The Trade-Off Between Public Investments And Pension Deficit: The Case Of Ceará State Government

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Abstract:
Background*: The fiscal dynamics of Brazilian state governments identify the relationships between public investments, the primary result, the pension deficit, debt and cash. Considering the evolution between 2015 and 2022, and the projection until 2095 for the pension deficit, it is necessary to study the long-term dependency relationship between investments and the pension deficit.*
Methodology*: This article suggests three empirical exercises modeling and measuring this relationship, considering different hypotheses, equations, and econometric techniques.*
Data*: Bimonthly series of accumulated data, as a ratio of Net Current Revenue (%), from 2015b6 to 2023b2.*
Results*: The results of the more robust technique show that there is a (statistically significant)
dependence of investments only in relation to the primary result, gross debt and cash. In other words, there is no dependence on the pension deficit.*
Conclusion: *With the aim of the state of Ceará continuing to lead the national ranking of states, maintaining its resilient and sustainable trajectory of public investments, it is necessary to monitor the relationship between this capital expenditure, and the main fiscal variables, such as pension deficit, as well as primary results, cash and debt.*
Key Word*: Fiscal dynamics; Public Investment; Pension deficit; Long-run relationship.*

I. Introduction

The public sector in Brazil is seen by society as a provider of essential services, with emphasis on the functions of health, education, public safety, and social security, which are more representative of total spending. There is still, however, another function of the government that is also seen by society as essential: the state as a public investor. According to a survey reported in Technical Note N. 52, of June 7, 2023, by the Independent Fiscal Institute (IFI), between 2010 and 2014, the federal government invested between 0.6% and 0.8% of GDP. From then on, with the fiscal crisis in the country, the federal government's investment level began to oscillate between 0.3% and 0.5% of GDP. In this scenario of fiscal restriction after 2015, state governments had been investing between 0.4% and 0.6% of GDP, with a substantial increase in 2022 to 0.9% of GDP. Municipal governments also increased their investment/GDP ratio in 2022: 0.8%. One can see Bonomo et al. (2021) for survey on public investment in Brazil.

Comparing only state governments including the Federal District (DF), based on the longest time series available at the Brazilian Public Sector Accounting and Tax Information System (SICONFI), we can see in Figure 1 that Ceará leads the ranking in the investment criterion paid each year as a ratio of the respective Net Current Revenue (NCR), considering the average between 2015 and 2022 of real values, i.e., deflated by the country's official inflation, the IPCA (Broad Consumer Price Index).

Observing the evolution of investment as a reason for NCR in the state of Ceará each year, there is a cyclical behavior. Investment to NCR in Ceará is always above the reason obtained when aggregating all states. Between 2015 and 2019, this state led the annual rankings in this criterion. In 2018, for example, with investments paid in the order of R$3.4 billion (real values in terms of December 2022), the state assumed its main role, recording a percentage of 8.9% of investments paid this year considering the sum of all 27 states, including DF.

In 2020, the state was the second largest investor, and in 2021, the fourth in the national ranking. In other words, this leadership of the state of Ceará as a public investor has been compromised since 2019. Last year (2022), the state was in 9th place, with 11.5%, with the state average close to 8.6%. In that same year,

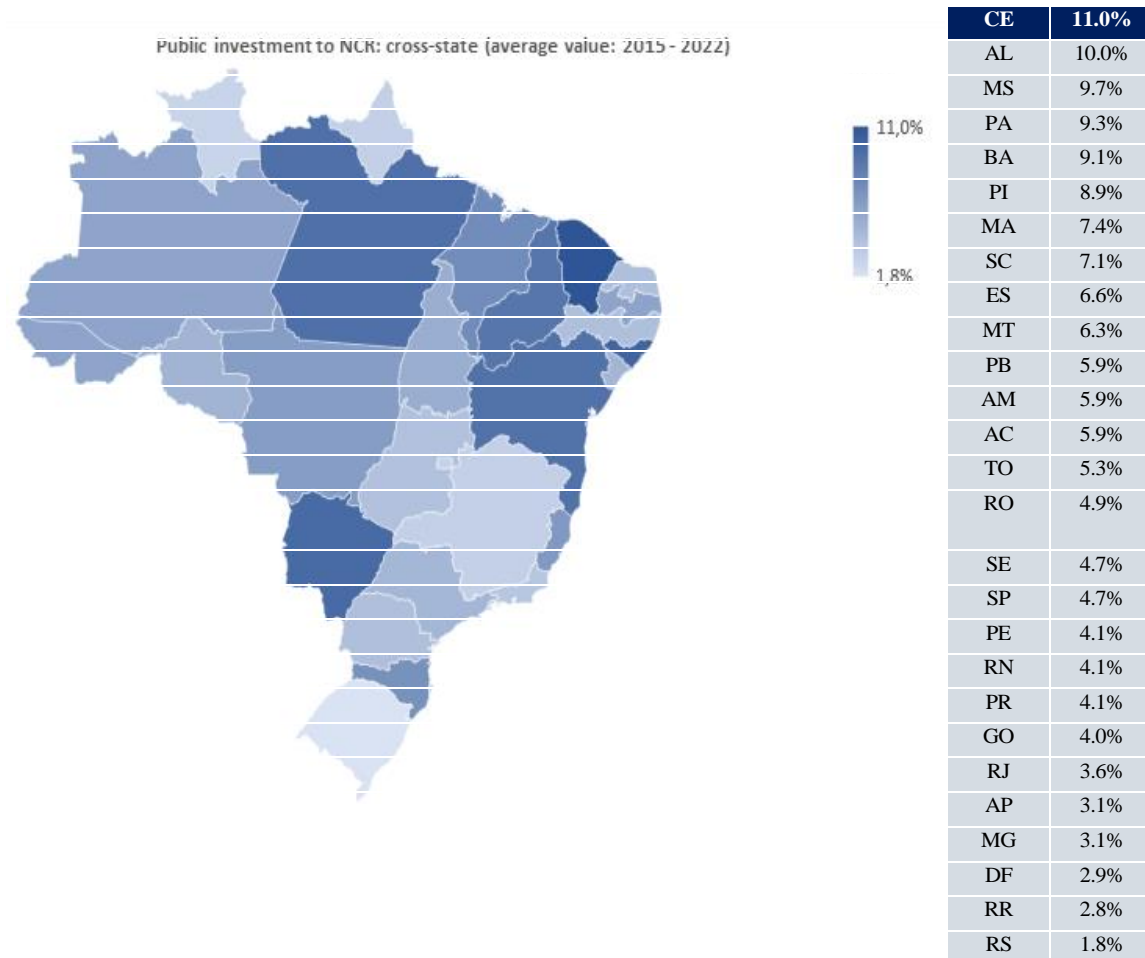Ceará's share in the aggregate investment of all states was only 4.0%, even with investments of around R$3.5 billion.

Public investment to NCR: cross-state (average value: 2015 - 2022)

State	%
CE	**11.0%**
AL	10.0%
MS	9.7%
PA	9.3%
BA	9.1%
PI	8.9%
MA	7.4%
SC	7.1%
ES	6.6%
MT	6.3%
PB	5.9%
AM	5.9%
AC	5.9%
TO	5.3%
RO	4.9%
SE	4.7%
SP	4.7%
PE	4.1%
RN	4.1%
PR	4.1%
GO	4.0%
RJ	3.6%
AP	3.1%
MG	3.1%
DF	2.9%
RR	2.8%
RS	1.8%

Figure 1: Ranking in the investment criterion paid each year as a ratio of the respective Net Current Revenue

This context on public investments associated with the fiscal situation of the Government of the State of Ceará suggests some important and timely reflections. The first is about sustainability and is based on the evidence that the state of Ceará went from a real level of R$2.4 billion in 2021 to R$3.5 billion in 2022 in paid investments, while in aggregate, the states went from R$45.1 billion to more than R$87.0 billion. In relative terms, a local increase of 44.7%, compared to an increase of 92.9% in the aggregate of states.

A relevant question is: how did this increase in capital spending happen in the states?

In 2021, the ratio between credit operations and paid investments was 61.8% in Ceará, and 21.5% in the aggregate of states, while in 2022, the values are 17.0% and 17.7% respectively. In other words, the state of Ceará has followed a recent national trend of financing a smaller portion of its investments with third-party resources.

The counterpart to this choice is the use of own resources, which could compromise the federal entity's cash stock. In real terms, deflated by the 2022 IPCA, the cash flow of the state of Ceará varied -10.2% between 2021 and 2022, while the aggregate cash flow of the states increased by 1.5%. In more detail, the cash of only 9 states increased in real terms from 2021 to 2022. In this case, aiming to provide sustainable capital spending, there must be a relationship between public investments, debt, cash, the pension deficit, and primary result.

Regarding this issue, the sustainability of investments in the state of Ceará, or in any other local government, theoretically depends on the following signs expected in these relationships: investments versus debt (negative), investments versus cash (positive). It is also desirable that investments are not very sensitive to movements in primary results and pension deficits. Only with dynamic and proactive monitoring will it be possible to infer or anticipate whether the state of Ceará will remain a protagonist in this ranking of public investors, whether maintaining the recent trend of financing with its own resources, i.e., strengthened primary

surplus and cash, or via increase in debt.

In this sense, the purpose of this article is to analyze whether the evolution of the projection of the pension deficit of the state employees' pension system of Ceará is capable of causing concern by compromising public investment, under different hypothesis. We suggest three empirical exercises.

It is noteworthy that, in Brazil, states and municipalities are allowed to establish their Own Social Security System (known as RPPS) for their public servants. This system offers comprehensive pension coverage and is managed by the federative entity that institutes it, which is responsible for joint funding with the employees and for covering any potential deficits. With the intention of mitigating the cost of capitalizing the system, it is permissible in Brazil for this pension system to be divided among two groups of servers (known as mass segregation), one financed by the capitalization regime and the other by the pay-as-you-go regime (also called a pay-as-you-go plan). In this study, the term "pension deficit" refers to the financial shortfall of the pay-as-you-go scheme, which is calculated by the difference between pension expenditures and revenues.

The first analysis of this article follows the premise that from the year 2023 onwards, the real annual variation in the projected pension deficit of the government employees' own pension system of a given government determines (in the opposite direction) the real annual variation in the public investment of that same government. By assuming this perfectly asymmetrical behavior between the variations of the pension deficit of its employees and public investments, Ceará would suffer projected consequences for 13 years, until 2035, and from then on, it would still take around three decades to return to the current level of investments, around 11.5%. The first caveat to this analysis suggested in the 2023 TCE Debate is the lack of statistical inference associating the deficit and investments. Thus, in the second exercise, we resort to an estimation using econometrics and measure the pension deficit elasticity of investments, based on a long-term error correction model (VEC), using relevant instruments. Finally, the most important caveat made in these analyzes lies precisely in the single premise assumed, which isolates investments and the pension deficit from other fiscal variables, such as current revenues and expenses, in addition to assuming the impossibility of contracting new operations credit. Thus, aiming to measure the effects of pension deficit on investments, however, now through an accounting and fiscal model suited to the dynamics of state governments, the third empirical exercise is based on the model suggested in Matos (2023). This model to be estimated using VEC assumes that accumulated investments as a ratio of NCR depend not only on the accumulated deficit (% of NCR), but also on the accumulated adjusted primary deficit (% of NCR), the cash stock and the consolidated debt, both also as a reason for the NCR.

The evidence obtained here for the state of Ceará is unprecedented and extremely relevant, as it helps to understand that the discussion promoted about monitoring the pension deficit of governments in states and municipalities is fundamental and timely and is therefore strictly necessary to model its possible impacts on governments' ability to meet other expenses.

II. Methodology

First exercise

The first empirical exercise is the simplest. We assume the premise that from the year 2023 onwards, the real annual variation in a government's pension deficit projection determines (in the opposite direction) the real annual variation in the public investment of that government. We highlight that this future projection of the pension deficit is officially provided by the government itself, and is made using actuarial, financial, economic, and demographic data. In other words, an increase of R$1,000 in the contribution (due to an insufficient relationship between revenue and expenses in the pay-as-you-go plan) in 2023 in relation to the contribution made in 2022 implies a reduction of exactly R$1,000 in the investment paid in 2023, in relation to 2022. We recognize that this assumption encounters certain limitations when assuming that the government cannot invest through the contracting of credit, but it is still opportune in the case of governments that do not define investment goals, and choose to invest residually as much as possible, after paying the main current expenses. This exercise allows you to visualize in a graph the future evolution, from 2023, of investments in response to the projected evolution of the pension deficit.

Second exercise

The second empirical exercise maintains the premise that the government cannot invest by contracting credit and that the other variables, such as primary result, debt, and cash availability are completely exogenous. The difference is in enabling the relationship between public investments and the pension deficit to be measured through an estimation of an equation with instruments. In other words, the idea is that there is statistical inference, and thus, it is possible to measure this relationship through a parameter, which can be null, positive, or negative, considering a statistical significance of 5%. Since the time series are calculated from accumulated values (1-year moving window),

all these variables are non-stationary. Thus, the econometric literature suggests that the estimation of this relationship should be done using the vector error correction (VEC) technique.

This technique is simple, very traditional, and allows you to estimate a cointegrating vector, which works as a long-term conditional relationship between public investment (inv) and the pension deficit (pd), represented by the following equation:

$$inv_t = \beta.pd_t + \varepsilon_t | Z_{1,t}$$
(1
)

This estimation allows us to isolate this long-term effect, through the estimation of a parameter that serves as a proxy for elasticity, since we use a set of relevant instruments, $Z_{1,t}$: thresholds associated with the dates of legal milestones, primary result ($prmr$), debt ($debt$) and cash ($cash$), all as the NCR ratio. This framework also allows us to analyze the impulse-response graph, that is, how investments behave after a shock to the pension deficit.

Third exercise:

The third exercise uses the econometric technical table, the VEC, but makes the main hypothesis of the analysis carried out so far more flexible, which isolates investments and the pension deficit from other fiscal variables, in addition to assuming the impossibility of contracting new credit operations. Thus, aiming to measure the effects of pension deficit on investments, however, now through an accounting and fiscal model suited to the dynamics of state governments, we use the dynamics suggested in Matos (2023), which allows accumulated investments as a reason for the NCR (inv) depend on the accumulated pension deficit to NCR (pd), the accumulated adjusted primary deficit as a ratio of NCR ($prmr$), the Cash Stock ($cash$) and Consolidated Debt ($debt$), both also as a ratio of NCR, according to the following equation:

$$inv_t = \beta.pd_t + \gamma.prmr_t + \delta.cash_t + \vartheta.debt_t + \varepsilon_t | Z_{2,t}$$
(2
)

In this equation, the set of instruments, $Z_{2,t}$ is comprised by the thresholds associated with the dates of legal milestones. This framework also allows us to analyze how investments behave after a shock to the pension deficit.

III. Data

Our purpose is to analyze whether future projections are a source of concern or just a warning, considering the effect that increased contributions to pension deficit may have on reducing investments. The first question we should ask is about the projected future of this deficit. What do actuaries who work for the state government think about this projection? To this end, it is initially important to observe the annual deficit projection series (brought to present value by inflation) from 2023 to 2095, made and informed by the government of the state of Ceará itself, based on information and accounting, fiscal, demographic, economic and actuarial.

Figure 2 analyzes the projection until 2095 of these deficits according to data reported by the state government itself in Annex 10 of the Summary Budget Execution Report (RREO).

The deficit reported in 2022 was R$914,165,626.85, and according to this official projection, there is an increasing trend that culminates in 2035 with the projected value of R$3,360,665,722.12. From then on, a succession of reductions in the pension deficit in Ceará began. It is only important to highlight that this projection reports values brought to present value, that is, they are real and, therefore, comparable to each other. Regarding the data used in the first exercise, the values of investments in the NCR and the deficit in the NCR for the year 2022 are sufficient, in addition to the annual pension projection series.

For the other empirical exercises, we use the aforementioned fiscal series accumulated over 6 bimonths and reported as a ratio of the NCR also accumulated), considering the longest period available at the National Treasury (SICONFI), from 2015b6 (sixth bimonthly of 2015) to 2023b2 (second bimonthly of 2023). The series of investments and pension deficit are reported in Figure 3.
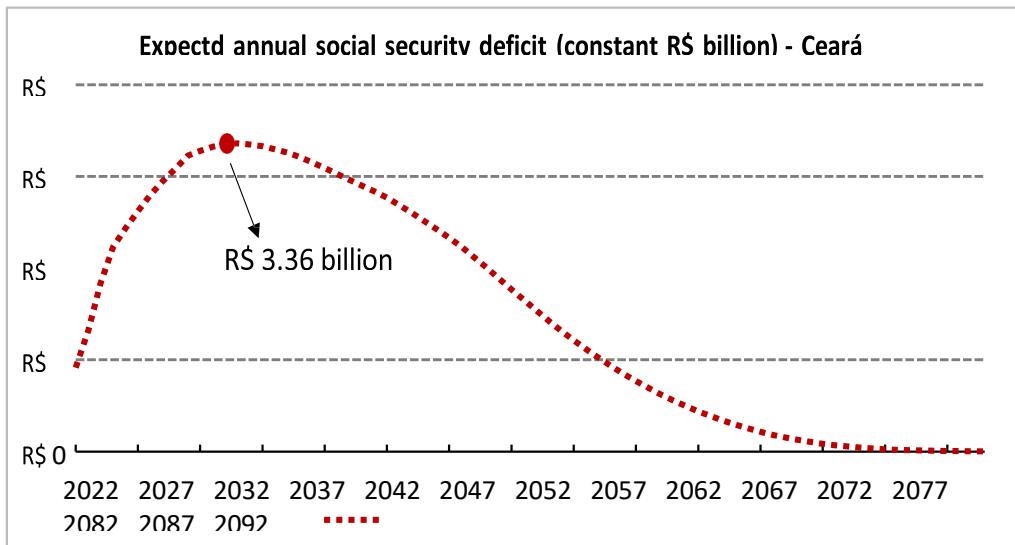
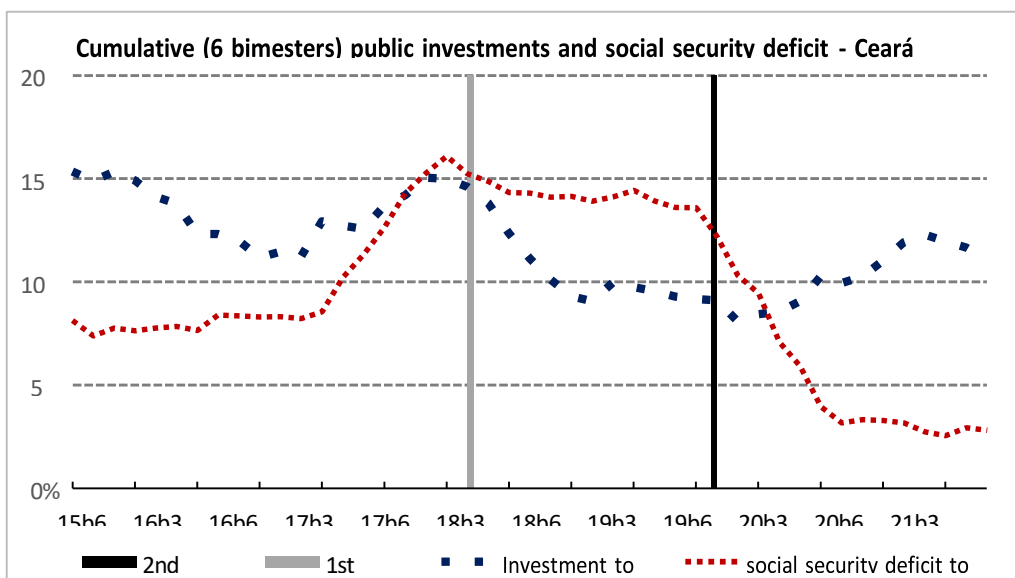**Figure 2: Expected annual social security deficit**

Figure 3: Series of investments and pension deficit

Over the entire period (2015b6 to 2023b2), the correlation is 0.038. However, it is essential to understand that in this interstice there were two extremely relevant legal frameworks, among others, which must be incorporated into statistical analyzes involving pension deficit in Ceará, as they are associated with mass segregation.

The Own Social Security Regime (RPPS) for State Civil and Military Public Servants of the Government of the State of Ceará is managed by the Social Security Foundation of the State of Ceará (CEARAPREV), established by State Complementary Law No. 184, of 11/21/ 2018. On the same date, there is Complementary Law No. 185, which provides for rules for the creation and operation of the complementary pension fund of the state of Ceará (PREVCOM). Finally, through Complementary Law No. 227 (12/16/2020), regulated by Decree No. 33,925 (02/05/2021), the mass of insured employees of the State of Ceará was segregated into three funds, separated from each other and holders of specific accounting records: i) the PREVMILITAR financial fund, structured under the pay- as-you-go regime, relating to the state military; ii) the FUNAPREV financial fund, structured under the pay-as-you- go regime, relating to civil servants; and iii) the PREVID security fund, structured under the capitalization regime, relating to civil servants.

It is important to analyze these numbers, considering the context of the review of mass segregation, as this mass segregation resulted in the transfer of policyholders, previously linked to the fund in pay-as-you-go FUNAPREV to the Fund in capitalization PREVID, retroactively to the beginning of 2021, with effect expected reduction in the contribution made by the State Treasury to cover FUNAPREV's financial insufficiency. Having clarified this, and assuming that the effects of the mentioned laws begin at the beginning of the following year,

the correlations are now calculated considering before and after each review.

The correlation for the period up to 2018b6 is 0.30. Now, considering the correlation for the period between the milestones (2019b1 – 2020b6) it is 0.80. Finally, for the period after the 2nd milestone, after 2021b1, there is a correlation of -0.82.

This first analysis is simple, unconditional, without any economic model, and only allows us to infer that, especially after the second complementary law at the end of 2020, there does seem to be a behavior between investments and the pension deficit, as suggested by the analysis of economist Raul Velloso. Visually, it is worth highlighting the asymmetric behavior between the series, after 2021b1, in which investments grow again, while the deficit continues to fall.

IV. Results

First exercise

The first analysis of this article follows the premise that from the year 2023 onwards, the real annual variation in the projected pension deficit of a given government determines (in the opposite direction) the real annual variation in the public investment of that same government (Figure 4).

The deficit is expected to grow between 2022 (R$ 914,165,626.85) and 2035 (R$ 3,360,665,722.12). How would the investment of the leading state in public investments in the country behave? Figure 4 reports this evolution between 2022 and 2095. In 2022, investments paid were R$ 3,485,610,286.08 (11.5% of NCR), while the deficit was 914,165,626.85 (3.0% from NCR). These series reverse the order of magnitude in the year 2025, when the deficit assumes the value of R$ 2,229,852,896.80 (7.3% of the NCR) and investments fall to the projected level of R$ 2,169,923,016.13 (7.1% of NCR). In 2035, when the pension deficit peaks, investments reach their lowest point in the series, R$ 1,039,11,190.81 (3.4% of the NCR).

As a result of the measures implemented by this government in recent years, and consequently the reduction in the projected pension deficit, from 2035 onwards, investments would grow again and in 2054, investments would reach R$ 2,281,832,433.19 (7.5% of NCR) and would overcome the deficit of R$ 2,117,943,479.74 (7.0% of NCR). Finally, the state would only return to its current level of investment in 2066, with R$3,553,980,497.09 (11.7% of NCR). What can be seen based on this analysis is that, assuming this perfectly asymmetrical behavior between the variations in the pension deficit and public investments, Ceará would suffer projected consequences for 13 years, until 2035, and from then on, it would still take around three decades to return to the current level of investments, around 11.5%.
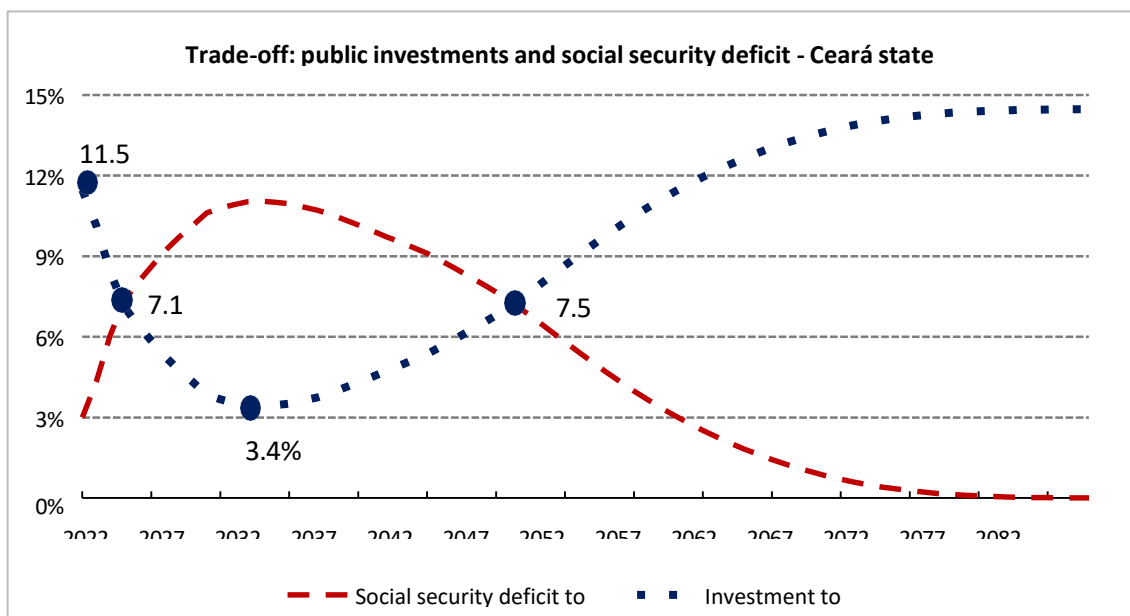

Figure 4: Social security deficit x Investment

Second exercise

The second empirical exercise maintains the premise that the government cannot invest by contracting credit and that the other variables, such as primary result, debt, and cash availability are completely exogenous. However, now we can measure this relationship through a parameter or elasticity, which can be null, positive, or negative, considering a statistical significance of 5%. According to the estimation results (VEC), there is a significant (5%) long-term conditional relationship between public investment (*inv*) and the pension deficit

(pd), given by:

$$inv_t = -0.702.\,pd_t + \varepsilon_t | Z_{1,t}$$

This significative negative elasticity (-0.702) is a proxy of the dependence of investments in response to pension deficit. In the first empirical exercise, the premise used was that a 1% increase in the NCR deficit implied a 1% reduction in the investment/NCR ratio. Now, the result obtained via VEC estimation suggests a less elastic relationship, as the parameter was not -1, but -0.702. Important evidence, which suggests a warning, and which identifies for the first time the values regarding this long-term relationship. This estimation also allows us to analyze if and when a positive shock (impulse-response) in the pension deficit proves to be statistically significant (5%, according to the red dashed lines) in impacting investments. According to Figure 5, this occurs, in the direction predicted by the estimation, a negative reaction, and this occurs after 9 two months, that is, 1 and a half years.

Figure 5: Dependence of investments in response to pension deficit
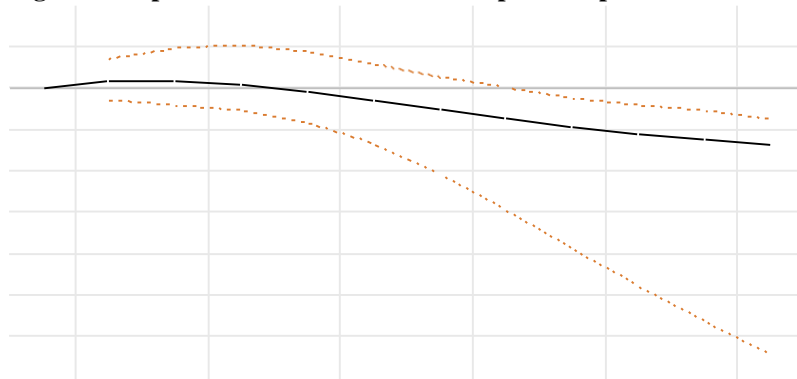
Third exercise

In the third exercise, we used the specific accounting dynamics developed and suggested by Matos (2023). The objective of this author is to define appropriate accounting equations from the budgetary perspective of state governments capable of determining the dynamics of the stock variables: consolidated debt and adjusted cash availability. From these, we have a unique dynamic that associates the movements of the main fiscal variables, which can be empirically tested using bimonthly data extracted from SICONFI, and which can also be used in automated public management tools aimed at continuous fiscal monitoring and individualized for each state government.

The difference is in allowing flexibility in the relationships between fiscal variables, modeling the dependence of investments (inv) in response to movements in the primary result ($prmr$), the pension deficit (pd), debt ($debt$) and cash ($cash$). The estimation results are:

$$inv_t = 0.064.\,pd_t + 1.598.\,prmr_t - 2.481.\,cash_t + 0.492.\,debt_t + \varepsilon_t | Z_{2,t}$$

In this equation, the set of instruments, $Z_{2,t}$ is comprised by the thresholds associated with the dates of legal milestones. We now demonstrate that, in this more realistic general equilibrium model, the explanatory power of the pension deficit is statistically null (even considering a significance of 10%). The values of the other parameters are all significant (5%). As expected, investments react positively to the increase in the primary result, since investments and primary expenditures tend to compete with each other. Unexpectedly, but corroborating the results reported in Matos (2023), investments maintain a negative long-term relationship with cash and a positive relationship with debt, a sign of unsustainability, according to the analysis proposed in Matos and Monteiro (2023). The impulse-response analysis (Figure 6) corroborates the insignificance of the parameter (0.064) associated with the pension deficit, as we show that a shock to this deficit is not capable of promoting a significant response (5%) in investments.

V. Conclusion

The empirical and theoretical literature on growth has highlighted the intuitive positive long-term consequences of public investment on economic growth. We mention a classic theoretical framework in Barro (1990), who builds a growth model including services and public investments as a productive input for private producers. Other seminal works also analyze the growth impact of public investment, as Barro and Sala-i-Martin (1992) and Glomm and Ravikumar (1994), for instance. In this discussion, and considering the current fiscal scenario in Brazil, in which the federal government reduces its participation in public investment, the role of states and municipalities becomes extremely relevant. See Matos and dos Santos (2020), and Matos et al. (2022) for a recent empirical finding on this role in Brazil and see Ferreira (2022) for the role of public investment of Ceara state government. With the aim of the state of Ceará continuing to lead the national ranking of states, maintaining its resilient and sustainable trajectory of public investments, it is necessary to monitor the relationship between this capital expenditure, and the main fiscal variables, such as pension deficit, as well as primary results, cash and debt.

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