activity to the investment cycle in works/facilities was of low magnitude.

The analysis of the results of the relation between permanent equipment/material and economic activity, measured by the IBCR-CE, suggests that there are co-movements in the same direction in the short-term between 2005 and 2008 and in the medium-term between 2009 and 2012. Regarding the first temporal interval, there is no clear definition of temporal advance between the variables. Regarding the second interval, fluctuations in investments in works/facilities influence the dynamics of economic activity at the medium-term frequency, with a lag of approximately 3 years. The partial gain measure indicates elasticity greater than 0.04 in the effect of the investment cycle on the economic activity cycle.

On the fiscal side, it is possible to identify a significant short-term impact (less than 2 years) caused by the investment cycles in permanent equipment/materials in the tax collection cycles between 2006 and 2009, with a constant elasticity of around 0.12. The commotion evidenced between 2009 and 2012 does not allow us to identify the determinant variable. On the other hand, the commotions between the medium-term cycles of works/facilities and ICMS collection are significant between 2010 and 2012, but with questionable significance regarding the possible influence caused by investments.

However, when compared to the other results reported in this section, the employment variable provides the most robust evidence of the impact of both investment items, especially in relation to the duration of this impact. The medium-term cycles (that is, with lags ranging from 3 to 4 years) of investments in permanent equipment/materials proved positive and significant in determining the job creation cycles during the period between 2007 and 2011. The commotion thereafter is significant, but without evidence in terms of which variable is shown to influence the other. Even stronger and more robust is the evidence on the medium-term relationship, with cycles that present a phasic commotion with lags of 3 to 4 years, between investments with construction/facilities and job generation. Except for the period of approximately 2 years, between mid-2013 and mid-2015, during the interstice from 2007 to 2018, there was a positive and significant impact, characterized by the ability of the cycles of resources committed to this investment item to determine the cycles of formal jobs in the state of Ceará.

This paper is composed in such a way that section 2 discusses the ambience of the Ceará State Government based on the State Competitiveness Ranking, with emphasis on the Fiscal Soundness

pillar. Section 3 discusses the modeling of the fiscal reaction of said state government, as a subsidy to infer about the sustainability of the investment policy. Section 4 on the relationship between credit operations, current surplus and investment flow. The fifth section explores the historical conduct of investments over the last two decades Section 6 discusses about the relationships over time and with different frequencies between investments and social and macroeconomic variables. Conclusions are reported in section 7.

## **2. Fiscal Context of the Subnational Federal Entities**

### **2.1 Relative Ambience of the Ceará State Government**

Brazil moved up a notch in the World Economic Forum ranking that evaluates the competitiveness of 141 countries. The country moved from 72nd position (2018) to 71st on the 2019 list, based on the Global Competitiveness Index (GCI).

It is equally important to establish a parallel, however, by comparatively studying the Brazilian states, through objective and reliable rankings that measure the ambience and competitiveness of each federative entity. In this sense, founded in 2008, the Center for Public Leadership (CLP) is a social organization that aims to transform Brazil by developing public leaders and mobilizing society in structural causes for a better state. Among its online content, the Ranking of State Competitiveness stands out, made available annually since 2016. This important instrument of comparison, based on objective and technical criteria usually reported by international agencies, follows a well-established methodology, developed from an extensive international benchmark study and specialized academic literature on the subject. The construction of the ranking had two stages: i) data treatment and ii) weighting of indicators and pillars.

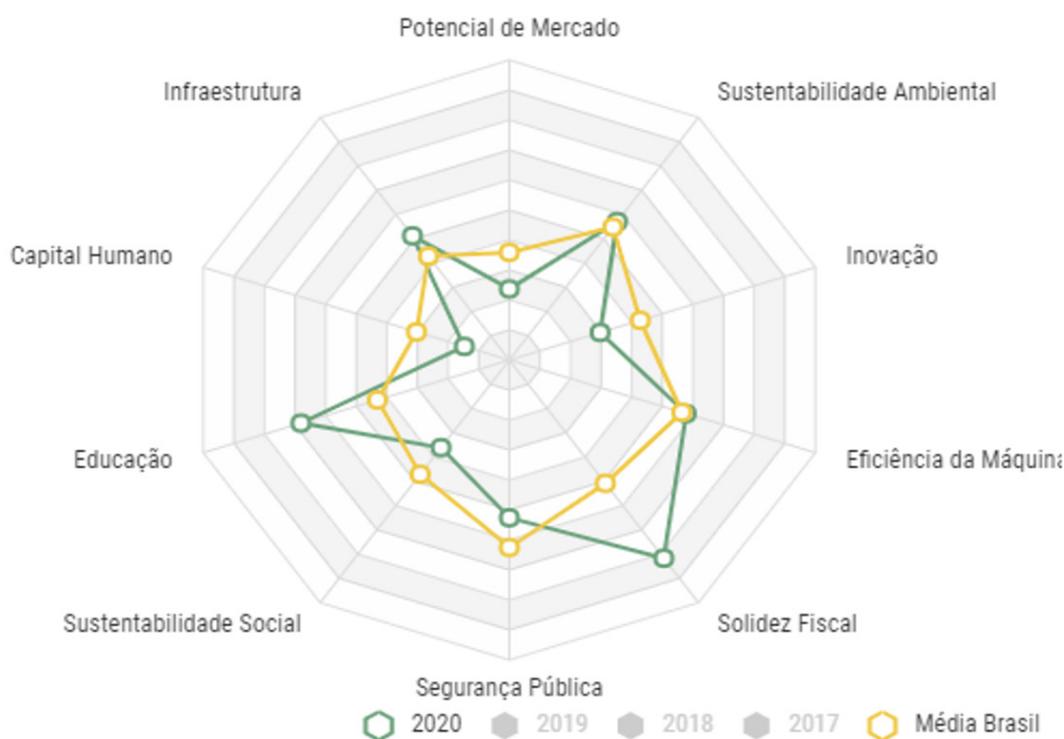
The data treatment is important to enable the aggregation of the indicators, given the different measurement units found in the 68 indicators. The criterion adopted was the normalization of the indicators between 0 and 100, maintaining the original dispersion of the data. This criterion is widely adopted in several other indexes and rankings, such as the Human Development Index (HDI). The data were normalized between 0 and 100, always obeying the criterion that the closer to 100, the better. Thus, for indicators that are inversely proportional, that is, the more the worse, the normalization was inverted. As an example, in the personal safety indicator, the state with the lowest homicide rate received a score of 100 and the state with the highest mortality rate received 0 (zero).

In addition, some adjustments are made in indicators where there is omission of information by some states. With the intention of promoting greater transparency in the disclosure of data, the federal entities that do not make information available are penalized with the last place in the ranking of this indicator and a very low score. In its latest version, each state can be evaluated, through their respective numbers in more than 70 objective indicators, grouped into 10 pillars: i) Market potential,

ii) Environmental sustainability, iii) Innovation, iv) Efficiency of the public machine, v) Fiscal strength, vi) Public security, vii) Social sustainability, viii) Education, ix) Human capital, and x) Infrastructure.

Chart 2 summarizes Ceará's situation in the year 2020 in relation to the country, looking at the indicators already aggregated by pillar. In this spider web graph, Ceará appears in the green line and Brazil in yellow. Initially, summarizing in a single value, Brazil presents an indicator of 47.5 and Ceará of 49.5, being Ceará in 10th in the aggregate ranking. In 2019, said state was 12th in the ranking, and the difference between it and the national average was minimal, signaling a recent improvement. Being one of the states usually ranked among the 10 worst in the main social and macroeconomic indicators, its position in the environment suggests a relative potential to be well exploited, vis-à-vis the other federal units.

**Chart 2.** states' Competitiveness Ranking - scores per Pillar Ceará State Government (2020)



Source: State Competitiveness Ranking by pillar, accessible at the following link: <https://www.rankingdecompetitividade.org.br/ranking/2020/pilar/solidez-fiscal>

A second step, from the perspective of the investor and policy makers, is to observe this ranking in a disaggregated manner, by pillar. Ceará obtained the following positions by pillar in 2019: i) Market potential (20th), ii) Environmental sustainability (14th), iii) Innovation (19th), iv) Efficiency of the public machine (9th), v) Fiscal strength (6th), vi) Public safety (26th), vii) Social sustainability (17th), viii) Education (5th), ix) Human capital (21st), and x) Infrastructure (9th).

According to Chart 2, Ceará stands out in relation to the country in 2020, only in the pillars: a) Infrastructure, b) Education, c) Efficiency of the Public Machine, d) Environmental Sustainability

and e) Fiscal Soundness. On the other hand, the state's distance in the pillars: a) Human Capital and b) Innovation draws negative attention.

This mapping or diagnosis by itself can be useful for the state to define which rubrics or pillars can and should be prioritized, either in the short-term or in the long-term, always analyzing the cost-benefit ratio of these measures. In this sense, it can guide decisions that aim to foster the potential of the workforce, associating this policy with the stimulus of access to higher education for the economically active population and consequently of its productivity, indicators in which Ceará has persistently been poorly positioned. Observing the public security pillar, the focus on the issues of prisoners without conviction and prison deficit can make the difference for Ceará to get out of the uncomfortable 20th position, for example. In the same way, the observation of the state's metrics in the indicators that make up the human capital pillar can be relevant to move the state out of the 22nd position in this indispensable pillar for economic growth.

In view of the pillars in which Ceará appears well in the rankings, we highlight the role of the state's evolution in the quality of telecommunications service and in the cost of electricity and basic sanitation, responsible for the improvement in Ceará's position in the infrastructure pillar.

It is fundamental to emphasize the effort made for more than a decade in education, with excellent values registered in the indicators for early childhood and high school education. It is also important to highlight the efficiency of the public machine, with emphasis on the transparency index, in which Ceará is in 3rd place in the country.

Ceará's greatest highlight, as seems to be corroborated by intuition and the impression made by society, resides in the fiscal pillar, a consequence of a history of austere managements by the state executive. This will be analyzed in more detail in the next subsection. The other pillar, in which the state also stands out, is education, whose position is 5th in the national ranking.

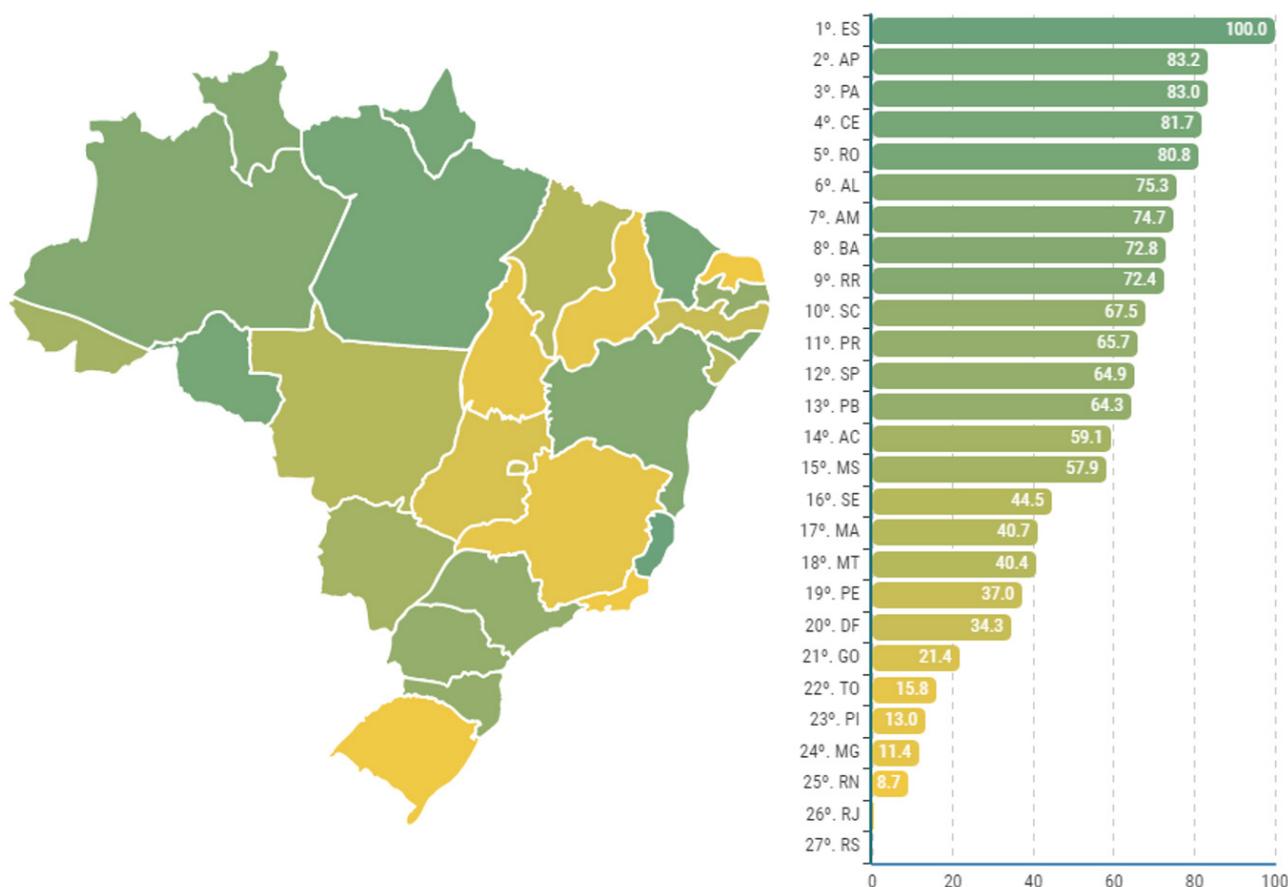
## 2.2 Relative Fiscal Position of the State Government of Ceará

Chart 3 shows the situation of the State Government of Ceará specifically in the Fiscal Soundness Pillar in the last year available in the State Competitiveness Ranking. As said, the state is ranked 1st in the Northeast and 4th in the country, the best national position among all the 10 pillars analyzed. In this pillar, the state's score was 81.7, close to the scores of the leading states, Pará and Amapá.

Table 1 reports the state's individual scores on all the indicators that make up the Fiscal Soundness Pillar for the years 2017 to 2020. Some of the indicators have changed over time, with some being created or discontinued over time. Looking at the indicators in 2020, there is a relative worsening of Ceará from 2017 to 2020 in Primary Result (difference between realized primary revenue and committed primary expenditure in the year, weighted by the state's nominal GDP), Fiscal

Solvency (ratio between Net Consolidated Debt (NCD) and Net Current Revenue (NCR)) and Budget Execution Success (settled expenditure by total updated expenditure).

**Chart 3.** State Competitiveness Ranking - Fiscal Strength Pillar (2020)



Source: State Competitiveness Ranking by pillar, accessible at the following link: <https://www.rankingdecompetitividade.org.br/ranking/2020/pilar/solidez-fiscal>.

There is some stability between 2019 and 2020 in the Liquidity (financial obligations as a ratio of gross cash) and Current Savings (current revenue minus current expenditure as a ratio of current revenue) and Fiscal Autonomy (ratio between own revenue and total revenue) indexes. In extremely important indicators, because they are monitored by the Complementary Law No. 101, of 05/04/2000 (Fiscal Responsibility Law), the state improved, with emphasis on the indicator Personnel Expenditure.

The main highlight consists of the state effort to maintain the highest Investment Capacity in the country, since the year 2016, this indicator being given by the ratio between liquidated investment and RCL.

Chart 4 reports the Government’s situation in the year 2020 in the 3 main fiscal indicators for the analysis suggested here in this project, which aims to: a) model the sustainability of investments,

through debt solvency, b) track the evolution of credit operations and the current surplus, and c) monitor the relationship between the flow of investments and macroeconomic and social variables.

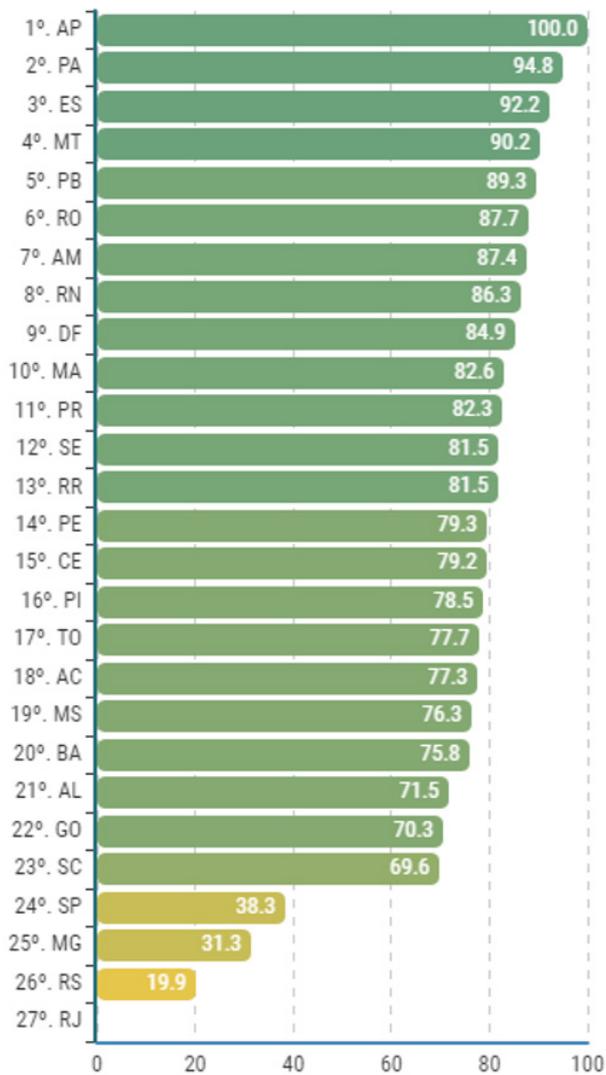
**Table 1.** Ceará Competitiveness Ranking - Fiscal Soundness Pillar Indicators (2020)

Solidez fiscal - Indicadores	2020		2019		2018		2017	
1. Autonomia Fiscal	52,3	15 <sup>º</sup>	60,3	14 <sup>º</sup>	55,3	16 <sup>º</sup>	56,0	16 <sup>º</sup>
2. Capacidade de Investimento	100,0	1 <sup>º</sup>						
3. Gasto com Pessoal	83,4	5 <sup>º</sup>	77,9	8 <sup>º</sup>	-	-	-	-
4. Índice de Liquidez	77,0	11 <sup>º</sup>	61,5	10 <sup>º</sup>	-	-	-	-
5. Poupança Corrente	47,4	8 <sup>º</sup>	54,2	10 <sup>º</sup>	-	-	-	-
6. Regra de ouro	77,4	8 <sup>º</sup>	-	-	-	-	-	-
7. Resultado Nominal	-	-	47,7	21 <sup>º</sup>	44,4	17 <sup>º</sup>	59,0	5 <sup>º</sup>
8. Resultado Primário	28,3	14 <sup>º</sup>	28,2	22 <sup>º</sup>	57,0	12 <sup>º</sup>	38,6	6 <sup>º</sup>
9. Solvência Fiscal	79,2	15 <sup>º</sup>	78,6	16 <sup>º</sup>	85,0	14 <sup>º</sup>	84,7	11 <sup>º</sup>
10. Sucesso da Execução Orçamentária	60,7	15 <sup>º</sup>	73,3	12 <sup>º</sup>	58,5	16 <sup>º</sup>	74,8	8 <sup>º</sup>

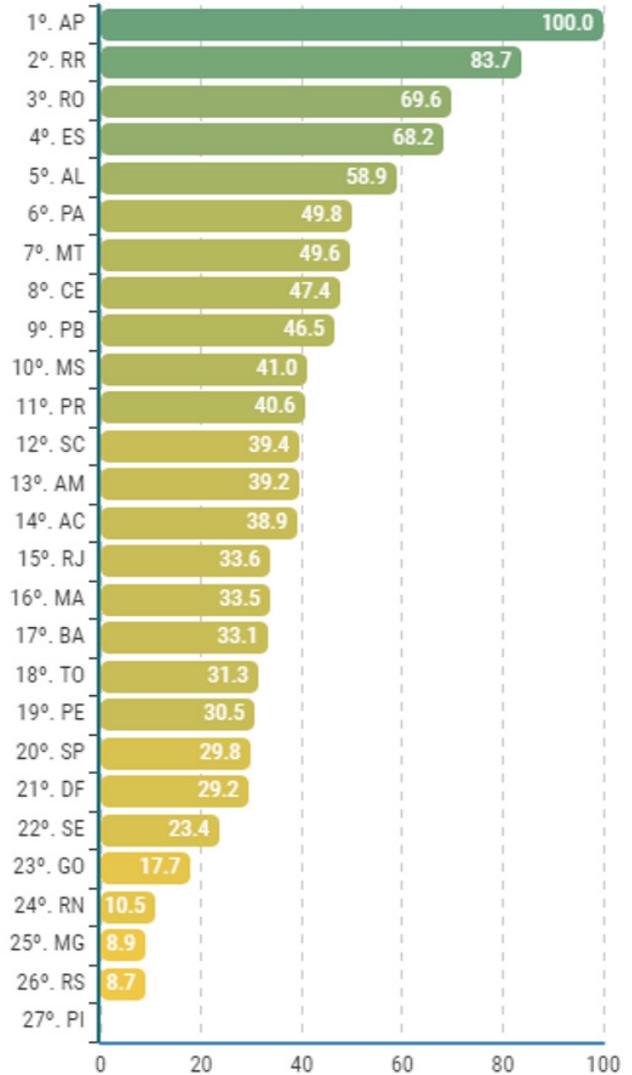
Source: Competitiveness Ranking of the States by indicator, accessible at the following link: <https://www.rankingdecompetitividade.org.br/ranking/2020/geral>

**Chart 4.** States' Competitiveness Ranking - Indicators: Fiscal Solvency, Current Savings and Investment Capacity (2020)

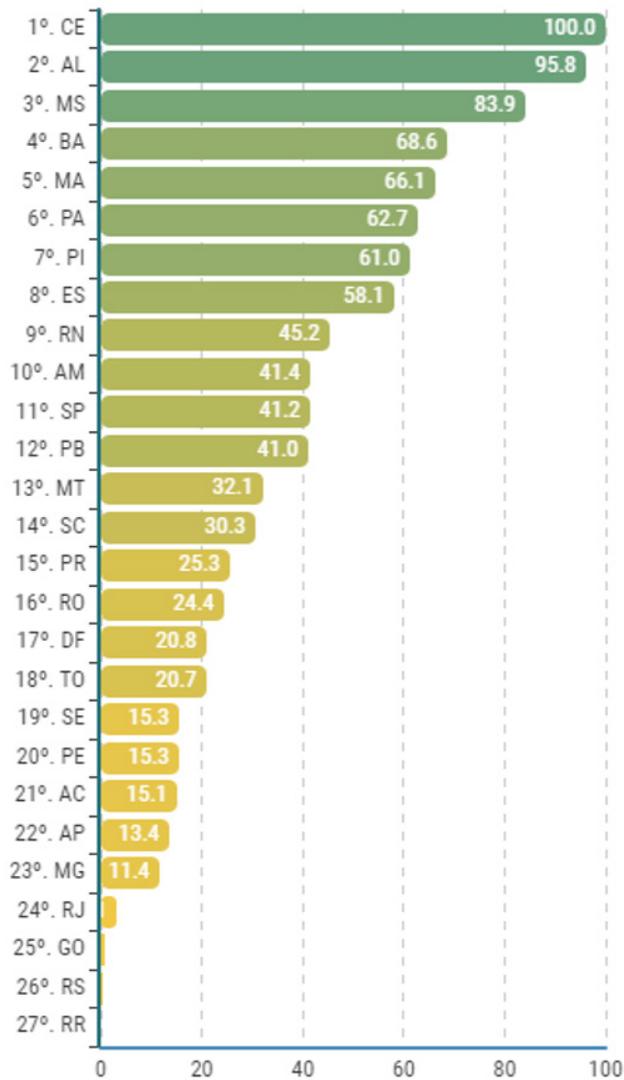
a) Fiscal Solvency



b) Current Savings



### c) Investment Capacity



Source: Competitiveness Ranking of the States by indicator, accessible at the following link: <https://www.rankingdecompetitividade.org.br/ranking/2020/geral>

## 3. Sustainability of the Ceará State Government Investments

### 3.1 Background on debt solvency and the sustainability of investments

The state is often attributed a vector of essential functions associated with the ability to regulate, stabilize shocks, redistribute income, foster economic activity, and promote social welfare. In this context, it is important to look at the public finance literature, which can add to the discussion about the specific role of the state as an investor, aiming to “complete markets,” that is, to invest in areas that seem to attract less attention and interest from private initiative, but that are nevertheless fundamental for a better business environment and for an increase in social infrastructure. It is essential to condition this role of public investment, whose relevance is not consensual, to a strategic

and specific performance and, especially, that it be based on public policy evaluation, ex ante, either during the execution of the public policy or after its conclusion).

Still from this point of view, it is also important to evaluate the management of the public sector with regard to the financial system and development. For example, it may be appropriate to measure the impact of public investment when it is financed via the primary current surplus or via the concession of new credits and loans, external or internal.

This context suggests the importance of monitoring the indebtedness of regional governments, in view of its benefits and consequences, paying attention to aspects of the debt, such as: (i) average cost, (ii) average term, (iii) guarantee framework, (iv) solvency, (v) transparency, (vi) resilience, (vii) composition, (viii) risk management, (ix) relationship with macroeconomic variables, (x) cycle analysis, (xi) optimal plateau modeling, (xii) modeling and volatility, (xiii) scenario analysis, (xiv) impact of the main drivers, and (xv) debt service flow monitoring.

Given this scenario, this section proposes to specifically address the public debt solvency pillar of the State Government of Ceará, based on a conditional and dynamic framework of fiscal reaction for the period between the 1st quarter of 2010 and the 2nd quarter of 2021.

Thus, after a comparative context of the indebtedness of the State Government of Ceará and the other subnational federal entities, and the descriptive analysis of the internal and external debt series of this federative entity, the solvency analysis will be based on the fiscal reaction framework, via estimation and via wavelet approach.

### 3.2 State/DF debts

According to the Manual of Fiscal Statements (MDF) of the National Treasury Secretariat (STN), the Consolidated Debt (CD) of a subnational federative entity, for fiscal purposes, corresponds to the total amount of assumed financial obligations, calculated without duplicity (excluding the obligations between direct administration organs and between these and indirect administration entities). Differently from the federal government, which can contract securities debt by issuing public bonds, the regional governments compose their debts in the following manner: a) contractual debt - realization of credit operations by virtue of laws, contracts, agreements, or treaties, for amortization in a period superior to 12 months; b) judicial writs of payment - issued as of May 5, 2000 and not paid during the execution of the budget in which they were included and c) credit operations with a period of less than 12 months, which have been included as revenues in the budget.

From this debt, the Net Consolidated Debt (NCC) is calculated, which consists in the indebtedness indicator most reported in the state public finance literature, since its formula considers that the Consolidated Debt (CD) must be reduced by deductions, which consist in the relative balance between financial assets (cash availability and other financial assets) and accrued liabilities (except

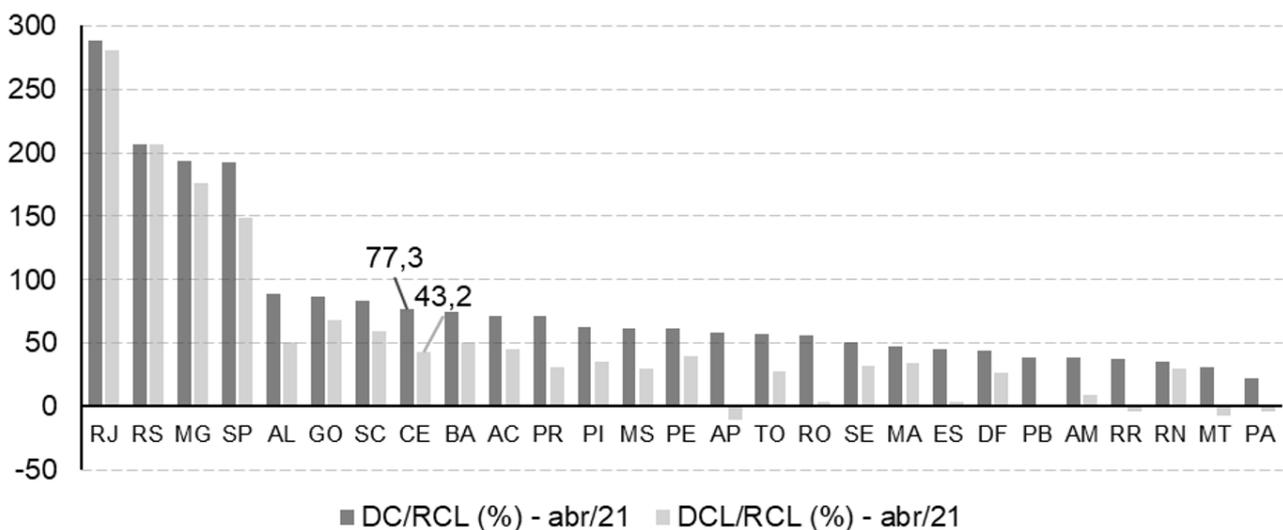
court-ordered debt). If the value of the financial assets is lower than the value of the accrued liabilities, there will be no deductions and both will be identical.

Based on data from the April 2021 Fiscal Management Report (RGF), available on the Brazilian Public Sector Accounting and Fiscal Information System (SICONFI) of the National Treasury Secretariat (STN), it is evident that the State of Ceará has a Consolidated Debt of almost R\$ 17.9 billion in April 2021, being the 9th national entity and the 2nd in the Northeast with the highest level. Considering the DCL, the value is approximately R\$ 10 billion, the 10th highest in the country and the 3rd in the region.

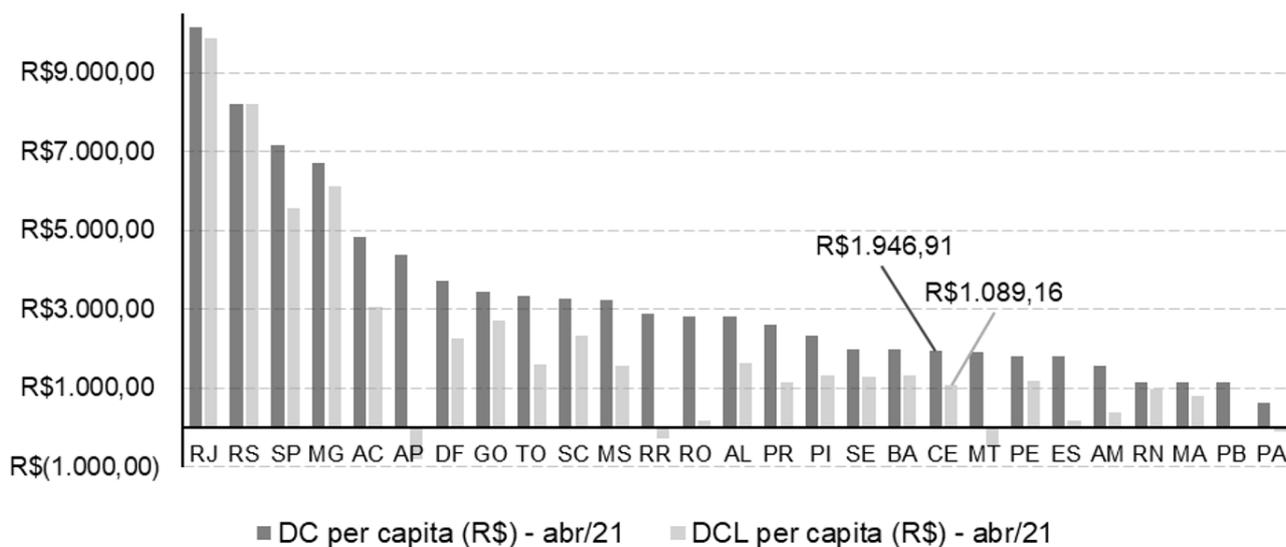
For a weighted comparison, Chart 5 reports both debts of each government, in per capita terms and as a ratio of the respective cumulative (6-month) adjusted DCL/RCL. The current level of 43.24% of the DCL/RCL of the state of Ceará is the lowest since June 2019 and closes a robust sequence of reductions that began in June 2020, when this ratio was over 60%. This reduction evidenced in recent months is important to offset the evidence that the state recorded the 6th highest variation in DCL/RCL from April 2015 to April 2021 (3.74%), a period over which, 20 governments recorded a reduction in this debt indicator.

**Chart 5.** Consolidated debts (gross and net) of regional governments (April/2021)

**1.a.** Debt in relation to Gross National Income (RCL)



### 1.b. Debt in per capita terms



Source: Fiscal Management Reports (RGF) available in the Accounting and Fiscal Information System of the Brazilian Public Sector (SICONFI) of the National Treasury Secretariat (STN)

The state ranks 10th in the ranking based on this main debt indicator.<sup>1</sup>

Also, according to Chart 5.a, the state has a DC/RCL of 77.30%, the 8th in the country. Again, there is a reduction in this item, which registered values greater than 80% in the 6 previous two-month periods. Observing a broader time horizon, Ceará was the state with the second highest growth in DC/RCL from April 2015 to April 2021. According to Chart 5.b, the state’s national position improves when both debts are weighted by the respective population, being, for example, the 19th based on its per capita DC of R\$ 1,946.41 in April 2021.

From Annex 2 – DCL Demonstrative for the first four months of 2021 of Ceará, it is observed that in April 2021, 93.6% of Ceará’s DC was in the form of contractual debt, with 92.6% of this contractual debt linked to loans and financing. There is about 2.9% of the CD linked to court-ordered debt and 3.5% composed of other debts. It is important to stress that there is a stock of court-ordered debt not included in the CD, even though they were issued after 05/05/2000 of more than R\$112 million, as well as an actuarial liability of the order of R\$72 billion, which does not compose the Consolidated Debt of a state.

### 3.3 External and internal debts of the State Government of Ceará

For purposes of mathematical, statistical and econometric studies, according to Santos and Matos (2021), it is important to disaggregate the Consolidated Debt into internal and external debt, as

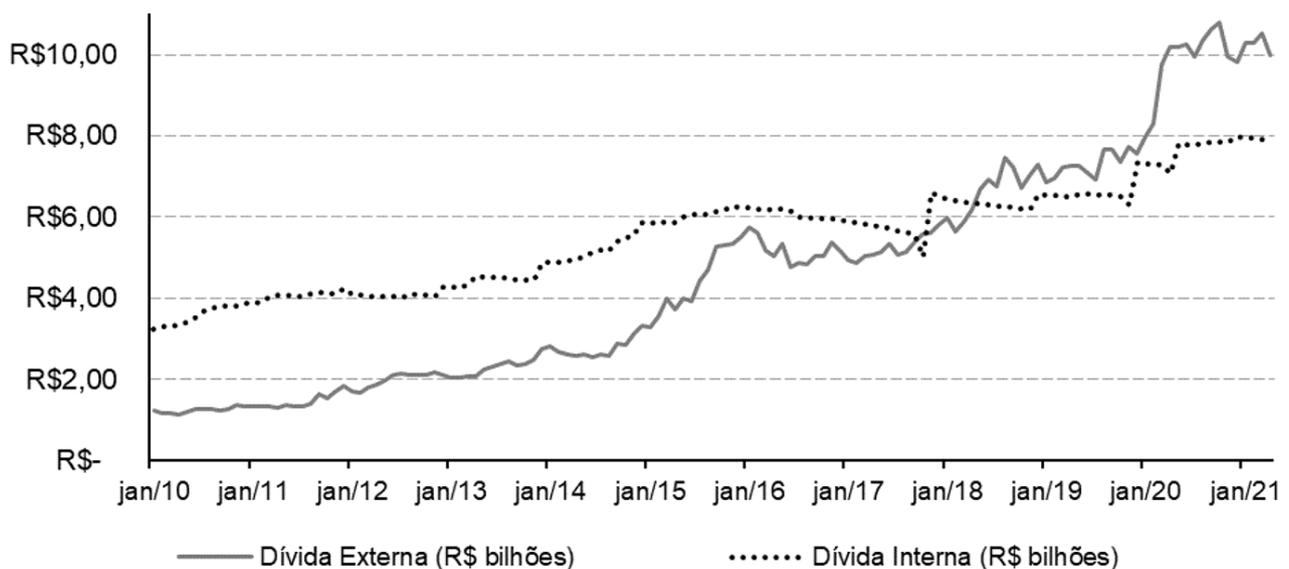
<sup>1</sup> Regarding this debt metric, the LRF and the resolution of the Federal Senate (RSF N. 40/2001) establish limits for the amount of public debt, so that the ratio between the DCL and the RCL of the states must be less than 200%. If there is an excess, there must be a trajectory of reduction of the debt ratio each year, by 1/15 of the initial excess.

well as, if possible, even by indexer. The external debt is essentially determined by loans and financings contracted with foreign agencies, usually indexed in foreign currency. In this way, all the residual of the CD, whether the contractual debt contracted with national organs and institutions, whether the court-ordered debt or even other debts, all of this makes up the internal debt.

Chart 6 reports the DC with monthly frequency for the state of Ceará disaggregated into its external and internal components, so that one can understand this evolution over time.

This chart shows that the internal debt, which came to represent 75.67% of the total debt in April 2011, presents a consistent tendency of decline in this participation of the DC. Exactly in the same month of April, however, of 2020, the internal debt reached its lowest representativeness, 41.02% of the total debt. In terms of nominal annual growth, the external debt grew throughout the period from January 2010 to April 2020 at a rate of 20.41% per year, while the internal debt grew at an annual rate of 8.25%. As already stated, Ceará is the national leader in the external component of its DC, with a current 55.89%.

**Chart 6.** External and internal debt of the State Government of Ceará (January/2010 to April/2021)



Source: Own preparation, based on data from the Finance Department (SEFAZ) of the State Government of Ceará.

The external debt basically has four indexes: U.S. dollar, euro, yen and special currency, being, however, essentially pegged to the U.S. dollar, with more than 97% of the stock indexed to this currency. The internal debt has a greater diversity of indexers, some of the most important being: Real (about 46%), URTJLP (approximately 30%), URCAM (11%) and UPR (8%).<sup>2</sup>

<sup>2</sup> A detailed study on the term and average cost of these debts can be found in Fiscal Monitoring Report No. 5/2021 of the Fiscal Monitor Program of the State of Ceará's Court of Auditors.

### 3.4 Descriptive Analysis of the Series of Economic Activity, Surplus and Debts of the State Government of Ceará

Before the study of solvency or sustainability itself, it is appropriate to bring the external and internal debts of the State Government of Ceará into the discussion on the state of Ceará's ability to save and invest.

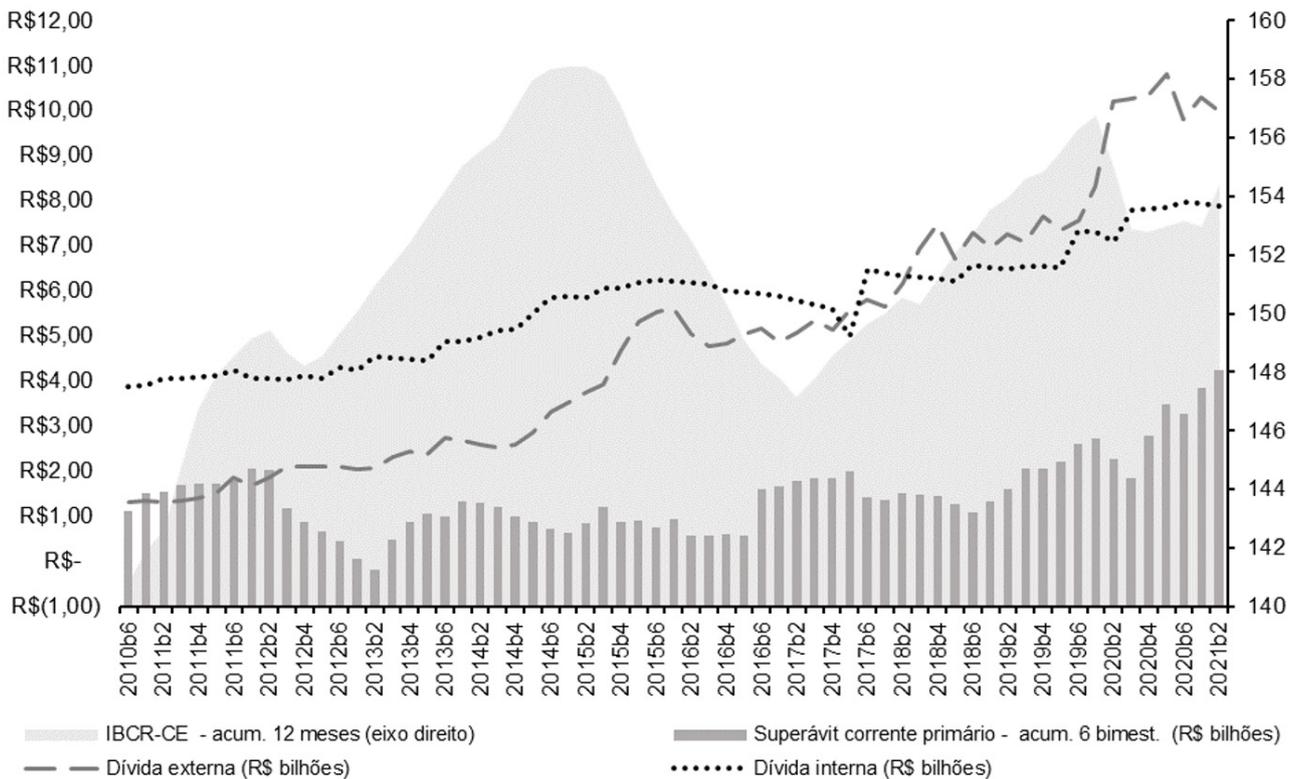
Initially, regarding the calculation of the so-called current primary variables, the current primary revenue consists of the sum of current revenues, except intra-budgetary, whose origins are: i) taxes, fees and improvement contributions, ii) revenues from contributions and iii) current transfers. Primary current expenses, on the other hand, also obtained from the series that disregard the intra-budgetary component, are composed of liquidated expenses with personnel and social charges and other current expenses.

This way, in both cases, revenues and expenses considered financial are excluded, among which, the most significant are the payment of interest on the debt and patrimonial revenues, for example. For the empirical study suggested here, applied to Ceará, the data used are obtained from Annex 01 - Balance Sheet, of the Budget Execution Summary Report (RREO) of the Government of the State of Ceará. About the Gross Domestic Product proxy, the Central Bank's Regional Economic Activity Index (IBCR-CE) is used - proxy of the state's production in the last 12 months.

According to Chart 7, the current primary surplus series presented its minimum value in the second bimester of 2013, when it recorded the only deficit in the interstice, of the order of R\$ 170 million, while the maximum value of R\$ 4.26 billion is the last observed, in April 2021. The series of investments oscillated between R\$ 3.32 billion in the second bimester of 2015 - when there was a peak in economic activity, measured by the Central Bank's Regional Economic Activity Index (IBCR-CE) - and the minimum settled in the last bimester, R\$ 1.66 billion.

Comparing both series, it is the first time that the state presents a sequence of current primary surplus higher than investments. This sequence begins in the fifth two-month period of 2019, with a single exception in the third two-month period of 2020, in which the results are equivalent, and a new sequence characterized by a surplus that is increasingly greater than liquidated investments. These last 6 quarters are also characterized by a reduction in external debt (-2.7%), and small increases in internal debt (1.3%) and economic activity (1.0%). This last year suggests a more detailed study to justify a more cautious profile in the conduct of investments, with a downward trend starting in 2019, while the recent increase in the surplus is due to growing government transfers and not to the increase in tax collection.

**Chart 7.** Bimonthly Evolution of the Economic Activity, Surplus and Debt Series of the State Government of Ceará (2010b6 to 2021b2) <sup>a</sup>



Comments: <sup>a</sup> IBCR-CE: Regional Economic Activity Index for the state of Ceará, with fixed base and accumulated 12-month seasonality adjustment, prepared by the Central Bank of Brazil.

Source: Own preparation, based on data obtained from the Central Bank of Brazil, Annex 01 - Budgetary Balance and Annex 06 - Statement of Primary and Nominal Results, both included in the Summarized Reports of the Brazilian Public Sector Accounting and Fiscal Information System (SICONFI) of the National Treasury Secretariat (STN).

Analyzing the evolution series of the internal and external debt and of the current primary surplus (accumulated over 6 two-month periods) during the observed period, 2010b6 to 2021b2, it is possible to see, according to Table 2, nominal two-month growth rates whose values are higher than the official two-month inflation measured by the Broad Consumer Price Index (IPCA). Even in real or deflated terms, the external debt has evolved at a bimonthly growth rate (2.277%) more intense than the surplus (1.175%) and the internal debt (0.147%). It is important to mention that the evolution of the external debt is very much linked to the dollar that is at a high level, and any small reduction tends to affect this rhythm in the opposite direction. As usual in the estimation of fiscal reaction models, the fiscal variables need to be weighted by a metric that measures output, the most common being the GDP. However, to take advantage of the fact that the fiscal variables have a bimonthly frequency, it would be necessary to adopt a proxy of economic activity with a corresponding frequency to maintain the very short-term informational content and the number of observations in the sample.

In this sense, the IBCR becomes a viable option for the subnational federal entities. It has a monthly periodicity, to capture the trend of economic activity in the short-term, meeting the objective when used as a weighting in the fiscal reaction function. Table 2 reports the bimonthly growth rates of the fiscal variables, weighted by the Economic Activity Index, IBCR-CE (accumulated in 12 months). The economic activity of the state of Ceará grew in real terms by 0.15% per two months, or 0.90% per year. These are charts after discounting official inflation.

**Table 2.** Growth Rates of the Primary Current Surplus and Debt Series for the State Government of Ceará (2010b6 to 2021b2) <sup>a</sup>

	Dívida externa	Dívida interna	Superávit corrente primário
Taxa de crescimento nominal bimestral	3,304%	1,152%	2,190%
Taxa de crescimento real bimestral	2,277%	0,147%	1,175%
	Dívida externa/IBCR-CE	Dívida interna/IBCR-CE	Superávit corrente primário /IBCR-CE
Taxa de crescimento bimestral	3,150%	1,002%	2,038%

Comments: a IBCR-CE: Regional Economic Activity Index for the state of Ceará, with fixed base and accumulated 12-month seasonality adjustment, prepared by the Central Bank of Brazil.

Source: Own preparation, based on data obtained from the Central Bank of Brazil, Annex 01 - Budgetary Balance and Annex 06 - Statement of Primary and Nominal Results, both included in the Summarized Reports of the Brazilian Public Sector Accounting and Fiscal Information System (SICONFI) of the National Treasury Secretariat (STN).

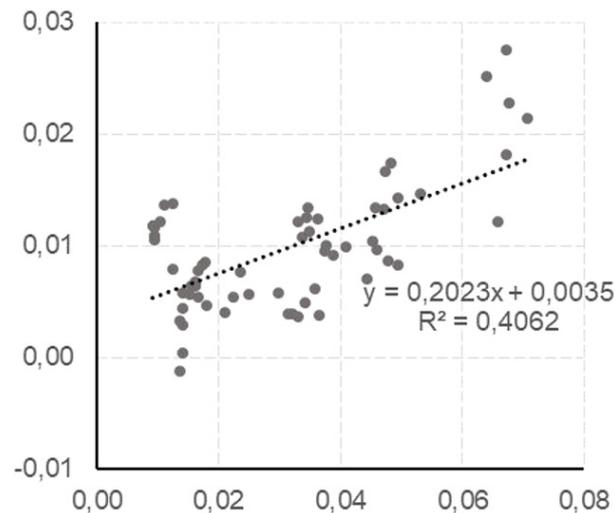
Finally, a last analysis, merely descriptive and of preliminary character, about the main relation to be measured in a framework of fiscal reaction, that is, the relation between the current primary surplus (accumulated over 6 two-month periods) weighted by the IBCR-CE - a proxy of the state's production in the last 12 months - and the debt (external or internal) outdated and equally weighted by the same IBCR-CE.

Chart 8 reports both relations, through a scatter plot, containing 62 bimonthly observations. It is possible, from this preliminary analysis, which does not allow the use of instruments, to infer that there is a positive and not negligible linear relationship between the weighted current primary surplus and both lagged weighted debts, with reasonable adjustment in terms of data fitting. This first evidence suggests, therefore, that there is an unconditional sign of solvency of both domestic and foreign debts,

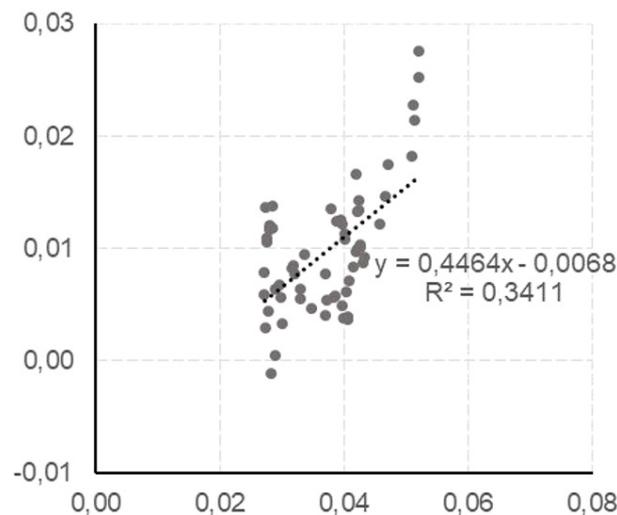
by causing positive reactions in the current primary surplus upon previous increases in each of these debts. However, it is strictly necessary to revisit this evidence by estimating the fiscal reaction, thus allowing a more theoretically grounded inference about the solvency of both debts in a joint analysis.

**Chart 8.** Dispersion between Debt and Primary Current Surplus, both Weighted by Economic Activity for the State Government of Ceará (2010b6 to 2021b2) a

a) External debt/BCR at t-1 (horizontal) vs Primary current surplus/BCR at t (vertical)



b) Domestic debt/BCR at t-1 (horizontal) vs Current primary surplus/BCR at t (vertical)



Comments: a IBCR-CE: Regional Economic Activity Index for the state of Ceará, with fixed base and accumulated 12-month seasonality adjustment, prepared by the Central Bank of Brazil.

Source: Own preparation, based on data obtained from the Central Bank of Brazil, Annex 01 - Budgetary Balance and Annex 06 - Statement of Primary and Nominal Results, both included in the Summarized Reports of the Brazilian Public Sector Accounting and Fiscal Information System (SICONFI) of the National Treasury Secretariat (STN).

### 3.5. Analysis of the Relationship between Surplus and Debt of the State Government of Ceará via Fiscal Reaction

#### 3.5.1 Theoretical framework

Public debt is an important instrument used by sovereign governments to manage fiscal imbalances that arise from mismatches between revenue generation and expenditure needs. Due to the growing fiscal imbalance faced by most Brazilian states, state governments are motivated or forced to resort to an alternative source of revenue in the form of loans and financing to increase their total revenue.

While this practice is not bad, an excessive accumulation of debt can create serious fiscal problems for current and future generations if not managed properly. If the mismanagement of these credit operations exerts little or insignificant effect on macroeconomic variables, there will be a tendency for the debt/GDP ratio to increase, draining revenue to service this debt. On the other hand, when the debt is properly managed with the proper purpose for which it was obtained, public investments tend to positively impact the economy, reducing the debt/GDP ratio.

This classic context in public finance justifies the concern with the topic of debt sustainability or solvency, whose definition can be associated with the capacity of a government to meet its financial obligation without being subject or obliged to resort to external aid. The International Monetary Fund (IMF) describes debt sustainability as the need to meet the solvency condition without being subject to correction or additional cost of financing. To further highlight the importance of sustainable debt, some studies state that such a solvency condition should ensure that public debt plus the discounted present value of primary current expenditures should not exceed the discounted present value of primary current revenues. In short, a public debt is said to be sustainable or solvent when it is not statistically explosive, or unpayable.

Many theoretical papers state that debt sustainability is not only explained by the limit on the level of the debt/GDP ratio, but also by a country's ability to meet its debt obligation. In early contributions in this empirical literature, the studies by Hamilton and Flavin (1986), Wilcox (1989), Trehan and Walsh (1991), and Bohn (2007) examined fiscal debt sustainability using analysis of the stochastic properties of the surplus or deficit. Bohn (1995, 1998) suggests a different test on sustainability, under the assumption that public debt policy is sustainable if the ratio of current primary surplus as a ratio of GDP reacts positively on the ratio of debt to GDP.

The plausible economic intuition is that if the government incurs debt, they have to take corrective measures in the future, so that the increase in the current primary surplus is able to guarantee a sustainable path for the public debt.

In this section, the idea is to follow this framework called fiscal reaction, proposed by Bohn (1998), using a more current and revisited version of the model, which allows for statistical inference

on the solvency of a federal, state or local government debt, from time series of revenues, expenditures or deficits, a topic seen as mainstream in public finance. Considering the different strands of research on this subject, it is possible to identify in the different techniques a common foundation: the intertemporal budget constraint, as an equilibrium condition to be met to ensure the solvency of a fiscal policy.

According to Bohn (1995, 1998), a government with infinite periods has the following budget constraint in t expressed as follows:

$$Div_t = (1 + i_t)Div_{t-1} + (G_t - R_t) \quad (1)$$

In this relationship,  $Div_t$  is the value of the public debt at the end of the period t,  $i_t$  is the nominal interest rate on the public debt in t,  $G_t$  is the current primary expenditure (excluding interest payments on the debt) in t e  $R_t$  represents its primary current revenue in t. More precisely, the current primary revenue consists of the sum of current revenues, except intra-budgetary revenues, whose origins are: i) taxes, fees and improvement contributions, ii) revenues from contributions and iii) current transfers. Primary current expenses, on the other hand, also obtained from the series that disregard the intra-budgetary component, are composed of settled expenses with personnel and social charges and other current expenses. Thus, in both cases, revenues and expenses considered financial are excluded, among which, the most significant are the payment of interest on the debt and property revenues, for example. For the empirical study suggested here, applied to Ceará, the data used are obtained from Annex 01 - Balance Sheet, of the Summarized Report of Budget Execution (RREO) of the Government of the State of Ceará.

In an intertemporal context, given a perfect forecast, it is possible to associate the initial stock of debt with a discounted infinite stream of revenues and expenditures, through the following relationship:

$$Div_0 = \lim_{n \rightarrow \infty} \prod_{t=1}^n \left( \frac{1}{1+i_t} \right) Div_n + \sum_{t=1}^{\infty} \left[ \frac{R_t - G_t}{\prod_{j=1}^t (1+i_j)} \right] \quad (2)$$

As usual in this literature, it is assumed that the state government is not able to renegotiate the debt infinitely many times, which implies the null value for the limit of the first term on the right of relation (2), reducing the intertemporal equilibrium to the following relation:

$$Div = \sum_{t=1}^{\infty} \left[ \frac{R_t - G_t}{\prod_{j=1}^t (1+i_j)} \right] \quad (3)$$

Where the stock of debt in t is equivalent to the sum of the present value of the primary surplus flow.

Statistically analyzing whether a given government satisfies this simple and intuitive intertemporal equilibrium relationship can be conducted in several ways, as explained in the literature review. According to the fiscal reaction function suggested in Bohn (1998), the government's intertemporal budget constraint is satisfied if there is a positive reaction of the GDP-weighted current primary surplus in  $t$ , as a result of increases in the debt/GDP ratio by  $t - 1$ . Another important aspect is to note that a common practice in public budget management, avoiding seasonality, is to aggregate the flow variables (fiscal and macroeconomic) bimonthly over the past 12 months, or 6 bimesters, whereas the stock variables do not need this manipulation. Revisiting relation (1) with this weighting by GDP gives the following relation:

$$\frac{Div_t}{PIB_t} = \frac{G_t}{PIB_t} - \frac{R_t}{PIB_t} + \frac{Div_{t-1}}{PIB_{t-1}} \cdot \frac{(1+i_t)}{(1+g_t)} \quad (4)$$

In this relationship,  $g_t$  is the nominal GDP growth rate in  $t$ . Bohn (1998, 2007) proposes an empirically testable linear modeling entitled the fiscal response function. Formally, this function is defined as follows:

$$sup_t = \rho div_{t-1} + \alpha Z_t + \varepsilon_t \quad (5)$$

In this relationship,  $sup_t = \frac{R_t}{PIB_t} - \frac{G_t}{PIB_t}$ ,  $div_{t-1} = \frac{Div_{t-1}}{PIB_{t-1}}$ , e  $Z_t$  consists of a vector of determinants of the current primary surplus. In one of the most classical versions of this model, the vector  $Z_t$  was composed of two elements:  $\tilde{r}_t$ , which consists of the deviation of GDP-weighted primary current revenues in  $t$ , e  $\tilde{d}_t$  is the GDP-weighted primary expenditure gap at  $t$ . These deviations are relative to the respective values obtained via the Hodrick-Prescott filter, whose smoothing parameter used was  $\delta=3.600$  commonly used for bimonthly frequency data. In this sense, the Model traditionally tested is given by the following regression:

$$sup_t = \gamma + \rho_{ext} div_{ext_{t-1}} + \rho_{int} div_{int_{t-1}} + \alpha_r \tilde{r}_t + \alpha_d \tilde{d}_t + \varepsilon_t \quad (6)$$

From this specification, some modeling extensions of this original framework emerged, such as the inclusion of the lagged endogenous, i.e., the current primary surplus.

Other versions suggest the inclusion of more control variables characterized as determinants of the current primary surplus, economic activity, and the debt in question. This type of more modern version of the fiscal reaction framework follows from Mendonça, dos Santos, and Sachsida (2009) and Campos and Cysne (2019), whose extensions were applied to Brazil, as well as Checherita-Westphal and Žďárek (2017) and Ogbeifun and Shobande (2020), whose applications were to Euro countries and emerging countries, respectively.

### 3.5.2 Empirical Evidence

In the Brazilian case, it is possible to mention applied studies, such as Pastore (1995), Garcia and Rigobon (2004), Simonassi and Arraes (2007) and Matos et al. (2013). Specifically about Ceará, Simonassi et al. (2013) and Aguiar (2017) can be cited, both suggesting the modeling of the pension system debt.

About the solvency of the DC of this federal entity, it is possible to highlight two recent citations. Matos and Santos (2021) address the solvency of the public debt of the state of Ceará, based on the fiscal reaction framework for the period between the 1st quarter of 2008 and the 3rd quarter of 2019 (2008b1 - 2019b3). The innovation is associated with the estimation of an extended version of the original fiscal reaction model, incorporating the measurement of the elasticities of oscillations of disaggregated items with a higher share in revenues or expenditures and that are sensitive to the conduct of state public policy. In sum, it is not possible to infer statistically that Ceará's debt is solvent during the 69 bimesters analyzed, because there is no significant positive fiscal reaction. It is also possible to evidence a significant dependence on the fiscal surplus mainly in response to the cycles of the main items that make up the current and capital expenses, with a greater influence of deviations in spending on interest and charges of the debt and in second place, the amortization of the debt.

Matos (2021), on the other hand, adds innovation with the following differentials: data update, disaggregation of the DC into external and internal debt, incorporation in the fiscal reaction of the dynamics of the lagged current primary surplus and of macroeconomic instruments, and measurement of the short and long-term effects, due to the nonstationary behavior of the time series. The evidence is robust to changing sets of controls and changing econometric specifications, considering the non-stationarity of the series. The results suggest that the current primary surplus reacts asymmetrically when domestic and foreign debts increase. Based on the structural and reasoned long-run relation between the surplus and each of the debts, the external debt is solvent, and the internal debt is insolvent. The variation of the external debt is very sensitive to exchange rate oscillations. Both debts present variations characterized by reversion to the mean. The impulse-response analysis shows that there are consequences in the surplus arising from shocks in the debts that do not dissipate up to 12 two-month periods ahead.

### 3.5.3 Revisiting Fiscal Reaction via wavelet

The first empirical and innovative contribution of this paper consists in revisiting the fiscal reaction, analyzing versions of the traditional modeling, but individually to infer about the individual solvency of the domestic and foreign debts. In this sense, the traditionally tested model given by regression (6) will be broken down into the following regressions:

$$sup_t = \gamma + \rho_{ext} div\_ext_{t-1} + \alpha_r \tilde{r}_t + \alpha_d \tilde{d}_t + \varepsilon_t \quad (7)$$

and

$$sup_t = \gamma + \rho_{int} div\_int_{t-1} + \alpha_r \tilde{r}_t + \alpha_d \tilde{d}_t + \varepsilon_t \quad (8)$$

The innovation refers to the methodological form of inference about the relationship between the surplus and the debt in question. It is suggested here the use of a mathematical technique that allows us to conclude about the commotions between two variables, with the proper instrumental control. The technique informs over the time analyzed and under different frequencies whether the cycles of one of the variables influenced or were influenced by the cycles of the other variable, and it is possible to measure the intensity and direction of the commotions, that is, whether they are cyclical or counter-cyclical. In this case, the modeling allows for influences in both directions, that is, not necessarily only the lagged debt influences the surplus and not even in a single direction during the whole time. There may be influences that vary over time, with frequencies that may range from one to a few bimesters in terms of lag, just as surplus cycles may be influencing and determining debt cycles.

This empirical exercise follows Lo Cascio (2015), whose application was to analyze the fiscal sustainability or solvency of the U.S. debt over the period 1795 to 2012, using wavelet. There do not yet seem to be similar applications for the Brazilian federal government, or for regional governments in Brazil.

About this technique, briefly, it is possible to highlight that the Wavelet transform has been used in several areas of study to perform the analysis of signals in the time and frequency domains. The tool was constituted as an advance on the spectral analysis developed by Fourier in the nineteenth century, as it overcomes a number of restrictions observed in the Fourier transform, such as signal reconstruction of non-stationary series, an especially important limitation in the field of applied economics.

The employment of this technique has been increasingly explored both in economic theory (Ramsey and Zang, 1996 and 1997; Ramsey and Lampart, 1998; Aguiar-Conraria, Azevedo and Soares, 2008; Aguiar-Conraria and Soares, 2011; Aguiar-Conraria, Martins and Soares, 2018; Matos et al., 2020) as well as in finance (Rua and Nunes, 2009; Reboredo and Rivera-Castro, 2014; Das, 2018). The great appeal of the literature has been especially for the consistency of the technique in manipulating series with structural changes.

Chart 9 reports the heat maps (left), as well as the phase diagrams (center) and the parameter values (right) that relate the surplus and the respective external (Chart 9.a) and internal (Chart 9.b) debt. A detailed description of this technique can be found in the Methodological Appendix.

The initial analysis is based on the observation of the heat maps of the coherences obtained following Aguiar-Conraria et al. (2018) methodologically. This analysis of the is based on the logic that the greater the coherence between the cycles of the two variables in question, the closer to dark red the color of the map should be. The gray line suggests an area significant at 10% and the black

line delimits the area significant at 5%, the latter being the one that will guide the analysis, as it is the standard in the literature.

In regions (time interval x frequency band) where the partial wavelet coherence shows statistical significance it is possible to study the advance relationship between cyclic oscillations from the partial phase difference diagram in the corresponding frequency band. If the partial phase difference is in the interval  $(0, \frac{\pi}{2})$  then it is said that the variable Y precedes the fluctuations of variable X in a pro-cyclical relationship. If the phase difference is in the interval  $(-\frac{\pi}{2}, 0)$  then we say that the variable X precedes the fluctuations in the variable Y in a pro-cyclical relation. On the other hand, if the phase difference is in the interval  $(-\pi, -\frac{\pi}{2})$ , then the variable Y precedes the fluctuations in the variable X but in an counter-cyclical relationship. If the partial phase difference is in the interval  $(\frac{\pi}{2}, \pi)$ , then the variable X precedes the fluctuations in variable Y in an anti-cyclical relation.

An important innovation in the wavelet analysis instrument pool proposed by Aguiar-Conraria et al. (2018) concerns the partial gain measure, which can be interpreted as the regression coefficient between the variables. In this case, in areas where the partial coherence is significant and there is a clear lead relationship between the series in the partial phase difference diagram, then the partial gain indicates the magnitude of the impact elasticity of the lead variable on the variable exposed to fluctuation, with the sign of the parameter being positive if the partial phase difference indicates a pro-cyclical relationship and negative sign if the partial phase difference indicates an anticyclical relationship. To segment the analysis, three frequency bands were established: i) short-term cycle, corresponding to fluctuations between 1 and 2 years; ii) medium-term cycle, with fluctuations between 2 and 3 years and; iii) long-term cycle (or business cycle core), for fluctuations between 3 and 6 years of duration.

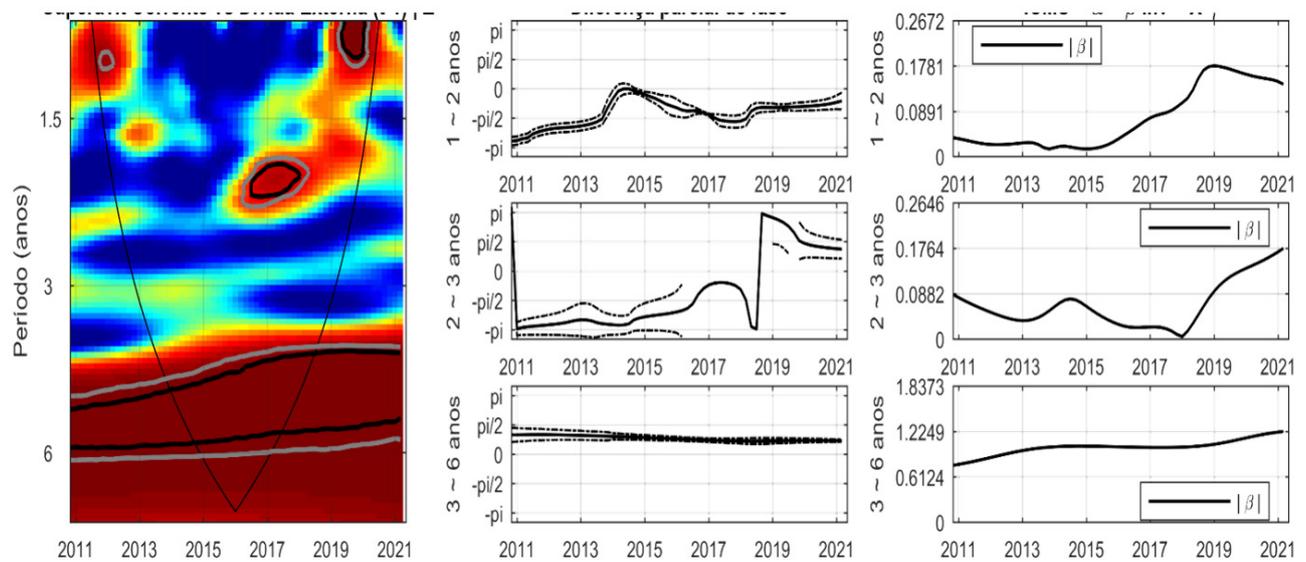
Chart 9.a corresponds to the partial wavelet analysis of equation (6), where the deviations of primary current revenue/GDP and primary expenditure/GDP are used as control variables. With respect to the short-term frequency, a statistically significant partial coherence area is observed in 2019. During the corresponding interval the partial phase difference lies between  $(-\frac{\pi}{2}, 0)$ , indicating that the increase in the external debt/GDP ratio causes a positive response in current primary surplus fluctuations up to one year later, signaling the meeting of the external debt solvency condition for the period. The partial gain diagram indicates an elasticity close to 0.16 during the period, suggesting an inelastic response of the surplus during the period.

In the medium-term cycle (frequency between 2 and 3 years), we observe a new sign of solvency during the years 2016 to 2017, with a new cyclical movement determined by the external debt, but now with a lower frequency, with a discrete reaction (approximately 0.02) of the surplus about 2 years later. This evidence of external debt solvency, even if for some periods, corroborates in part the previous evidence reported in Matos (2021).

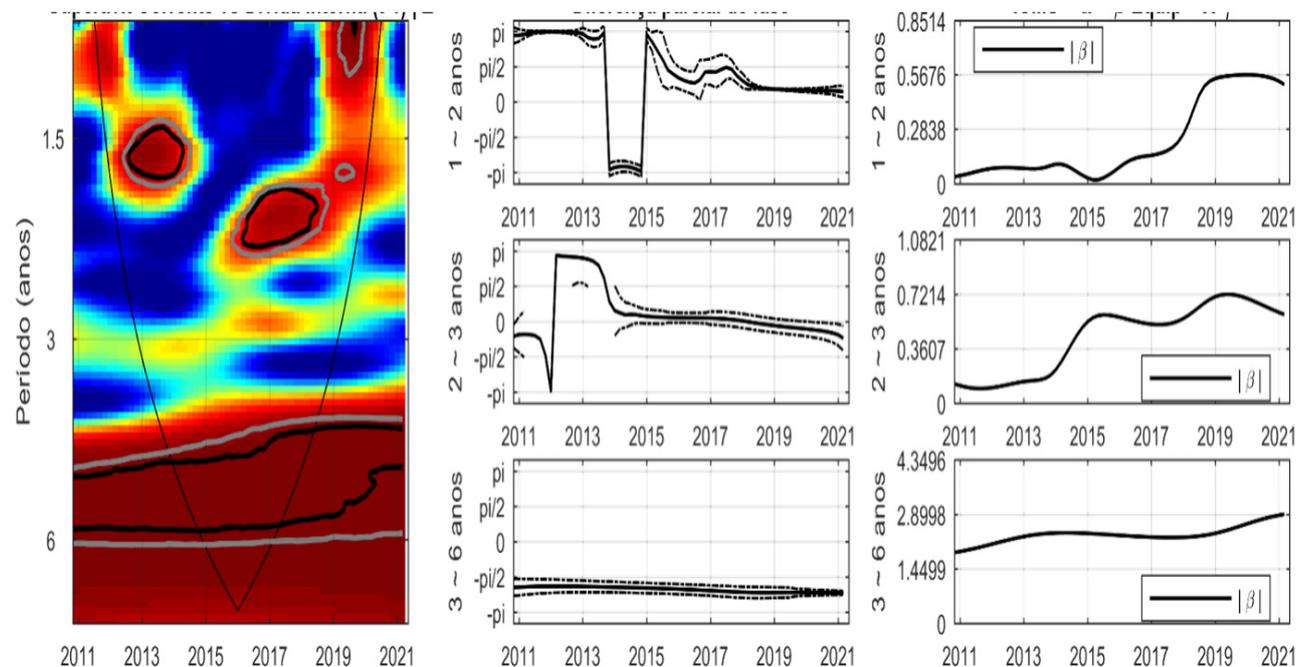
Also based on Chart 9.a, one can observe a very relevant and totally innovative evidence, which suggests there is a robust and continuous long-term relationship from 2014 to 2017, characterized by the dominance of the surplus cycles, which strongly influenced in a pro-cyclical way (parameter with value greater than 1.0) the external debt cycles with lags that can reach up to 5 years.

**Chart 9.** Conditional Analysis via Coherence, Phasing and Gain between Debt (External and Internal) and Primary Current Surplus, both Weighted by Economic Activity of the Government of the State of Ceará (2011b1 to 2021b2) <sup>a, b</sup>

a) External Debt and Current Primary Surplus



b) Domestic Debt and Current Primary Surplus



Comments: <sup>a</sup> IBCR-CE: Regional Economic Activity Index for the state of Ceará, with fixed base and cumulative

12-month seasonality adjustment, prepared by the Central Bank of Brazil.

<sup>b</sup> Instruments used: Deviations (via HP Filter) of primary current revenues and expenses.

Source: Own preparation, based on data obtained from the Central Bank of Brazil, Annex 01 - Budgetary Balance and Annex 06 - Statement of Primary and Nominal Results, both included in the Summarized Reports of the Brazilian Public Sector Accounting and Fiscal Information System (SICONFI) of the National Treasury Secretariat (STN).

According to Chart 9.b, between the end of 2012 and 2013 there is an anticyclical relationship between domestic debt and the surplus in the short-term, and it is not possible to identify a dominance by one of the variables. Between 2016 and the beginning of 2018, a pro-cyclical relationship is evidenced with a frequency of two years, and again without any determined dominance. This result does not corroborate the evidence of domestic debt insolvency reported in Matos (2021). The only relationship where dominance can be asserted is evidenced during the period and 2014 to 2017. It is a long-term relationship, as well as the one reported for external debt, also with influence of surplus cycles at the 5-year frequency, however, with opposite directions and with very strong intensity, since the parameter assumed values greater than 2.5.

In other words, the period from 2014 to 2017 is characterized by the dominance of the primary current surplus, whose long-term cycles have determined the external debt cycles in the same direction and the domestic debt cycles in the opposite direction.

#### **4. Ceará State Government Credit Operations and Investments**

Beyond the budget constraint equation usually reported in the debt solvency literature, which associates debt and surplus, it is possible to understand the dynamics of the debt in response to the flows of new credit granting, amortization and interest payments. In this section, the analysis aims at monitoring the evolution of the debt together with the evolution of domestic and foreign credit operations, as well as relating, even if visually, the evolution of credit with the primary current surplus and investments.

If we look at the history of these operations available in the System for Analysis of Public Debt, Credit Operations, and Federal, State, and Municipal Guarantees (SADIPEM) for the State Government of Ceará, since 1991 there have been a total of 175 operations, of which 75 are considered closed and another 80 are in effect. The total value of the contracting or issuing value of these 75 closed operations is of the order of R\$ 61.94 billion. About the operations in effect, SADIPEM's position is from April 06, 2021, and according to this position, there is a total of R\$ 16.63 billion in contractual debts, with the exception of the stock of court-ordered debt, whose order and magnitude was more than R\$ 522 million.

These SADIPEM data, together with other data available at the STN, show that the flow of inflows of funds through these credit operations is very variable, with some quarters with zero inflows, followed by quarters with inflows of hundreds of millions of reais. A summary of this strong variation between close quarters, either in current or accumulated values can be seen in Table 3. The main variation observed is in domestic credit as a consequence of the operation already detailed in this report, associated with the renegotiation credit of R\$ 920 million with Banco do Brasil.

**Table 3.** Ceará State Government Credit Operations

Variável	Posição em 2021b3			Posição acumulada de 12 meses (2020b4 - 2021b3)		
	Valor (R\$ correntes)	Varição em relação a 2021b2	Varição em relação a 2020b3	Valor (R\$ correntes)	Varição em relação ao acumulado (2020b3 - 2021b2)	Varição em relação ao acumulado (2019b4 - 2020b3)
Crédito interno	R\$942.638.522,22	7732,11%	16,06%	R\$ 975.379.814,64	15,44%	-42,77%
Crédito externo	R\$ 42.110.970,92	-7,42%	79,70%	R\$ 406.061.877,26	4,82%	-39,86%

Source: Own preparation, based on data obtained from Annex 01 - Budgetary Balance contained in the Summarized Reports of the Brazilian Public Sector Accounting and Fiscal Information System (SICONFI) of the National Treasury Secretariat (STN).

Table 4 reports a detailed analysis of the average term weighted by the residual value, as well as informs about the main interest rates applied in the different types of debt, whether contractual or non-contractual, in the case of the actuarial liability. The current external loans or financing were mainly contracted with 7 foreign financial institutions, with the Inter-American Development Bank (IDB) and the International Bank for Reconstruction and Development (IBRD) being the most relevant lenders, with 94% of the total borrowed.

Domestic loans, on the other hand, are concentrated in 6 large banks, with the largest participation of the Federal Savings Bank - Caixa Econômica Federal (CEF), Banco do Brasil (BB) and the National Bank for Social Economic Development - Banco Nacional de Desenvolvimento Econômico Social (BNDES). Clearly, external credit and financing operations are associated with longer terms than domestic loans. The only operation classified as other contractual debt contracted with CEF is scheduled to be paid on August 1st, 2033. The amounts of tax and social security installments contracted with the Federal Government are of low order and magnitude. The amount of court-ordered debt is scheduled to be paid by the end of December 2024. The list with the main details of all the 80 credit operations in effect in this state, in descending order of outstanding balance on the base date, is in the Appendix.

**Table 4.** Term and cost of credit operations of the State Government of Ceará (Position: 04/06/21)

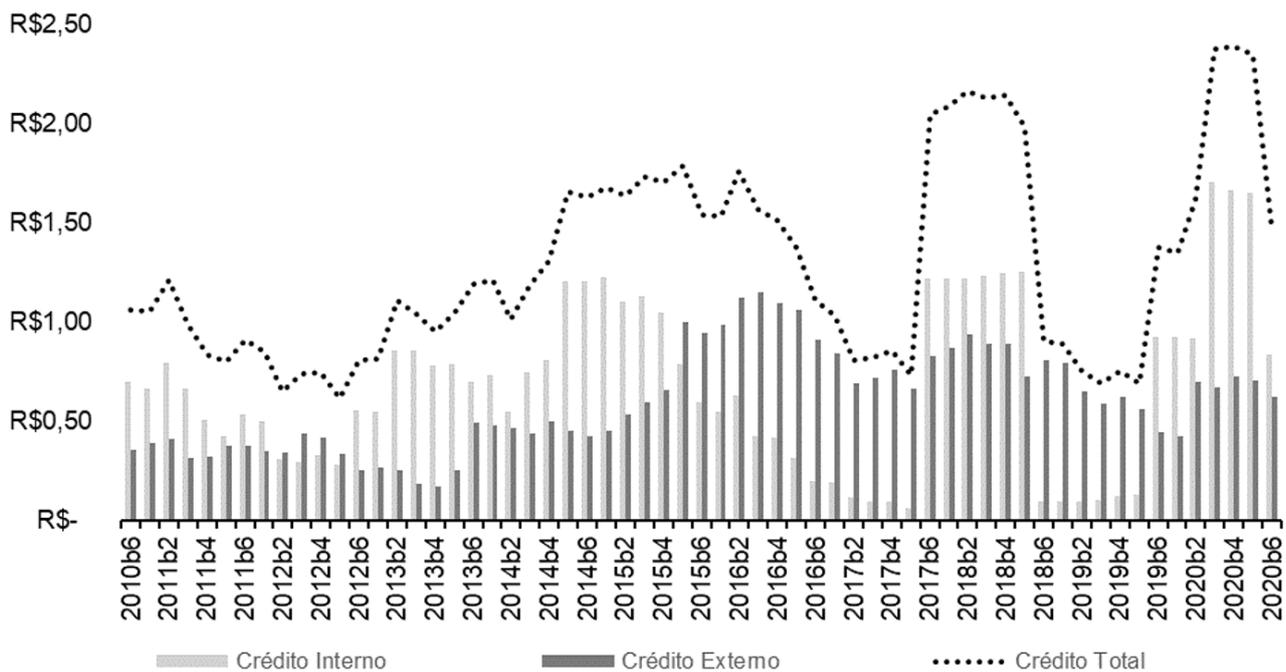
Tipo de dívida	Saldo devedor na data base	Prazo residual médio ponderado (anos)	Principais taxas de juros e demais encargos
Empréstimo ou financiamento - Externos	R\$ 9.804.832.323,18	10,40	LIBOR (6 meses ou 3 meses) + spread (fixo ou variável) + 0,75% a.a. de taxa compromisso sobre saldo não desembolsável
Empréstimo ou financiamento - Internos	R\$ 5.581.006.302,15	4,13	TJLP + (de 1,1% a.a. até 2,2% a.a.) ou TR + (de 5% a.a. até 6,5% a.a.)
Outras dívidas contratuais	R\$ 324.525.712,65	12,33	3,08% a.a. até 31/12/2026 e a partir de 01/01/2027 será alterada para 6,00% a.a.
Parcelamento previdenciário	R\$ 3.778.461,55	10,69	SELIC
Parcelamento tributário	R\$ 39.312.640,04	4,31	SELIC
Precatórios	R\$ 522.599.686,44	3,72	TR
Refinanciamento com a União	R\$ 879.949.217,70	26,54	IPCA+ 4% a.a.
Outras dívidas não contratuais	R\$ 72.713.887.750,71	-	-
<b>Total Geral</b>	<b>R\$ 89.869.892.094,42</b>	<b>9,00</b>	

Source: Own preparation, based on data obtained from the Federal, State and Municipal Public Debt, Credit Operations and Guarantee Analysis System (SADIPEM).

Chart 10 reports the evolution of this accumulated flow of 6 bimesters of domestic and foreign credit operations and total credit, allowing us to measure the participation of each in the composition. What can be observed from 2010 to 2017 is a smoother behavior of total credit, with approximately linear trends of growth or decrease. In this interstice, the accumulated domestic credit was more volatile than foreign credit, with oscillations that allow us to see a participation of 78% of total credit in 2010b4, going up to around 40% in 2012b, returning to 82% of the total in 2013b4, and reaching a low participation again in 2017b5, with less than 10%. This low participation throughout 2017 is due to the low level of new domestic credit and the consistent increase in foreign credit since the end of 2014.

Observing the most recent series, from 2017 to 2020, on the one hand, the accumulation of external operations remains with a certain consistency, while the internal credit operations start to have a more abrupt behavior, in view of occasional concessions with a high order of magnitude, most of them in the form of loans / financing to pay the amortization of public debt for the triennium 2019 to 2021 with the consequent maintenance of the investment capacity of the financed provided in the Pluriannual Plan and the Annual Budget Law.

**Chart 10.** Bimonthly Evolution of the Series of Credit Operations of the State Government of Ceará (2010b6 to 2020b6)

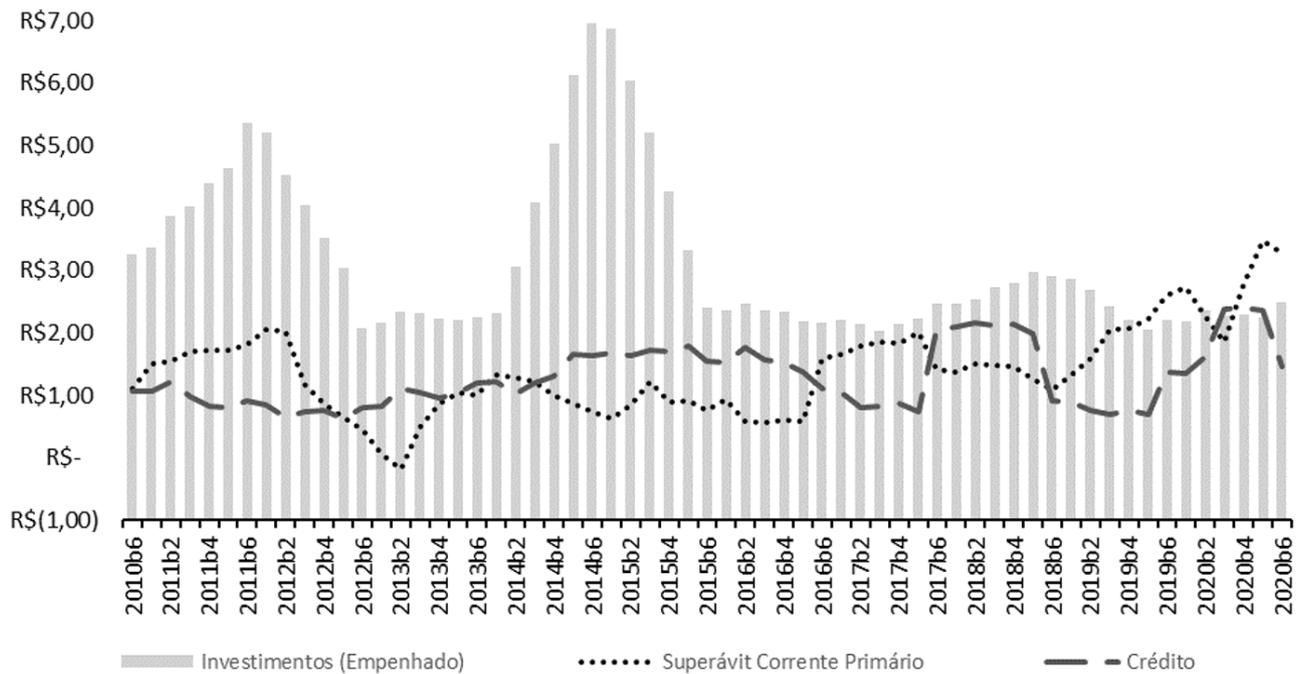


Source: Own preparation, based on data obtained from the Central Bank of Brazil, in Annex 01 - Budgetary Balance contained in the Summary Reports of the Brazilian Public Sector Accounting and Fiscal Information System (SICONFI) of the National Treasury Secretariat (STN).

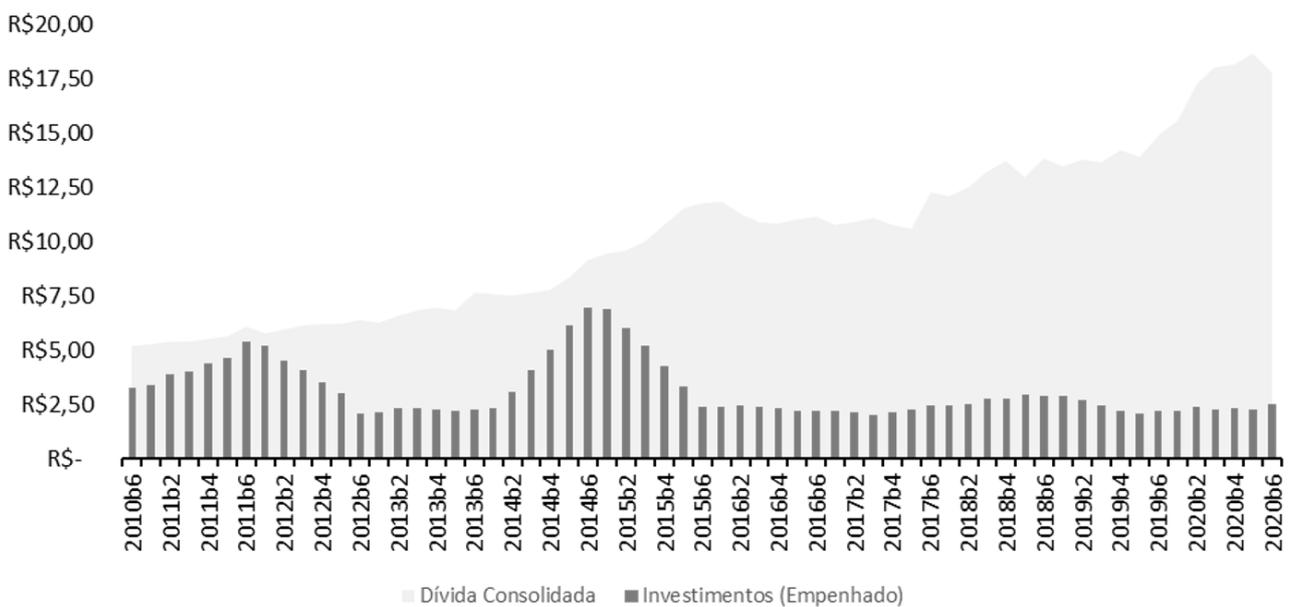
Chart 11 reports the series of surplus, total credit and investments. The analysis of Chart 11 suggests that the series of accumulated committed investments presented two peaks, at the end of 2011 (R\$ 5.35 billion) and 2014 (R\$ 6.95 billion), presenting in the last 5 years, between 2016 and 2020, an approximately constant behavior, on the order of R\$ 2.3 billion.

**Chart 11.** Bimonthly Evolution of the Series of Investments, Surplus, Credit Operations and Debt of the State Government of Ceará (2010b6 to 2020b6)

a) Investments, Current Primary Surplus and Credit (series of accumulated values for 6 bimesters)



b) Consolidated Debt



Source: Own preparation, based on data obtained from the Central Bank of Brazil, Annex 01 - Budgetary Balance and Annex 06 - Statement of Primary and Nominal Results, both included in the Summary Reports of the Brazilian Public Sector Accounting and Fiscal Information System (SICONFI) of the National Treasury Secretariat (STN).

According to Chart 11.a, it is possible to verify a kind of compensation between current primary surplus and total credit, with close average values, R\$ 1.16 billion and R\$ 1.27 billion, respectively, if the period from 2010 to 2018 is considered. From then on, the current primary surplus starts to grow

intensely, increasing more than 200% by the end of 2020, if compared to the value at the end of 2018, even exceeding for the first time in the series analyzed the value of committed investments in 2019b5.

Chart 11.b shows that in the last 5 years, even with constant investments, the consolidated debt no longer accompanies the series of investments, growing robustly from R\$11.8 billion to R\$17.8 billion from the end of 2015 to the end of 2020.

## **5. Investment Policy of the Government of the State of Ceará (2004 to 2020)**

### **5.1 Investment and Economic Growth**

In the development of economic thought, there was the formulation of theories and models that attempted to explain economic growth and the generation of wealth in nations. In these theoretical models, the role of the State in the conduct of fiscal and monetary policies and the effects of this conduct on the generation of wealth and development of countries has been considered and reflected upon at various historical moments. Thus, the participation of the State in the economy is a frequent topic of academic debate among economists, characterizing the importance of reflecting on this participation and its effects on the growth of economies. One of the forms of state presence in the economy occurs in the area of public sector investments.

On this theme, it can be seen that the formulation of public investment policies are consequences of the political and ideological vision of a society, where a public debate takes place that defines the purposes to be served, the amounts to be committed to the chosen demands, and their funding sources. Once the political and ideological discussions are over, it is a relevant role for the public investment policymaker to define, execute, control, and evaluate the impact of this policy. Regarding impact evaluation, the investment policymaker's scope is to use the fundamentals of economic theory applied to investment with empirical modeling, identifying the impacts on the indicators defined in the adopted model.

The investment policymaker must also measure its initial cost. This is the time to define public spending and its sources of financing. It is through public spending that the state investment is made, financed by its own resources or by those of third parties. Thus, public spending is financed by resources obtained from the exploitation of government property, by taxation, or by the creation of public debt. These sources of financing investment spending must be balanced in the government's fiscal policy, since it is necessary to preserve the multiplier effect of investments on the growth of an economy.

### **5.2 Public Investment of the Brazilian States**

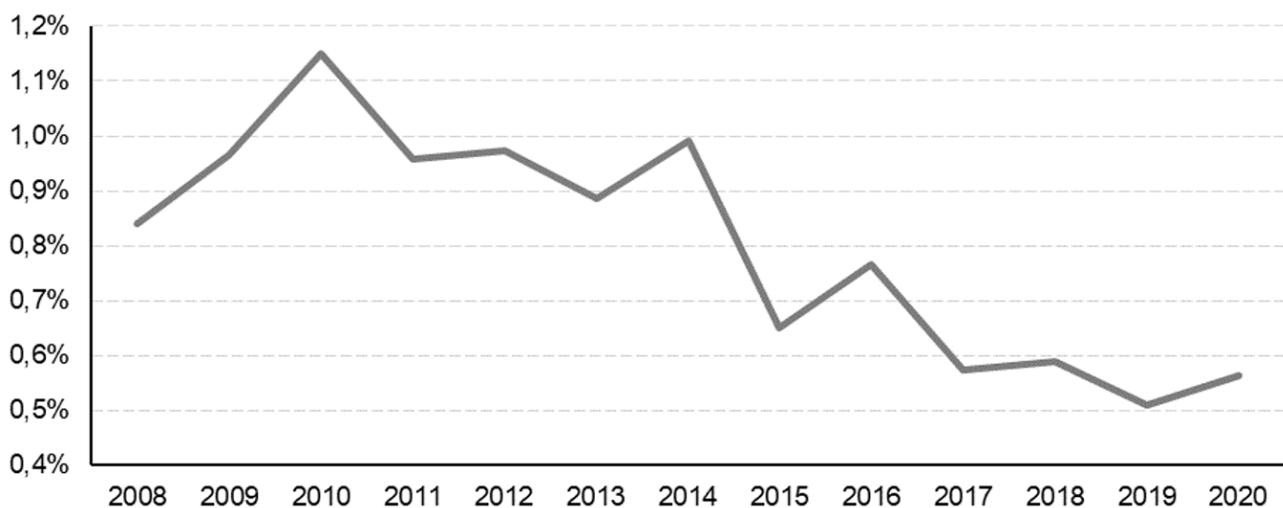
An important component of public spending, which has a high multiplier effect, are the investments. When made in strategic and quality areas, they bring to the economy several positive

externalities, such as employment and income generation, GDP growth, higher tax collection by the federated entities, among other benefits for the economy and the population. When one looks at the public investment in Brazil, one notices that it is low in relation to the GDP and in relation to the Net Current Revenue. In the composition and execution of the public budget of the Brazilian federated entities, there is little room for this capital expenditure, since most of the resource is already committed with active and inactive personnel and with the cost of the public sector.

Analyzing the investments made by the federal government in recent years, a drop can be seen starting in 2010, culminating in a percentage of 0.6% of GDP in 2020. An insignificant value compared to the average rates of 6.4% in emerging countries and 5.5% in South American countries. Chart 12 shows the evolution of investments from 2008 to 2020 in Brazil.

Analyzing the federal state entities, the heterogeneity is great. As mentioned above, the fiscal crisis in the states has left little room for these entities to make public investments. There are states with lack of control and critical fiscal situation, such as Rio de Janeiro, Minas Gerais, Rio Grande do Sul, among others. But there are few examples of successful management that has allowed fiscal sustainability over the years. Ceará and Espírito Santo are the best examples of states that have a solid fiscal situation. In the specific case of Ceará, this balanced management and control of the public accounts allowed the state to use its savings to allocate the necessary investments for the execution of public policies required for the economic development of the region. The most impressive is the ability to invest, being a poor state and representing only about 2% of the Brazilian GDP, with the second worst RCL in the country in 2020.

**Chart 12.** Federal Government Investment/GDP - 2008 to 2020



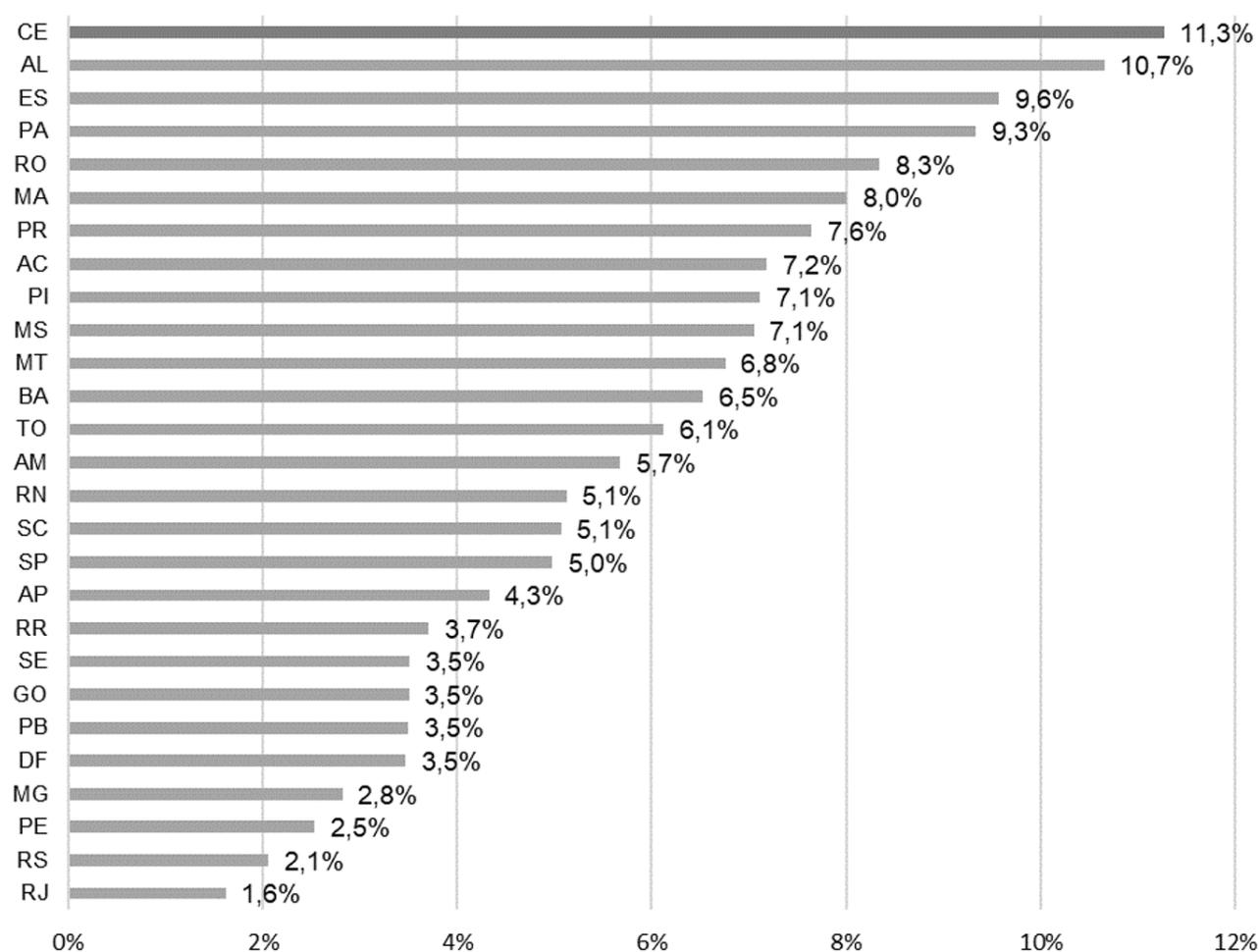
Source: Own preparation, based on data obtained from the National Treasury Secretariat and SEFAZ/CE.

This shows that a balanced fiscal management allows investments to be made continuously. In this sense, the State of Ceará has stood out nationally as the largest investor in the country, when

compared to its net current revenue. And in absolute terms it is also one of the biggest investors in Brazil, remembering that its economy and available revenue is one of the smallest.

In 2020 (Chart 13), the state government spent 11.3% of its net current revenue on investments, totaling approximately R\$2.5 billion. This percentage in 2019 was 10.6%. In addition to increasing the percentage, it is important to note that this position as the first in public investment in the country has been maintained over the past 6 years. It is also evident that the average investment of the other states is always well below the percentage and the absolute value made by Ceará. All this effort and control in fiscal and financial management to create savings and use it to make the necessary public investments to improve the quality of life of the population brought results in the generation of employment and income, in the economic development, in the improvement of the quality of education, where the State of Ceará stands out in Brazilian public education, with international recognition as well. These results are validated by the study.

**Chart 13.** Relationship between committed investments and RCL (accumulated in 2020)



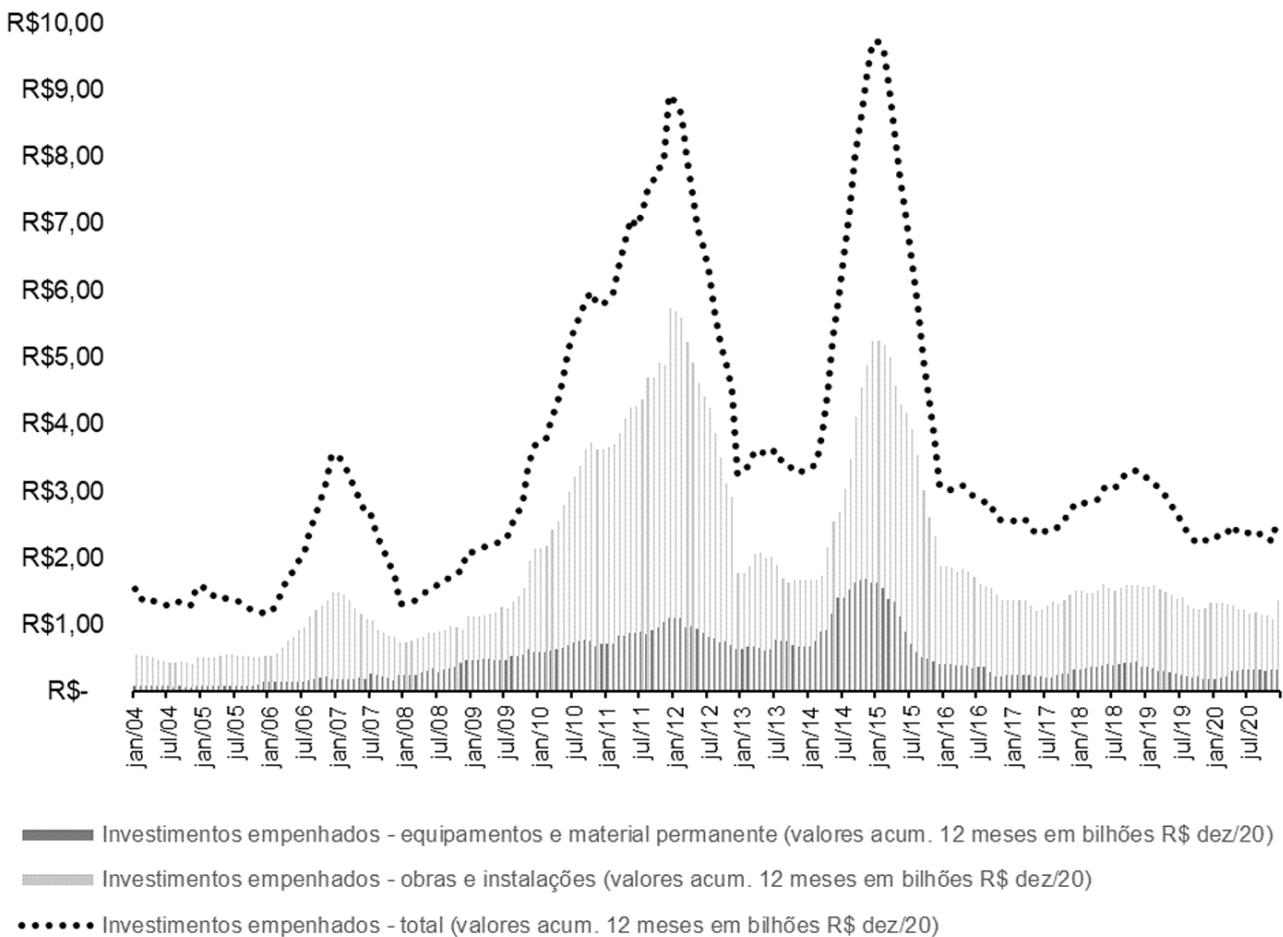
Source: Own preparation, based on data obtained from the National Treasury Secretariat

### 5.3 Evolution of the Investment Commitment by the Government of the State of Ceará

If the monthly nominal series of committed investments from 2004 to 2020 is observed, about 55% of the total investment is associated with the works and installations item, and almost 14% with the equipment and permanent material item. In the sequence, 8% is represented by the aid item and 7% by the other third party services - legal entity item. For this reason, that is, due to the representativeness and the concept of the two main items, the analysis in this section will be based only on the investments committed in works/facilities and equipment/permanent material.

Chart 14 reports the evolution of public investments in the state of Ceará, considering real values, in terms of December 2020, accumulated 12 months. There seem to be cycles of total investment that are not well defined or even regular over time, which are accompanied by the items already mentioned. It is important to highlight the values of R\$ 8.9 billion committed in December 2011 and R\$ 9.7 billion in January 2015.

**Chart 14.** Investments committed by the State Government of Ceará in equipment/permanent material, works/facilities and total (Jan/2004 to Dec/2020)



Source: Own preparation, based on data obtained at SEFAZ/CE.

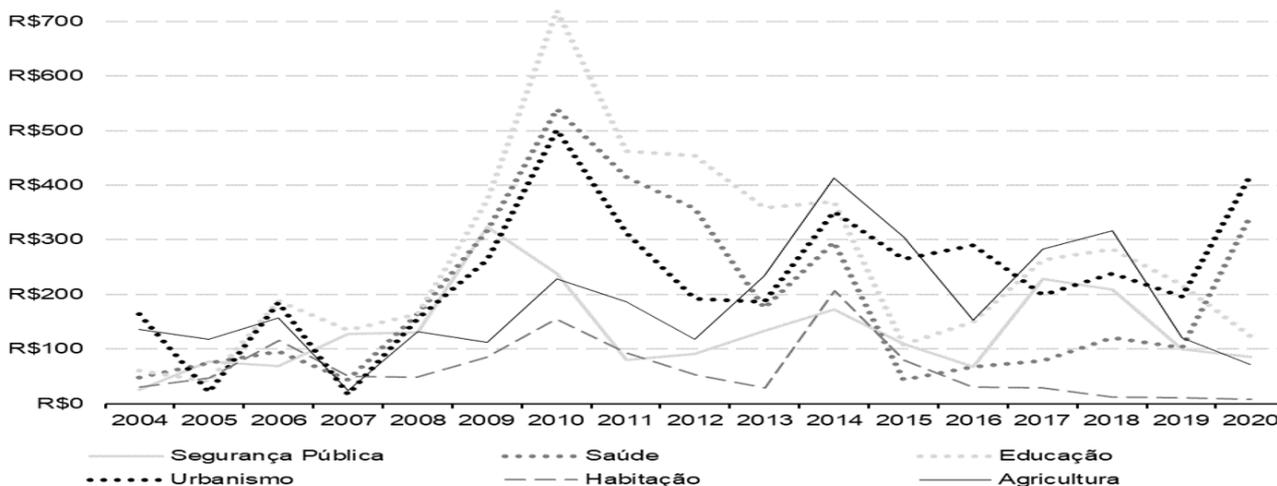
Still regarding these series of accumulated actual values, on average, there is the accumulated commitment for 12 months of about R\$ 500 million in equipment/permanent material, R\$ 1.9 billion in construction/installations and R\$ 3.5 billion in total. Observing the dispersion controlled by the average values, it is evident that the series of investments committed in equipment and permanent material is the most volatile of the series reported.

#### 5.4 Beneficiated areas with investments from the Government of the State of Ceará in the period from 2004 to 2020

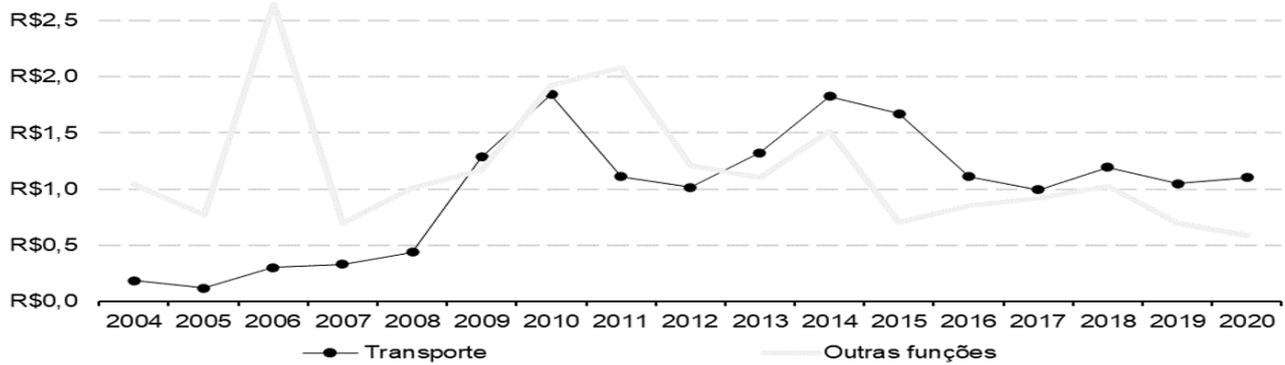
In the analysis of investments made in the period from 2004 to 2020 in the State of Ceará, it is possible to verify the distribution of investments in different functions, with highlight to the transport function that received the largest contribution of investments in the period analyzed. Chart 15 presents the amount committed by function, considering inflation, that is, brought to present value. In Chart 15.a the functions whose value committed in investment was less than R\$ 1 billion are plotted, here denominated functions with lower values. In Chart 15.b, are plotted the transport function and an aggregate of other functions that have committed more than R\$ 1 billion in investment in the verified period, denominated functions with higher values.

**Chart 15.** Investment per Function - 2004 to 2020 (values in R\$ of August/2021)

a. Investments (R\$ million per year) in functions with lower values



b. Investments (R\$ billion per year) in functions with higher values



Source: Own preparation, based on data obtained at SEFAZ/CE.

In terms of representativity considering the whole inter-story, it is possible to order as follows: housing (2.0%), public security (4.1%), agriculture (5.7%), health (6.0%), urbanism (7.2%), education (8.1%), transportation (30.7%), and other functions (36.2%). It is also possible to identify occasional cycles of high variation, with urbanism in 2006 and 2008, housing in 2014, and public safety in 2017. Observing this interstice segregating it into 3 parts, it is observed that all the functions had growth in committed investments in the second third in relation to the first third, with highlights for transportation, education, health, and urbanism. However, with the exception of public security, the other functions registered a real fall in commitment from the second third to the third period third, so that the most recent amounts committed in housing and other functions are on average, in real terms, lower than the initial amounts.

### 5.5. sources of resources of the investments of the Government of the State of Ceará in the period from 2004 to 2020

Chart 16 summarizes the investments by source of financing during the period from 2004 to 2020. The state government made most of its investments in this period in the transportation function, with the prevalence of external and internal credit operations resources, in the amounts of R\$ 3.44 billion and R\$ 2.88 billion, respectively. With respect to the resources coming from the state treasury, it is informed that the contribution of resources was R\$ 3.94 billion in the historical series.

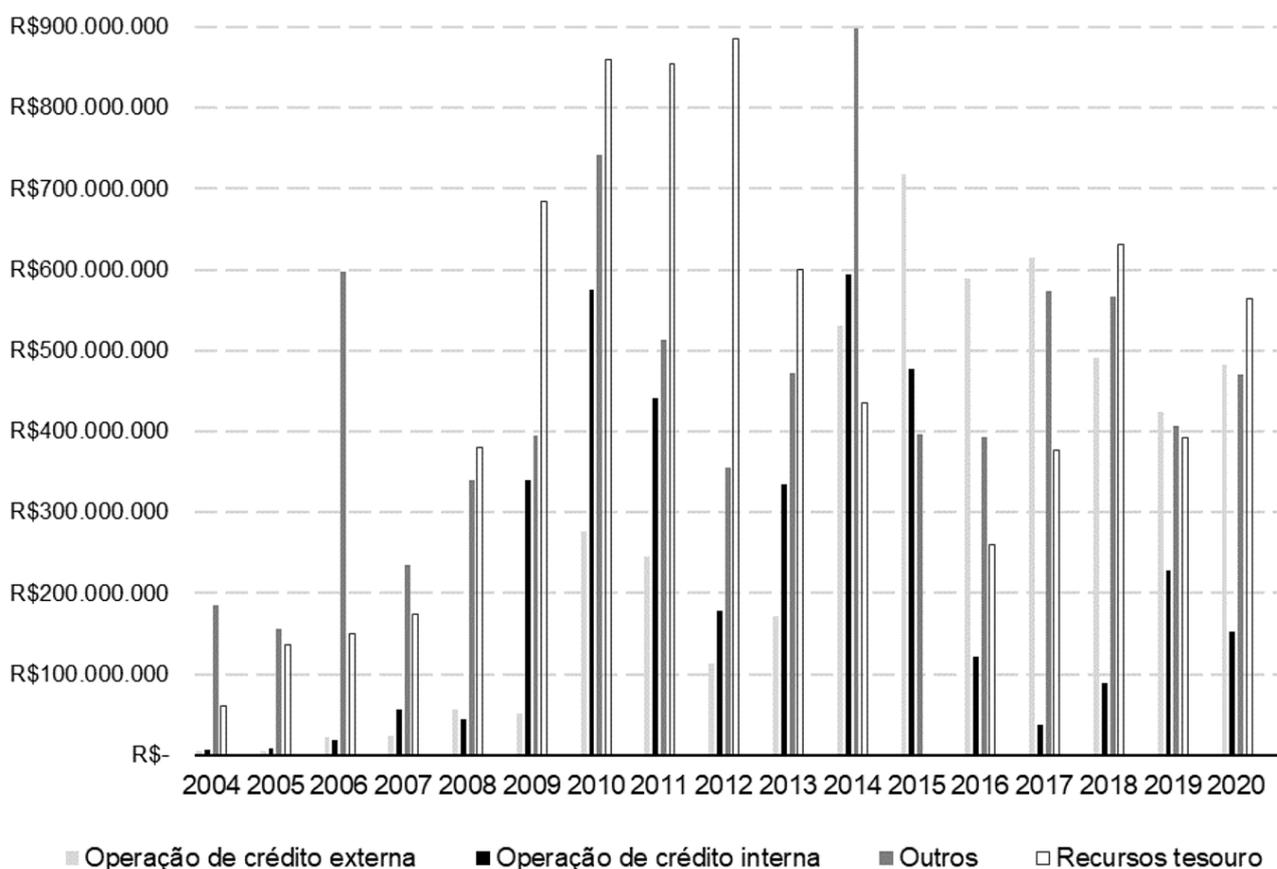
It is possible to order these sources of financing as follows: internal credit (15.5%), external credit (20.2%), treasury resources (32.0%) and other sources (32.5%). It is also possible to identify an increase in the level of sources of both credit operations in 2006 and then in 2009 and 2010. From 2014 on, the participation of domestic credit showed a tendency to drop sharply, while foreign credit was the only source that showed growth when comparing the third period of the third of the time sample in relation to the second third.

It is fundamental to highlight the robust growth of investments with treasury own sources at the beginning of the sample, with peaks of positive variation in 2005, 2008 and 2009, as well as the

concern about the reduction of this investment source mainly in the period from 2013 to 2015, and more recently in 2019.

The importance of this discussion about the sources of investments is related to the question addressed in the literature about the existence of “misallocation” of public investments when made with own resources (primary current surplus), or with alternative sources of resources (credit operations).

**Chart 16.** Investments in Equipment/Permanent Material and Works/Facilities



Source: Own elaboration, based on data obtained at SEFAZ/CE

## 6. Macroeconomic Impact of the Ceará State Government Investments

### 6.1 Introductory Background

The state has a more discretionary role, but one that should not be arbitrary: its role as an investor. In this aspect, it is important to highlight the part of the literature that believes that public investment should “complete markets,” that is, the state should invest in areas that seem to attract less attention and interest from private initiative, but that are still fundamental for a better business environment and for an increase in social infrastructure.

As already anticipated in the introduction, in this section, the most important of this project, the objective is to infer on the impact of public investments committed by the State Government of Ceará on some of the main macroeconomic indicators.

Methodologically, this second empirical exercise follows the first empirical exercise proposed in section 3, which reviewed the fiscal reaction to make inferences about debt solvency, and thus the sustainability of investment.

That is, the methodology will be via the wavelet approach, which allows inferences to be made about the conditional or instrumental commotions between the investment cycles and the macroeconomic variable in question. So that it is possible to infer if, when, and with what frequency they are in the same or opposite direction. If it is possible to identify which variable is determining this commotion and with what intensity this influence, or impact occurs.

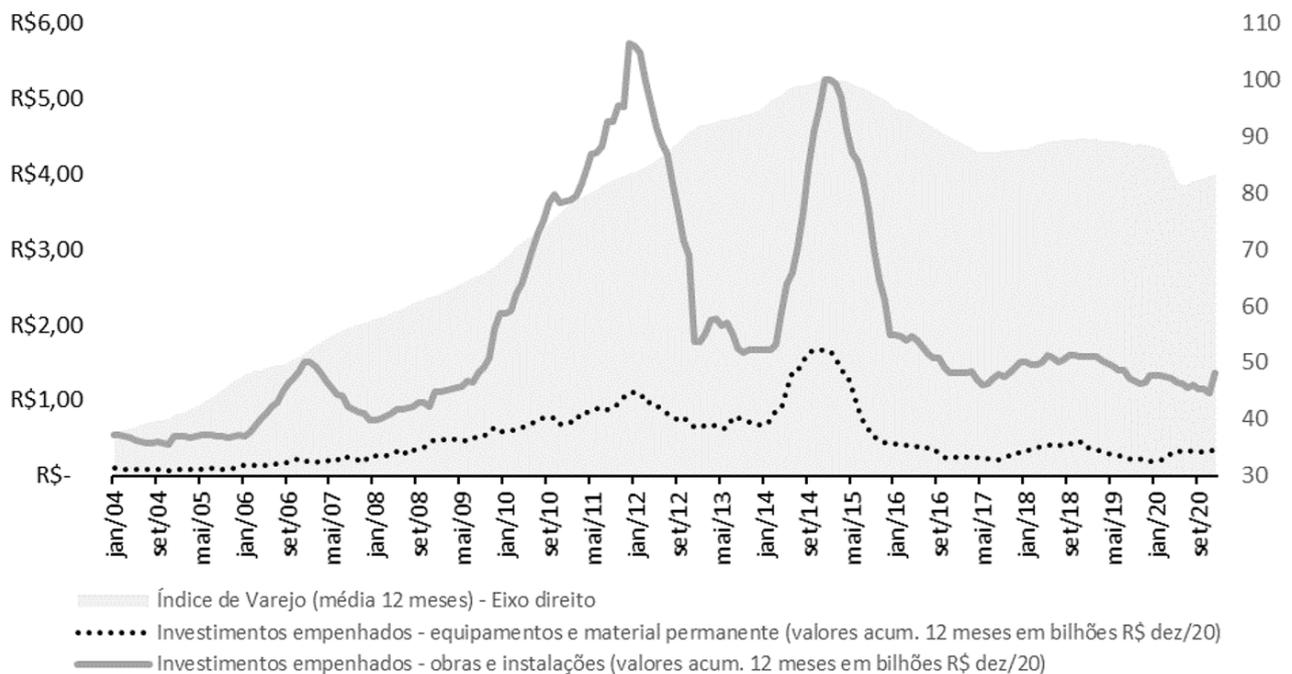
This empirical exercise will be replicated for all variables, always following the same procedure, which includes the use of the same instrumental variables: the country's basic interest rate, SELIC, as a metric that influences every operation associating savings and investments in the country, and the country's economic activity index, as a way to capture the influence of federal public policies that have shown themselves capable of determining economic activity in subnational federal entities.

The macroeconomic variables are: a) Retail Sales Volume Index, b) Industrial Production Index, c) Economic Activity Index (IBCR-CE), d) Merchandise Circulation Tax (ICMS) collection, and e) Formal employment generation. Except for the ICMS collection series, obtained in Annex 03 - Net Current Revenue, of the RREO of the State of Ceará Government, the other series were extracted from the Central Bank. All the series are originally monthly and were, for the purposes of the yearly analysis, annualized.

## 6.2 Relationship between Investments and Retail in the State of Ceará

Chart 17 reports the evolution of investments in the most important items and the Retail Sales Volume Index in the state of Ceará. Visually, there seems to be a linear movement of the indicator and the investments analyzed until 2011, when from then on the investments start to oscillate a lot, without necessarily influencing the retail sector in the short-term. This sector registers a drop between 2015 and 2017, with some stability until the end of 2020. The correlation between this economic indicator and the investments made in permanent equipment/materials is 0.6, and considering the works/facilities, it is 0.55.

**Chart 17.** Bimonthly Evolution of the Series of Investments (Equipment/Permanent Material and Construction/Installation, Respectively) and the Retail Index of the State of Ceará (Jan/2004 to Dec/2020) <sup>a</sup>

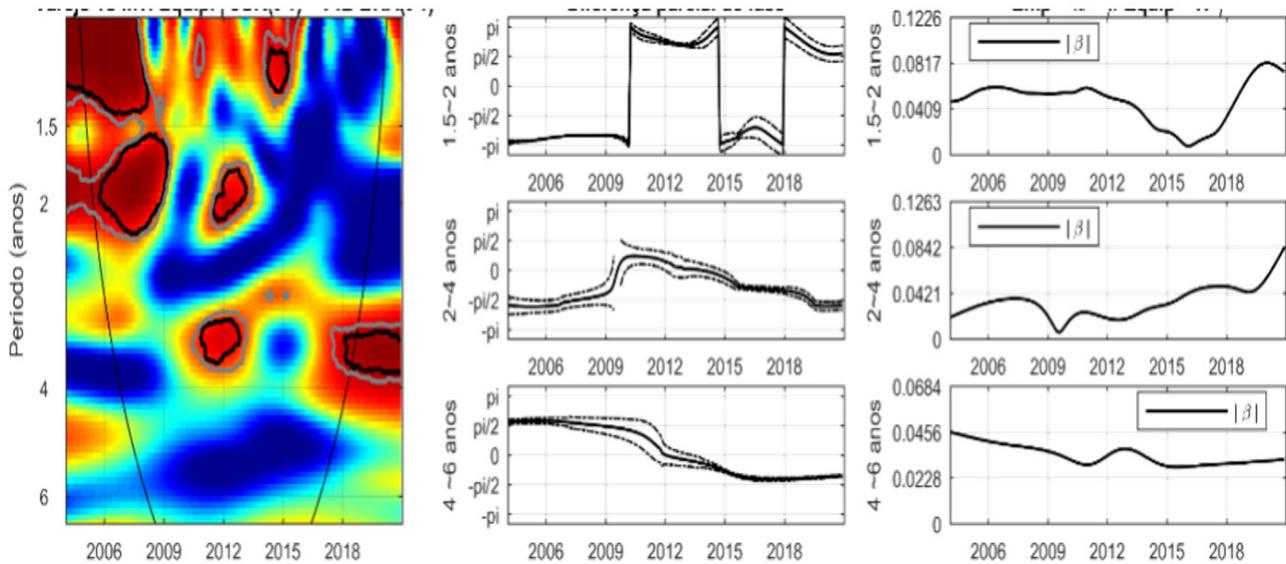


Source: Own preparation, based on data obtained from the Central Bank of Brazil and the SEFAZ/CE.

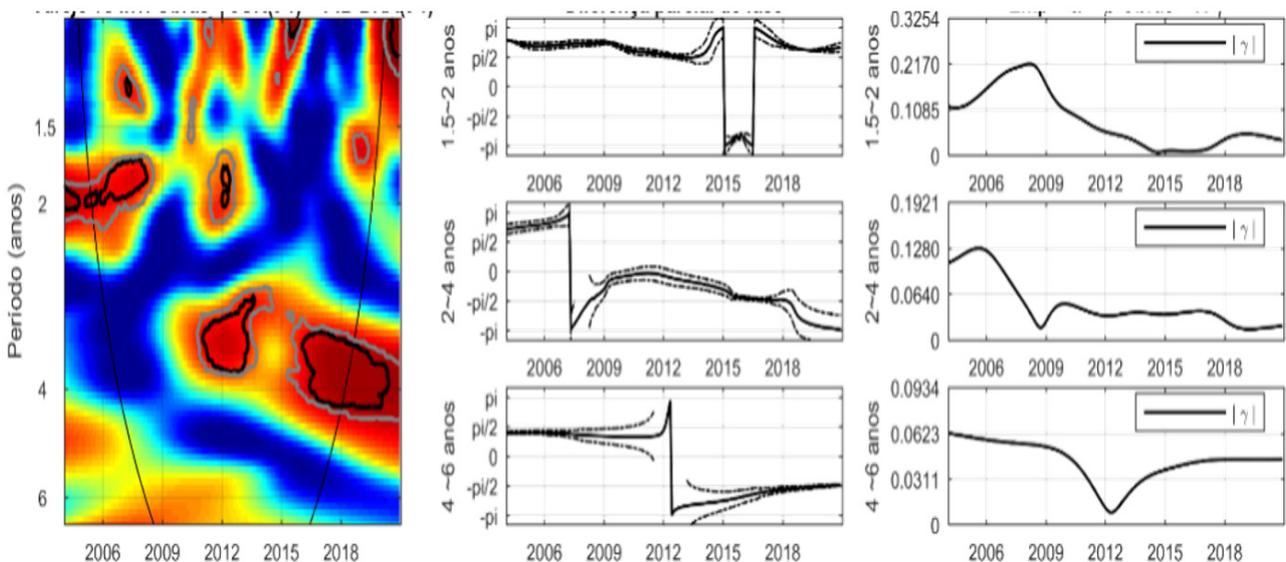
More important than this graphical analysis, however, is the inference, from the coherence heat maps, the phase diagram and the measurement of the impact of investments, all reported in Chart 18. The analysis always starts with the heat maps, in the red regions, which suggest significant commotions between the cycles of the variables. It is possible to summarize the results, identifying only one area, in which there is identification of impact of investments in works/facilities on retail sales volume, in the period between the second half of 2012 and the first half of 2013. The cycles of this investment item determined significantly and in the same direction the retail cycles at a frequency of 3 years, even with low elasticity of impact, of the order of 0.03.

**Chart 18.** Conditional Analysis via Coherence, Phasing and Gain Diagram between Investments (Equipment/Permanent Material and Works/Facilities) and the Retail Index of the State of Ceará (Jan/2004 to Dec/2020) <sup>a</sup>

a) Investments in Equipment/Permanent Material and the Retail Index



b) Construction/Installation Investments and the Retail Index



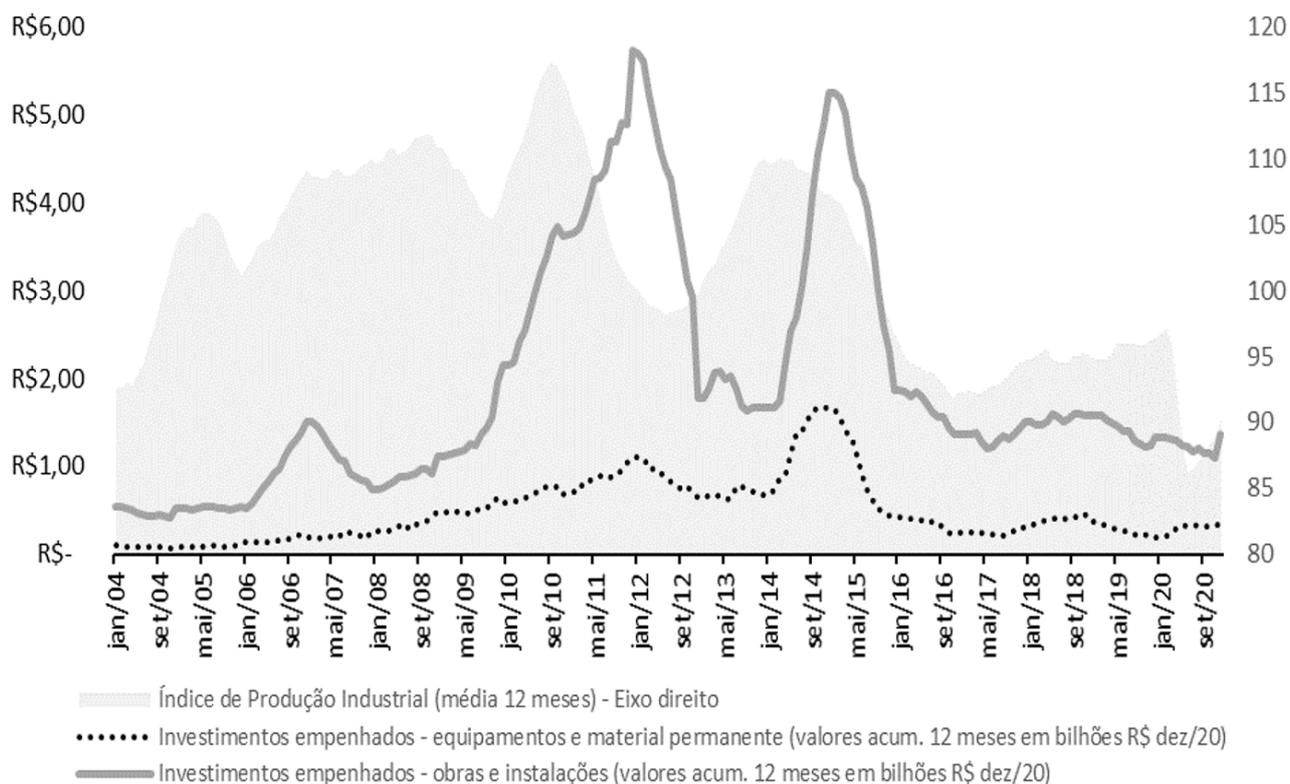
Observations: <sup>a</sup> Conditional Wavelet (instruments: SELIC interest rates and national economic activity) via Coherence Map (left), Phase Diagram (center) and Impact Parameter (right)

Source: Own preparation, based on data obtained from the Central Bank of Brazil and SEFAZ/CE.

### 6.3 Relationship between Investments and Industrial Production in the State of Ceará

Chart 19 reports the evolution of investments in the most important items and the Industrial Production Index in the state of Ceará. Visually, there seems to be a linear movement of the indicator and the investments with works/facilities analyzed until 2010, when from then on, the cycles of investments in works/facilities start to be apparently anticipated by the cycles of industrial production. The correlation between this production and investments in permanent equipment/material is 0.33, and considering the works/facilities, it is 0.20.

Chart 19. Bimonthly Evolution of the Investment Series (Equipment/Permanent Material and Construction/Installation, Respectively) and the Industrial Production Index of the State of Ceará (Jan/2004 to Dec/2020) <sup>a</sup>

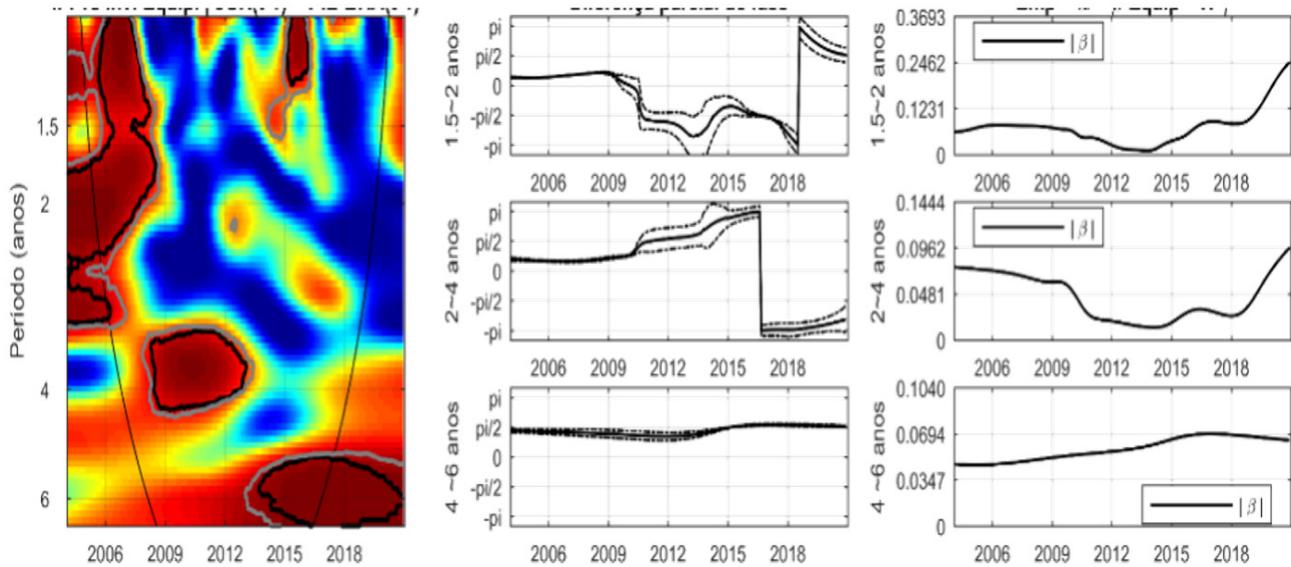


Source: Own preparation, based on data obtained from the Central Bank of Brazil and the SEFAZ/CE.

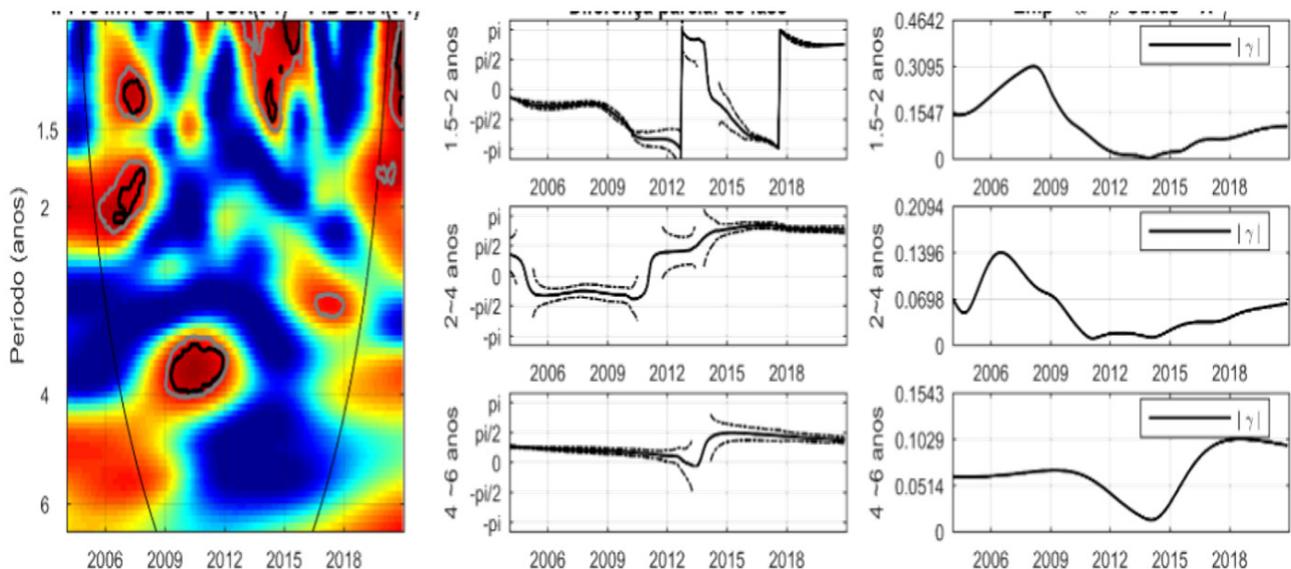
The wavelet metrics are reported in Chart 20. The results suggest initially that during the years 2006 to 2009, the short-term cycles of industrial production influenced the cycles of investments in permanent equipment/material and that from 2009 to 2012, this same influence occurred, however, at a different frequency, via medium-term cycles. There only seems to be an impact of the medium-term cycles (3 years) of investments in works/facilities determining the industrial production cycles in the period in phases from 2009 to 2010, and this impact has a low value, ranging between 0.01 and 0.07.

**Chart 20.** Conditional Analysis via Coherence, Phasing and Gain Diagram between Investments (Equipment/Permanent Material and Works/Facilities) and the Industrial Production Index of the State of Ceará (Jan/2004 to Dec/2020) <sup>a</sup>

a) Investment in Equipment/Permanent Material and the Industrial Production Index



b) Investments in Works/Facilities and the Industrial Production Index



Observations: <sup>a</sup> Conditional Wavelet (instruments: SELIC interest rates and national economic activity) via Coherence Map (left), Phase Diagram (center) and Impact Parameter (right)

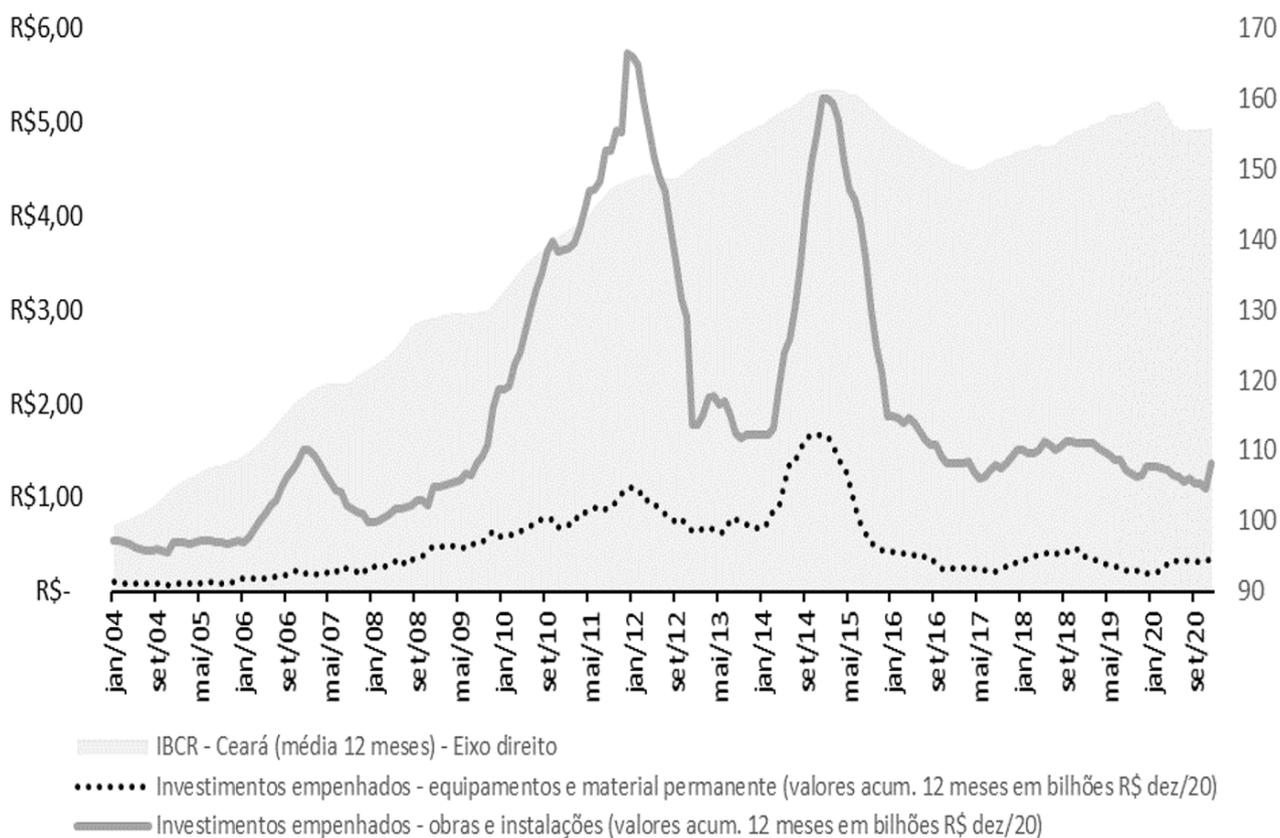
Source: Own preparation, based on data obtained from the Central Bank of Brazil and SEFAZ/CE.

#### 6.4 Relationship between Investments and Economic Activity in the State of Ceará

Chart 21 reports the evolution of investments in the most important items and the Index of Economic Activity of the State of Ceará (IBCR-CE). Visually, there seems to be a linear movement of the indicator and the investments analyzed until 2011, when from then on the investments start to oscillate a lot, without necessarily influencing the IBCR-CE in the short-term, which remains evolving until mid-2015. There is a drop between 2015 and 2017, with a resumption of activity until

the end of the interstice. The correlation between this economic indicator and the investments made in permanent equipment/materials is 0.55, and considering the works/facilities is 0.51.

**Chart 21.** Bimonthly Evolution of the Investment Series (Equipment/Permanent Material and Construction/Installation, Respectively) and the Economic Activity Index (IBCR-CE) of the State of Ceará (Jan/2004 to Dec/2020) <sup>a</sup>

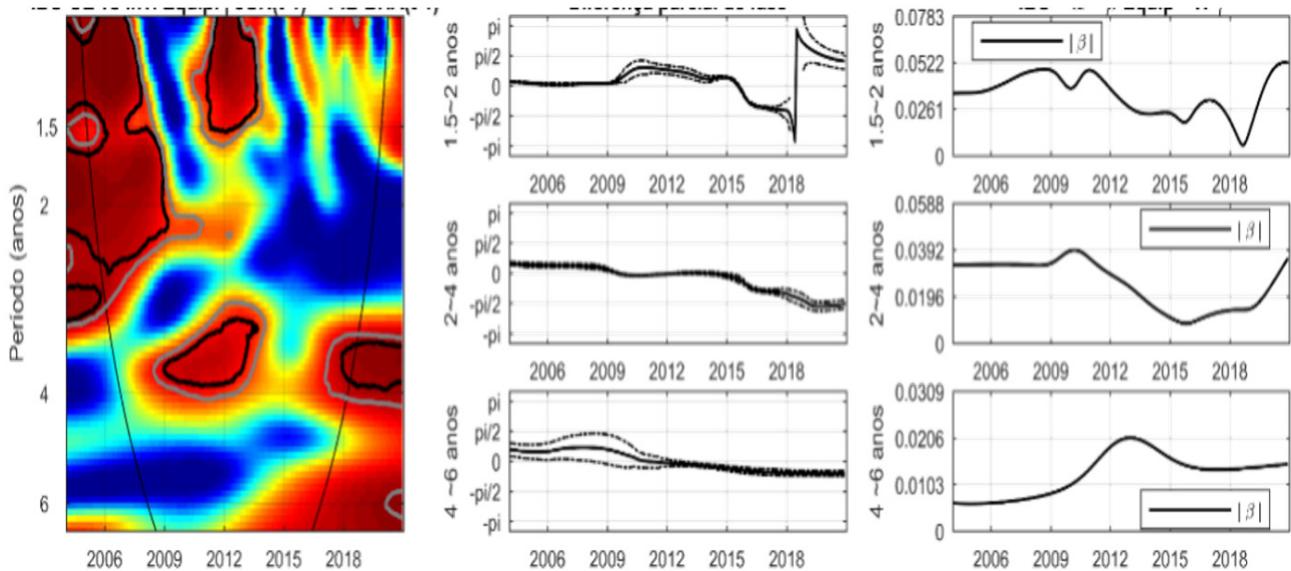


Source: Own preparation, based on data obtained from the Central Bank of Brazil and the SEFAZ/CE.

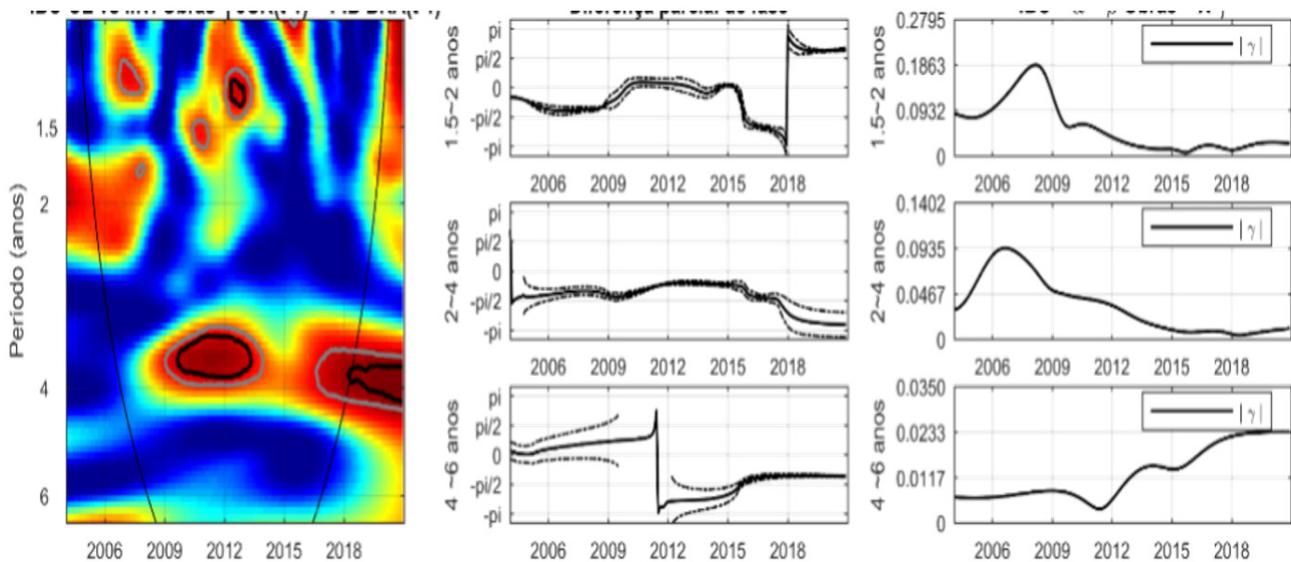
More important than this graphical analysis, however, is the inference from the coherence heat maps, the phase diagram and the measurement of the impact of investments, all reported in Chart 22. The analysis of the results of the relationship between permanent equipment/materials and the IBCR-CE suggests that there are moves in the same direction in the short-term between 2005 and 2008 and in the medium-term between 2009 and 2012, but without a clear definition of which variable is the determinant. The clearest and most important result consists in the evidence that the medium-term cycles of investments in works/facilities are significantly able to positively determine the economic activity cycles, with a lag of approximately 3 years, between mid-2009 and the end of 2012, with elasticity higher than 0.04.

**Chart 22.** Conditional Analysis via Coherence, Phasing and Gain Diagram between Investments (Equipment/Permanent Material and Works/Facilities) and the Economic Activity Index (IBCR-CE) of the State of Ceará (Jan/2004 to Dec/2020) a

a) Investments in Equipment/Permanent Material and the Economic Activity Index



b) Investments in Works/Facilities and the Economic Activity Index



Observations: <sup>a</sup> Conditional Wavelet (instruments: SELIC interest rates and national economic activity) via Coherence Map (left), Phase Diagram (center) and Impact Parameter (right)

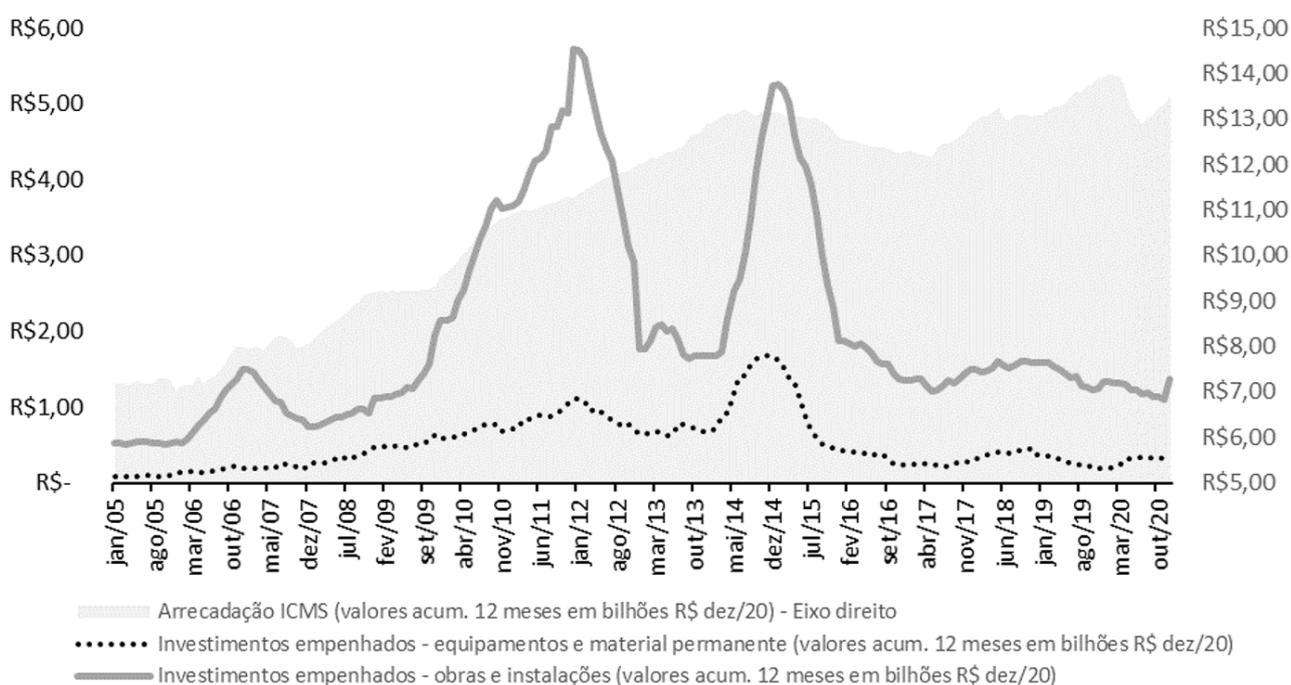
Source: Own preparation, based on data obtained from the Central Bank of Brazil and SEFAZ/CE.

## 6.5 Relationship between Investments and ICMS Revenue in the State of Ceará

Chart 23 reports the evolution of investments in the most important items and of ICMS collection in the state of Ceará. Visually, there seems to be a linear movement of the indicator and

the investments analyzed until 2011, when from then on, the investments start to oscillate a lot, while the collection keeps growing until 2014. With the fiscal crisis in the country, this collection registered a downward oscillation, with due recovery in 2017. The correlation between this fiscal indicator and the investments committed in permanent equipment/materials is 0.45 and considering the works/facilities is 0.43.

**Chart 23.** Bimonthly Evolution of the Series of Investments (Equipment/Permanent Material and Construction/Installation, Respectively) and ICMS Collection of the State of Ceará (Jan/2005 to Dec/2020) <sup>a</sup>

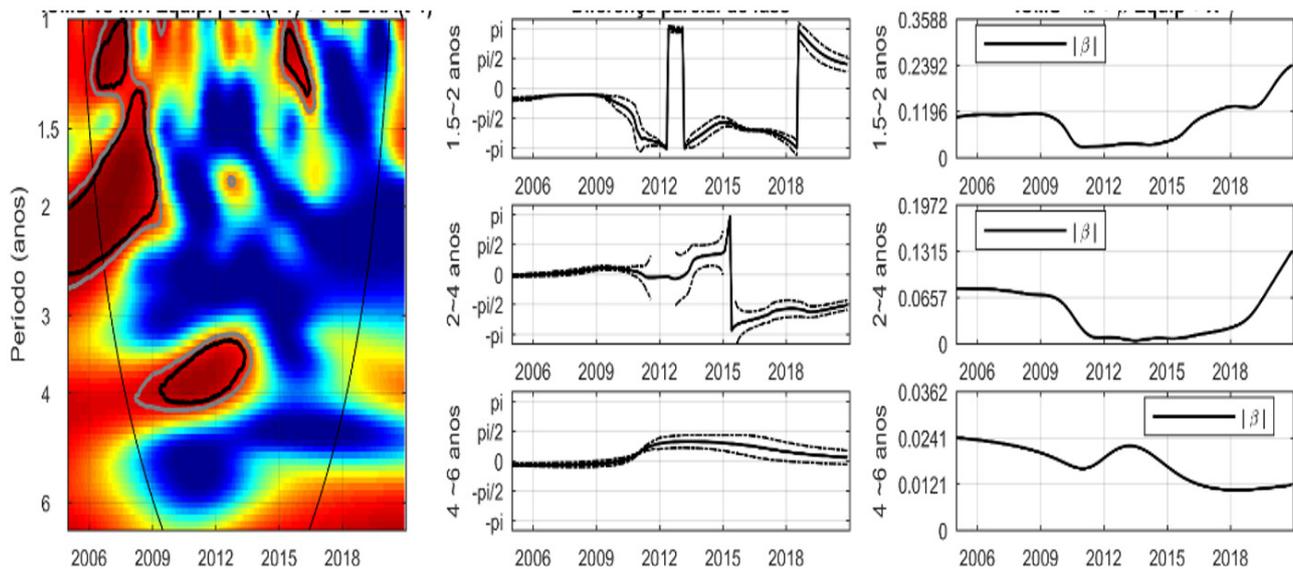


Source: Own preparation, based on data obtained at SEFAZ/CE.

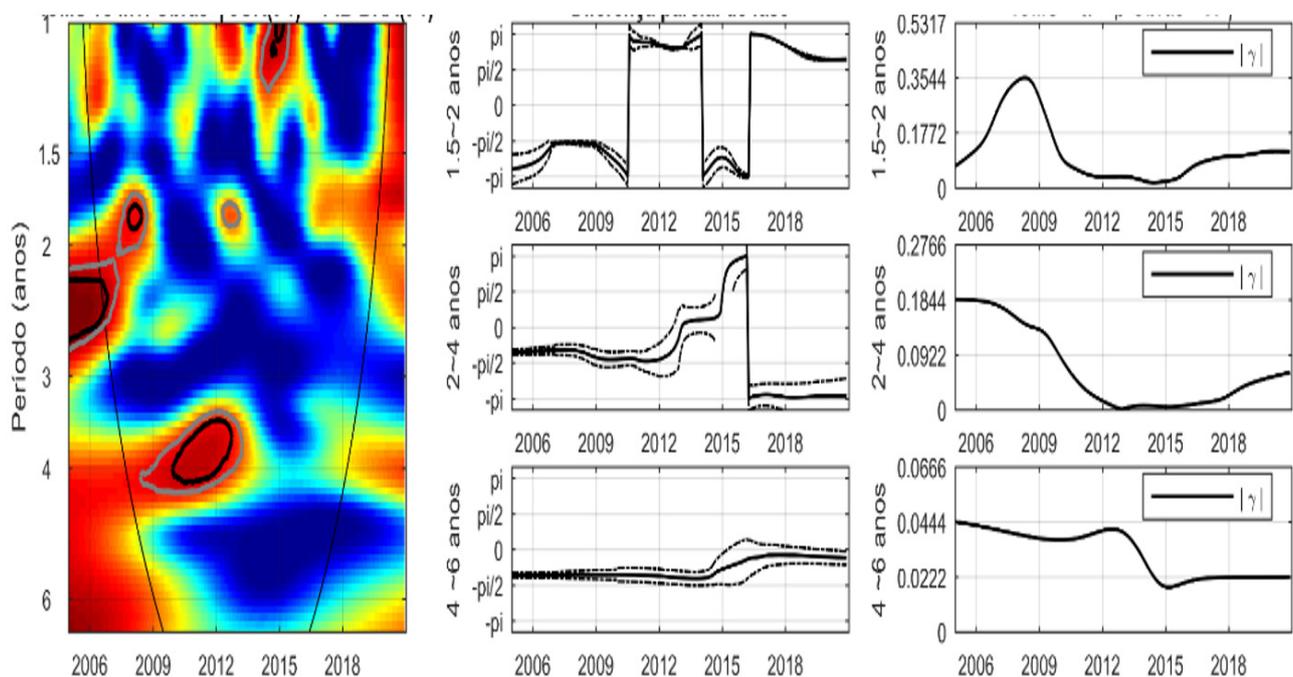
More important than this graphical analysis, however, is the inference, from the coherence heat maps, the phase diagram and the measurement of the impact of investments, all reported in Chart 24. It is possible to identify a significant short-term impact (less than 2 years) caused by the investment cycles in permanent equipment/materials in the collection cycles between 2006 and 2009, with a constant elasticity of around 0.12. The commotion evidenced between 2009 and 2012 does not allow us to identify the determinant variable. On the other hand, the commotions between the medium-term cycles of works/facilities and ICMS collection are significant between 2010 and 2012, but with questionable significance regarding the possible influence caused by investments.

**Chart 24.** Conditional Analysis via Coherence, Phasing and Gain Diagram between Investments (Equipment/Permanent Material and Works/Facilities) and the ICMS Revenue of the State of Ceará (Jan/2005 to Dec/2020) <sup>a</sup>

a) Investments in Equipment/Permanent Material and the Collection of ICMS



b) Investments in works/facilities and the collection of ICMS



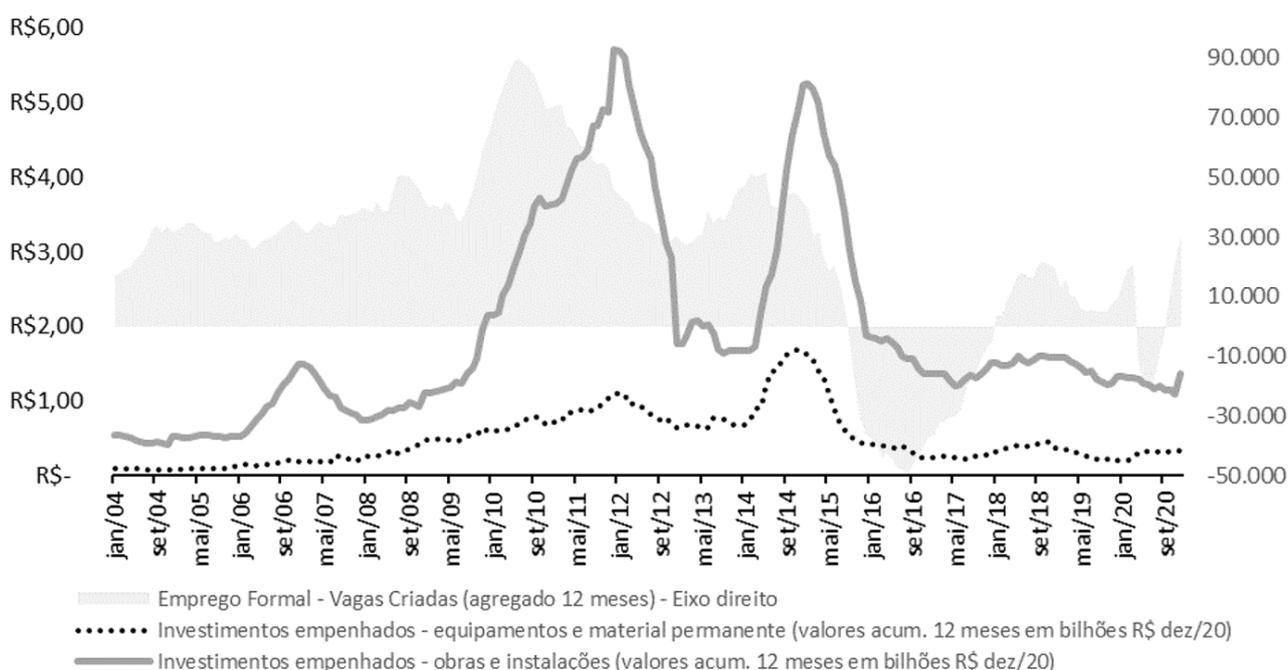
Observations: <sup>a</sup> Conditional Wavelet (instruments: SELIC interest rates and national economic activity) via Coherence Map (left), Phase Diagram (center) and Impact Parameter (right)

Source: Own preparation, based on data obtained at SEFAZ/CE.

### 6.6 Relationship between Investments and Job Generation in the State of Ceará

Chart 25 reports the evolution of investments in the most important items and the generation of formal jobs in the state of Ceará. Visually, there seems to be a linear movement of jobs generated or destroyed with both items of investment, with apparent anticipation on the part of jobs. Unlike the other economic series analyzed before, job generation oscillates a lot and recorded negative results in the crisis during the years 2015 to 2017 and more recently, in the pandemic. The correlation between this economic indicator and the investments committed in permanent equipment/materials is 0.37 and considering the works/facilities is 0.31.

**Chart 25.** Bimonthly Evolution of the Series of Investment (Equipment/Permanent Material and Construction/Installation, Respectively) and Formal Employment Generation in the State of Ceará (Jan/2004 to Dec/2020) <sup>a</sup>

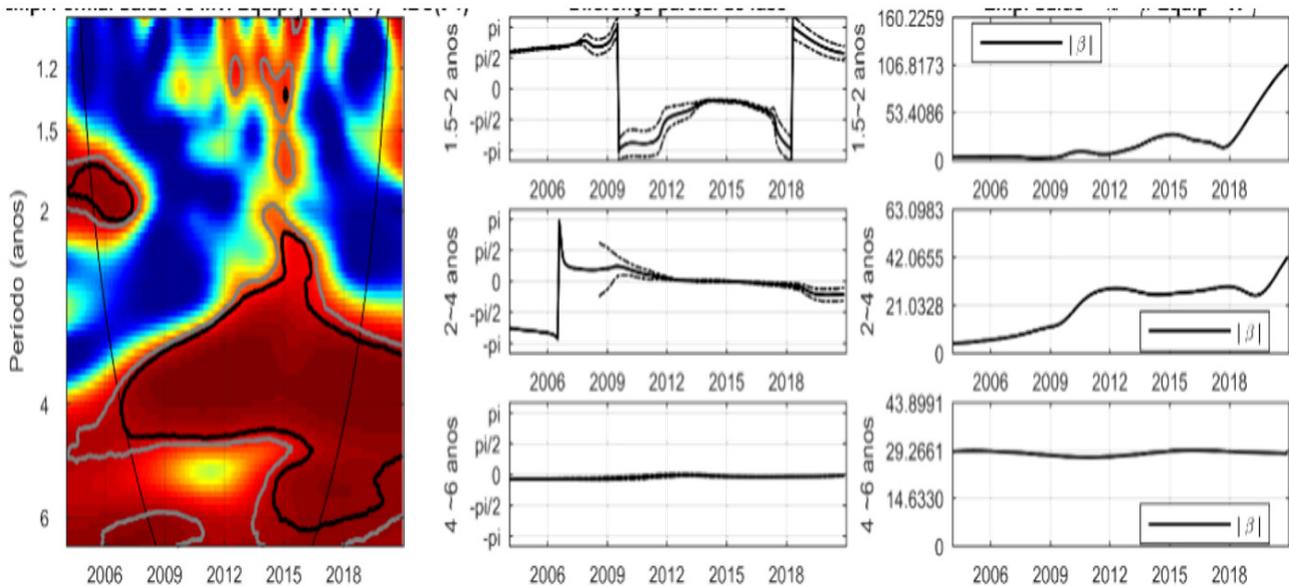


Source: Own preparation, based on data obtained from the Central Bank of Brazil and the SEFAZ/CE.

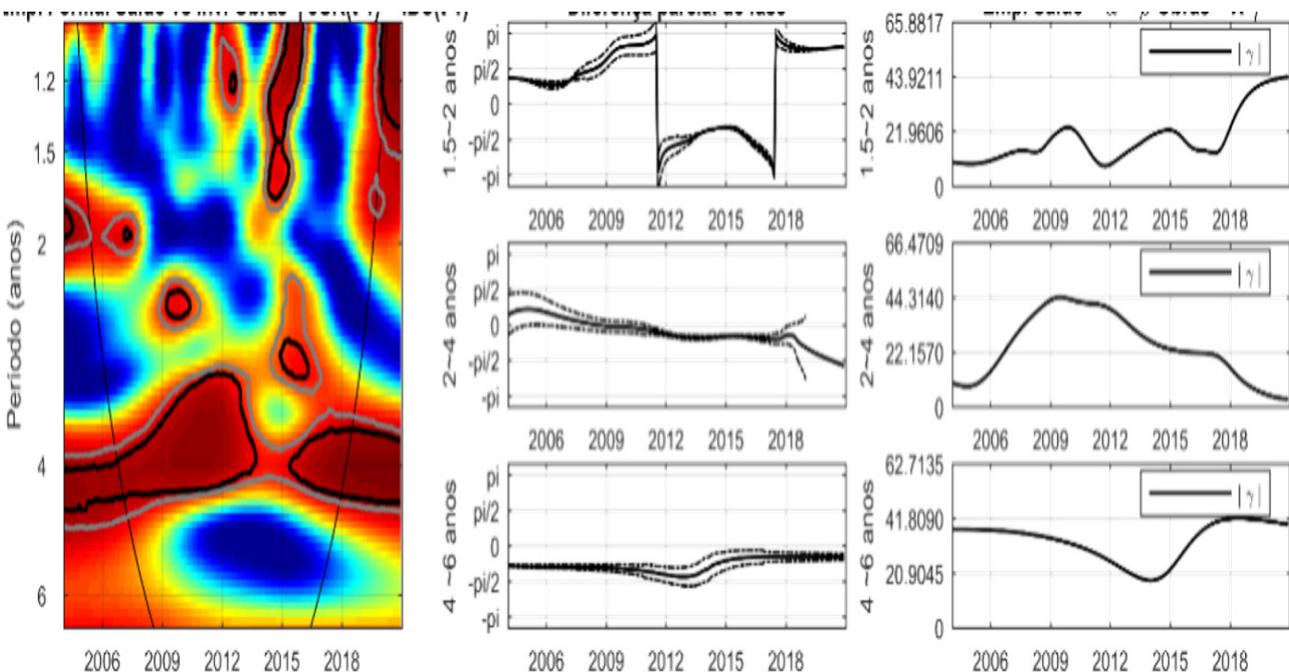
More important than this graphical analysis, however, is the inference from the coherence heat maps, the phase diagram and the measurement of the impact of investments, all reported in Chart 26. Without any doubt, when compared to the other results reported in this section, we have in this variable and jobs the most robust evidence of the impact of both investment items, mainly, regarding the time duration of this impact. The medium-term cycles (with lags ranging from 3 to 4 years) of investments in permanent equipment/materials proved to be positive and significant in determining the job creation cycles during the period between 2007 and 2011. The commotion thereafter is significant, but without evidence in terms of which variable is able to influence the other.

**Chart 26.** Conditional Analysis via Coherence, Phasing and Gain Diagram between Investments (Equipment/Permanent Material and Works/Facilities) and the Generation of Jobs in the State of Ceará (Jan/2004 to Dec/2020)

a) Investment in Equipment/Permanent Material and the Generation of Formal Jobs



b) Investments in Works/Facilities and the Generation of Formal Jobs



Observations: <sup>a</sup> Conditional Wavelet (instruments: SELIC interest rates and national economic activity) via Coherence Map (left), Phase Diagram (center) and Impact Parameter (right)

Source: Own preparation, based on data obtained from the Central Bank of Brazil and SEFAZ/CE.

Even stronger and more robust is the evidence on the medium-term relationship, with cycles that present phasic movements with lags of 3 to 4 years, between investments in works/facilities and job creation. With the exception of the period of approximately 2 years, between mid-2013 and mid-2015, during the interstice from 2007 to 2018, there was a positive and significant impact, characterized by the ability of the cycles of the resources committed to this investment item to determine the cycles of formal jobs in the state of Ceará.

## **7. Conclusions**

The present work sought to comprehensively make a robust analysis of the fiscal situation of the State of Ceará, verifying the evolution of the main indicators with regard to the sustainability of public accounts, the way debt and current surplus behave, the way in which the fiscal balance can provide a sustainable policy of investments and what the impacts of this policy are. Basically, the analysis was explained in two points: the management and balance of public accounts, and the evaluation of public policies aimed at investments.

In the first moment the fiscal context of the state is verified, showing the results achieved and recognized in national rankings, that despite the difficulty of the improvement of many social indicators of Ceará, the state stands out in the fiscal issue and in education. The work demonstrates that the management of the fiscal policy of the state has placed Ceará over the past decades as a national example, also demonstrates that this policy has provided a sustainable policy of public investment.

Still on the first point of the management of public accounts and seeking to establish a strategic scenario where investment decisions are based on ex ante, during, and ex post evaluations of public policies, the solvency of the debt and the sustainability of the investments were analyzed through a descriptive analysis and citing some other studies that lead us to conclude that there is sustainability in the debt and in the investments, even with short-term oscillations.

Seeking more specific and robust results, the wavelet fiscal reaction function was revisited in an innovative way, verifying the relationship between the surplus and the internal and external debt.

From this modeling one can conclude that there is coherence between the cycles of the variables in question, but that solvency can be verified more strongly in some periods suggesting a short and medium-term solvency of the external debt. A relevant evidence is that there is a robust and continuous long-term relationship. The study shows that, with some fluctuations, the Ceará debt is solvent.

It is also possible to infer that the values for investments, current surplus, credit operations, and debt go relatively together. And this balance of variables is what makes the difference between a balanced or disastrous fiscal management. In the case of Ceará, the adjustment and management formula has worked and provided a high level of investments. As already mentioned in this paper, the main objective of the work is to infer the impacts and results of this investment policy.

With respect to the impacts of the investment policy of the State Government of Ceará on the selected macroeconomic variables, it is possible to summarize some evidence. Between 2006 and 2009, the resource commitment, mainly in equipment and permanent material, especially in transportation (20.7% of the total), proved to be able to influence the collection of ICMS in two years ahead, according to an elasticity such that a 10% increase in investment, for example, is able to boost collection by 1.2%. In monetary values brought to present value, the investment committed in permanent equipment/materials was of the order of almost R\$ 200 million, on average per year, and on average it was financed about 60% with treasury resources, while tax collection was over R\$ 8 billion per year.

After this impact, it is evident that the commitment of resources in works and facilities is able to influence, in a horizon of 3 years, both the IBCR-CE between 2009 and 2012, as well as industrial production between 2009 and 2010, and the volume of retail sales between 2012 and 2013; in all cases with average elasticity of approximately 0.04. In other words, a 10% increase in construction/facilities investments may have been responsible for the increase 3 years ahead of about 0.4% of these economic activity indicators, in these respective time interstices. Between 2009 and 2013, the specific function with the highest destination of resources was transportation with 28.7%.

From the viewpoint of job creation, the investments committed in equipment between 2007 and 2011 - whose average value was around R\$ 285 million per year, with 58% coming from the Treasury's own resources - proved to be able to impact the balance of jobs 3 years ahead, in such a way that a 10% increase in these investments seems to be able to increase the balance by 4 thousand formal jobs. The commitment in works/facilities - whose average value from 2007 to mid-2013 and from mid-2015 to 2018 was R\$ 1.25 billion per year, with 33% being financed by the treasury's own resources - has shown itself capable of generating jobs in such a proportion that a 10% increase in investment generates an increase of almost 3 thousand jobs 3 years ahead.

Finally, it is inferred that the sustainable investment policy adopted by the federal entity Ceará has provided positive results in the analyzed segments. It is also important to say that this follow-up must be constant, ex ante, during and ex post, verifying the best allocation of financial resources. The investments have to be diversified in areas that bring added value to the Ceará GDP, in economic segments that generate income and value.

In practical and applied terms, this type of work adds value by allowing the importance of public policy analysis to be verified, and it is possible to measure the quality gain in management when scientific verification of results is sought, beyond pure empirical verification. From the viewpoint of public policy makers, studies that allow an analysis with the academic, public sector, and private sector visions bring a quality gain in the follow-up and verification of these results. The work also brings inputs for new studies and modeling of sustainable and optimized management of public investments.

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### Methodological Appendix

The Continuous Wavelet Transform (CWT) is composed of the calculation of the coefficients of scaled and translated versions that surround the original signal analyzed ( $x(t)$ ). The process of computing the translation and scaled coefficients (continuous complex conjugate value) is obtained by using the Morlet wavelet ( $\psi(x)$ ). This function is considered an efficient mother wavelet for measuring estimates of amplitude and instantaneous phase of a signal in the neighborhood of each ordered time-frequency pair ( $\tau, s$ ).

In algebraic terms, CWT of a time series  $x(t)$  is given by:

$$W_x(\tau, s) = \int_{-\infty}^{\infty} x(t) \left[ \frac{1}{\sqrt{|s|}} \overline{\psi_{t,s}} \left( \frac{t - \tau}{s} \right) \right] dt \tag{9}$$

where  $s$  is the scaling parameter that controls the length of the signal and  $\tau$  is the translation parameter that controls the location of the signal.  $\overline{\psi_{t,s}}(t)$  denote the versions of the wavelet mother (Morlet wavelet in this case). To the extent that CWT manipulates two domains it is necessary to ensure correspondence between the operations performed in one domain with respect to the other. For further discussion of the properties (linearity, similarity, shift, differentiation, and convolution theorems).

The Continuous Wavelet Transform (CWT) is composed of the calculation of the coefficients of scaled and translated versions that surround the original signal analyzed ( $x(t)$ ). The process of computing the translation and scaled coefficients (continuous complex conjugate value) is obtained by using the Morlet wavelet ( $\psi(x)$ ). This function is considered an efficient mother wavelet for measuring estimates of amplitude and instantaneous phase of a signal about each ordered time-frequency pair ( $\tau, s$ ).

As explained in the article, dissimilarity coefficients denote a measure of distance between the spectrum of two time series. From a mathematical point of view, dissimilarity is calculated from the decomposition into singular values of a pair of CWT's, such that:

$$dist(W_x, W_y) = \frac{\sum_{k=1}^K w_k^2 [d(I_x^k, I_y^k) + d(u_x^k, u_y^k)]}{\sum_{k=1}^K w_k^2} \tag{10}$$

where  $W_x$  e  $W_y$  are the CWTs of the time series  $x(t)$  e  $y(t)$ ;  $w_k^2$  are the weights of the square of covariance explained by each axis;  $I_x^k$  e  $I_y^k$  are the standard leads and  $u_x^k$  e  $u_y^k$  are the singular vectors. Thus, the distance between the two spectra  $dist(W_x, W_y)$  is given by the angle between each pair of the corresponding component, defined by the consecutive points of the two vectors and taking the average of these values. Thus, the closer to zero this distance measure is, the more similar are the CWT's of  $x(t)$  e  $y(t)$ .

Partial Wavelet Coherence (PWC), on the other hand) is responsible for measuring the dependence (comovement) between time series signals in the time and frequency domain, controlling for the influence of an exogenous variable  $z(t)$ . To present the formulation of this function, it is necessary to initially present the unconditional version of Wavelet coherence (WC), and then condition this function. WC starts from the computation of the crossed Wavelet transform (XWT) between the time series  $x(t)$  e  $y(t)$ . THE XWT ( $W_{xy}(\tau, s)$ ) measures the covariance between two time series for each ordered time-frequency pair, and is given by

$$W_{xy}(\tau, s) = W_x(\tau, s) \cdot \overline{W_y(\tau, s)} \quad (11)$$

Based on  $W_{xy}(\tau, s)$  the complex Wavelet coherence between  $x(t)$  e  $y(t)$  is given by:

$$\rho_{xy} = \frac{S(W_{xy})}{\left[ S(|W_x|)^2 S(|W_y|)^2 \right]^{1/2}} \quad (12)$$

where  $S$  denotes a smoothing operator in time and scale;  $|W_x|^2$  e  $|W_y|^2$  denote the Wavelet Power Spectra (WPS) of  $x(t)$  e  $y(t)$  respectively.<sup>3</sup>

And the Wavelet coherence (WC) is given by the absolute value of the complex coherence wavelet function:

$$R_{xy} = |\rho_{xy}| \quad (13)$$

Finally, PWC between  $x(t)$  e  $y(t)$  controlling for the influence of the time series  $z(t)$  can be measured as the absolute value of the partial complex Wavelet coherence ( $\rho_{xyz}$ ):

$$R_{xy|z} = |\rho_{xy,z}| = \left| \frac{\rho_{xy} - \rho_{xz}\overline{\rho_{yz}}}{\sqrt{(1 - R_{xz}^2)(1 - R_{yz}^2)}} \right| \quad (1)$$

Following the traditional reaction modeling described in equations (7) and (8), the vector  $Z_t$  instrumental control vector was composed of two elements:  $\tilde{r}_t$ , which consists of the deviation of GDP-weighted primary current revenues in  $t$ , e  $\tilde{d}_t$  is the deviation of GDP-weighted primary expenditures in  $t$ . These deviations are relative to the respective values obtained via the Hodrick-Prescott filter, whose smoothing parameter used was  $\delta=3.600$  commonly used for bimonthly frequency data.

<sup>3</sup> (WPS)<sub>i</sub>( $\tau, s$ ) =  $|W_i(\tau, s)|^2$  for  $i = x, y$ .

## Appendix

Table A1. Credit Operations in effect for the State of Ceará's Government, according to SADIPEM (Position: 04/06/21)

Saldo devedor na data base	Classificação no RGF	Nome do credor	Data da contratação, emissão ou assunção	Moeda da contratação, emissão ou assunção	Data da quitação
R\$ 70.735.028.340,07	Passivo atuarial		31/12/2016	Real	31/12/2021
R\$ 1.870.812.000,00	- Externos	Banco Interamericano de Desenvolvimento	27/12/2013	Dólar dos EUA	15/08/2038
R\$ 1.759.626.037,63	- Externos	Banco Internacional para Reconstrução e Desenvolvimento	19/12/2013	Dólar dos EUA	15/02/2043
R\$ 1.246.421.750,37	Restos a pagar não processados		01/01/2016	Real	31/12/2021
R\$ 1.015.344.095,41	- Externos	Banco Internacional para Reconstrução e Desenvolvimento	19/03/2009	Dólar dos EUA	15/09/2034
R\$ 972.340.213,07	- Internos	Banco do Brasil S/A	22/11/2017	Real	22/11/2027
R\$ 950.809.891,53	- Externos	Banco Interamericano de Desenvolvimento	01/06/2016	Dólar dos EUA	15/02/2041
R\$ 879.949.217,70	Reestruturação da dívida de estados e municípios	União	12/11/1998	Real	15/10/2047
R\$ 810.958.882,33	- Internos	Banco do Brasil S/A	13/05/2020	Real	13/05/2030
R\$ 743.636.335,53	- Internos	Banco do Brasil S/A	21/12/2012	Real	15/02/2043
R\$ 631.450.657,80	Outras dívidas (não contratuais)		01/01/2016	Real	30/12/2048
R\$ 577.010.387,85	- Externos	Banco Interamericano de Desenvolvimento	22/12/2009	Dólar dos EUA	15/10/2034
R\$ 518.483.807,45	Precatórios posteriores a 05/05/2000 (inclusive) vencidos e não pagos		31/12/2017	Real	31/12/2024
R\$ 451.495.288,83	- Externos	Banco Interamericano de Desenvolvimento	25/11/2010	Dólar dos EUA	30/09/2035
R\$ 437.565.477,30	- Internos	Banco Nacional de Desenvolvimento Econômico e Social	26/02/2014	Real	15/03/2027
R\$ 424.458.411,82	- Externos	Banco Internacional para Reconstrução e Desenvolvimento	03/10/2012	Dólar dos EUA	15/12/2036

**Table A1.** Credit Operations in effect for the State of Ceará's Government, according to SADIPEM (Position: 06/04/21) - continued

Saldo devedor na data base	Classificação no RGF	Nome do credor	Data da contratação, emissão ou assunção	Moeda da contratação, emissão ou assunção	Data da quitação
R\$ 392.183.729,58	- Externos	Banco Interamericano de Desenvolvimento	28/12/2017	Dólar dos EUA	15/10/2042
R\$ 324.525.712,65	Demais dívidas contratuais	Caixa Econômica Federal	30/08/2018	Real	01/08/2033
R\$ 316.006.298,05	- Externos	Banco Internacional para Reconstrução e Desenvolvimento	22/09/2009	Dólar dos EUA	15/10/2029
R\$ 306.602.736,10	- Externos	Corporação Andina de Fomento	28/08/2013	Dólar dos EUA	28/08/2025
R\$ 295.692.230,00	- Externos	Banco Interamericano de Desenvolvimento	02/09/2013	Dólar dos EUA	15/05/2033
R\$ 284.295.900,18	- Internos	Banco Nacional de Desenvolvimento Econômico e Social	28/11/2013	Real	15/12/2024
R\$ 280.637.843,23	- Internos	Banco Nacional de Desenvolvimento Econômico e Social	19/09/2014	Real	15/10/2049
R\$ 280.311.709,64	- Externos	Banco Interamericano de Desenvolvimento	22/12/2009	Dólar dos EUA	15/07/2034
R\$ 223.633.041,04	- Internos	Banco Nacional de Desenvolvimento Econômico e Social	21/12/2012	Real	15/01/2044
R\$ 207.206.980,18	- Externos	Banco Internacional para Reconstrução e Desenvolvimento	22/12/2009	Dólar dos EUA	15/10/2033
R\$ 173.810.526,32	- Internos	Banco do Brasil S/A	02/12/2019	Real	02/12/2029
R\$ 173.810.526,32	- Internos	Banco Itaú Unibanco S/A	02/12/2019	Real	02/12/2029
R\$ 173.810.526,31	- Internos	Banco Santander (Brasil) S.A.	02/12/2019	Real	02/12/2029
R\$ 173.043.239,28	- Internos	Banco Nacional de Desenvolvimento Econômico e Social	07/12/2010	Real	15/12/2026
R\$ 167.255.346,12	- Externos	Banco Interamericano de Desenvolvimento	22/12/2009	Dólar dos EUA	15/07/2034
R\$ 162.586.058,47	- Externos	Banco Interamericano de Desenvolvimento	17/10/2018	Dólar dos EUA	15/10/2043

**Table A1.** Credit Operations in effect for the State of Ceará's Government, according to SADIPEM (Position: 06/04/21) - continued

Saldo devedor na data base	Classificação no RGF	Nome do credor	Data da contratação, emissão ou assunção	Moeda da contratação, emissão ou assunção	Data da quitação
R\$ 142.569.414,03	- Internos	Banco Nacional de Desenvolvimento Econômico e Social	11/06/2010	Real	15/06/2031
R\$ 132.733.750,73	- Internos	Banco Nacional de Desenvolvimento Econômico e Social	28/11/2013	Real	15/12/2027
R\$ 129.491.555,08	- Externos	Banco Interamericano de Desenvolvimento	01/06/2016	Dólar dos EUA	15/04/2041
R\$ 124.412.370,16	- Internos	Caixa Econômica Federal	08/10/2010	Real	06/08/2034
R\$ 123.528.856,62	- Externos	Banco Interamericano de Desenvolvimento	20/05/2009	Dólar dos EUA	20/05/2029
R\$ 121.022.184,75	- Internos	Banco Nacional de Desenvolvimento Econômico e Social	29/09/2014	Real	15/10/2026
R\$ 113.181.058,90	- Externos	Fundo Internacional de Desenvolvimento Agrícola	28/06/2013	Direito Especial - SDR	12/06/2031
R\$ 109.780.707,32	- Externos	MLW Intermed Handels - und Consultinggesellschaft für Erzeugnisse und Ausrüstungen des Gesundheits - und Bildungswesens GmbH	11/05/2016	Euro	30/12/2027
R\$ 107.911.232,91	- Internos	Caixa Econômica Federal	30/06/2010	Real	06/02/2034
R\$ 100.987.002,47	Apropriação de depósitos judiciais		01/01/2018	Real	30/12/2048
R\$ 95.447.000,79	- Internos	Caixa Econômica Federal	06/03/2014	Real	15/09/2034
R\$ 82.595.784,09	- Internos	Banco do Nordeste do Brasil S/A	20/10/2005	Dólar dos EUA	27/03/2028
R\$ 60.483.919,79	- Internos	Caixa Econômica Federal	06/12/2013	Real	15/06/2034
R\$ 59.095.548,76	- Internos	Banco do Brasil S/A	04/07/2014	Real	15/08/2034
R\$ 48.154.814,54	- Internos	Caixa Econômica Federal	24/07/2018	Real	15/10/2027
R\$ 46.590.549,66	- Internos	Banco do Nordeste do Brasil S/A	25/08/2005	Dólar dos EUA	27/03/2028

**Table A1.** Credit Operations in effect for the State of Ceará's Government, according to SADIPEM (Position: 06/04/21) - continued

Saldo devedor na data base	Classificação no RGF	Nome do credor	Data da contratação, emissão ou assunção	Moeda da contratação, emissão ou assunção	Data da quitação
R\$ 43.981.894,73	- Internos	Caixa Econômica Federal	30/06/2010	Real	06/03/2034
R\$ 40.475.798,11	- Externos	Banco Internacional para Reconstrução e Desenvolvimento	07/07/2006	Dólar dos EUA	15/01/2023
R\$ 39.677.366,56	- Internos	Banco Nacional de Desenvolvimento Econômico e Social	06/06/2008	Real	15/06/2024
R\$ 27.821.790,18	- Externos	Fundo Internacional de Desenvolvimento Agrícola	28/06/2013	Euro	12/06/2031
R\$ 27.282.675,00	- Externos	Banco Internacional para Reconstrução e Desenvolvimento	30/12/2019	Dólar dos EUA	15/09/2050
R\$ 23.196.874,00	Parcelamento e renegociação de demais contribuições sociais	União	09/05/2019	Real	09/04/2024
R\$ 21.280.574,58	- Externos	Banco Interamericano de Desenvolvimento	21/05/1997	Dólar dos EUA	21/05/2022
R\$ 18.502.045,41	- Externos	Kreditanstalt für Wiederaufbau	07/12/2005	Euro	30/12/2025
R\$ 17.720.664,63	- Internos	Caixa Econômica Federal	08/10/2010	Real	06/08/2034
R\$ 11.215.381,45	Parcelamento e renegociação de demais contribuições sociais	União	23/08/2013	Real	16/08/2027
R\$ 9.819.501,29	- Externos	Banco Internacional para Reconstrução e Desenvolvimento	30/12/2019	Dólar dos EUA	15/08/2050
R\$ 5.114.738,28	- Externos	Kreditanstalt für Wiederaufbau	26/06/2019	Euro	15/04/2034
R\$ 4.115.878,99	Precatórios posteriores a 05/05/2000 não incluídos na dívida consolidada		31/12/2019	Real	31/12/2021
R\$ 3.360.588,01	Parcelamento e renegociação de demais contribuições sociais	União	09/05/2019	Real	09/04/2024
R\$ 2.811.945,90	Parcelamento e renegociação de contribuições previdenciárias	União	25/07/2017	Real	28/02/2034
R\$ 2.576.884,97	- Internos	Banco Nacional de Desenvolvimento Econômico e Social	22/06/2010	Real	15/07/2021

**Table A1.** Credit Operations in effect for the State of Ceará's Government, according to SADIPEM (Position: 06/04/21) - continued

Saldo devedor na data base	Classificação no RGF	Nome do credor	Data da contratação, emissão ou assunção	Moeda da contratação, emissão ou assunção	Data da quitação
R\$ 1.689.880,83	- Internos	Caixa Econômica Federal	17/06/1998	Real	06/03/2024
R\$ 1.613.482,37	- Internos	Banco Nacional de Desenvolvimento Econômico e Social	28/09/2018	Real	15/10/2031
R\$ 1.341.214,60	- Internos	Caixa Econômica Federal	17/06/1998	Real	06/03/2024
R\$ 1.151.821,20	- Externos	Japan Bank for International Cooperation	01/08/1997	Yene	20/08/2022
R\$ 1.079.636,93	- Internos	Caixa Econômica Federal	30/06/2004	Real	06/12/2021
R\$ 966.515,65	Parcelamento e renegociação de contribuições previdenciárias	União	16/12/2020	Real	30/06/2025
R\$ 893.253,00	- Internos	Caixa Econômica Federal	30/04/2004	Real	06/09/2021
R\$ 752.015,26	- Internos	Caixa Econômica Federal	17/06/1998	Real	06/08/2023
R\$ 596.317,74	Parcelamento e renegociação de demais contribuições sociais	União	23/08/2013	Real	31/07/2034
R\$ 553.058,47	Parcelamento e renegociação de demais contribuições sociais	União	22/08/2017	Real	31/01/2030
R\$ 385.676,20	Parcelamento e renegociação de demais contribuições sociais	União	23/08/2013	Real	31/07/2034
R\$ 355.177,49	- Internos	Caixa Econômica Federal	30/12/2003	Real	06/05/2022
R\$ 351.965,16	- Internos	Caixa Econômica Federal	30/12/2003	Real	06/02/2022
R\$ 261.395,06	- Internos	Caixa Econômica Federal	30/04/2004	Real	06/05/2021
R\$ 152.389,44	- Internos	Caixa Econômica Federal	30/04/2004	Real	06/09/2021
R\$ 4.744,17	Parcelamento e renegociação de demais contribuições sociais	União	16/12/2020	Real	30/09/2021