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A Note on the public investment-debt-cash linkages: a Brazilian cross-state analysis

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Abstract

We propose a discussion on the recent situation of investment by state governments in Brazil. After stability between 2015 and 2018, and a real drop in the following years, states invested almost R$ 76 billion in 2021. This record value has been less financed by borrowing; in 2015 this dependence was 57.9%, and in 2021, 12.1%. Our main findings are based on the estimation of a dynamic balanced panel over the period from 2015 to 2021. We find significant elasticities of the investment to Net Current Revenue (NCR) in response to its own lag (-0.21), the lagged external debt to NCR (-0.07), the lagged domestic debt to NCR (-0.14), and the lagged cash to NCR (0.14). This finding suggests that public investments have reacted to ensure its sustainability, in response to observed changes in debt and cash.

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1. Introduction

The relevance of strengthening public finance management by a federal or subnational government should not have a purpose in itself. In societies whose socio-macroeconomic conditions are unfavorable, the main role of an austere fiscal policy lies in its ability to raise per capita income and reduce its inequality. In this context, every contribution in monitoring fiscal variables is justifiable, with emphasis on the resilience and predictability of tax revenues and expenses with payroll and social charges, as well as the solvency of public debt. These are the minimum necessary conditions for the government – particularly in a low-income country and in times of crisis – to be a robust provider of essential services in areas such as health, education, security and pensions, and to be able to maintain the flow of public investments.

Regarding the public investments, policy makers should listen researchers and follow the literature on the linkages with the economic side, as well as the relationship between investments and other fiscal variables. The former issue has attracted increasing attention from the public finance literature and from international institutions, such as the International Monetary Fund (IMF) and the World Bank (WB), since the 1990s. We highlight the intuitive positive long-term consequences of public investment on economic growth. First, we mention a classic theoretical framework in Barro (1990), which 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 in the context of endogenous growth models, as Barro and Sala-i-Martin (1992) and Glomm and Ravikumar (1994), for instance.

A relevant contribution to this discussion is the incorporation of government debt in their endogenous growth framework suggested by Turnovsky (1999). More recently, Chatterjee and Turnovsky (2007) and Agenor (2010) have explored the importance of tied vs untied aid, and the role of infrastructure network effects and the efficiency of public investment in low-income countries, while Berg et al. (2010) look into the macroeconomic effects of aid-financed public investment, however disregarding the interaction of structural and policy conditions with debt dynamics. In this extensive theoretical literature, one of the most relevant contributions for us is Buffie et al. (2012). They propose a model to study the macroeconomic effects of public investment. A first differential is that their approach applies specifically to the reality of low-income countries, which seems adequate given our purpose to study Brazilian states. Second, they assume the role of the investment-growth linkages, public external and domestic debt accumulation, fiscal policy reactions necessary to ensure debt-solvency, and macroeconomic adjustment required to ensure internal and external balance.

This discussion which considers the relationship between fiscal variables is essential for us, given our purpose to model how public investments have reacted to ensure its sustainability, in response to observed changes in (external and domestic) debt and cash. More specifically, we propose an empirical exercise applied to state governments in Brazil based on a dynamic balanced panel over the longest available period, from 20015 to 2022, to better understand the public investment-debt-cash linkages.

We add to a recent discussion promoted by Simonassi et al. (2021) and Bonomo et al. (2021). The former work suggests that the increase in subnational government investments produces a virtuous cycle that contributes to subsequent increases in revenue that overlap with the respective increases in costing, over the period from 2008 to 2016. The second work suggests that public investment is not closely related to fiscal rules in Brazil but is mainly determined by fiscal conditions at state level. Our results allow us to add to this debate.

Moreover, we are aligned to a discussion promoted by Matos (2023). This author proposes an unprecedented theoretical accounting framework suitable for the budget execution of these subnational governments. In applied terms, there is an empirical exercise based on this

modeling is proposed, with bimonthly data from 2015 to 2022 for all 27 governments, by estimating the vector model suitable for the stationarity of the time series.

The conduct of public policies by state governments is restricted by a set of old, rigid and universal rules. These subnational federative entities do not have revenue autonomy and cannot obtain contractual debt for current expenditure purposes. This context capable of compromising public investments motivates a specific analysis on the dynamics of the movements between: debt, cash, and investments. A study on the relationship between cash, debt and public investments by state governments is also relevant given the order of magnitude. Looking at the average real values (R$ dec/2022), during the period from 2015 to 2022, committed investments reached R$ 60.8 billion per year. The average cash value in the same period was R$ 157.3 billion. Domestic and external debts registered R$ 951.3 and R$ 137.9 billion, respectively.

Although we are not unconditional supporters of public investment, we recognize the role of the public sector as an investor, aiming to "complete markets". In other words, investing in areas that seem to attract less attention and interest from the private sector, but which are still fundamental for a better business environment and for an increase in social infrastructure, mainly in low-income economies. Well-executed high-yielding public investment can imply in crowding-in, raise output and consumption and be self-financing in the long run.

Regarding the Brazilian states investment-growth linkage, Matos and dos Santos (2020) estimate an extended version of Barro-style growth panel regression, over the period from 2003 to 2017, controlling for household, enterprise, and government credit, exports, imports, years of schooling, government capital and current expenditures. They suggest that capital and current spending are relevant and different drivers of cross-state growth in Brazil. They find that government capital and current expenditure elasticities of GDP growth are: 1.01 and -1.75, respectively. Matos et al. (2022) suggest revisiting this issue by estimating a panel over the period from 2004 to 2019, however taking into account also for the same fiscal variables from municipal governments. They find a relevant role for both state and municipal governments capital spending.

Nonetheless, the positive macroeconomic impacts of public investments depend on the continuity, robustness, and sustainability of the flow of this type of capital expenditure, which is directly related to the sources of financing. It is precisely this last issue that our study empirically addresses. In this sense, theoretically, a subnational government in Brazil can finance public investment with official aid resources. Besides this exogenous source, we also need to assume that concessional borrowings may be available to any government state. However, these funding sources are not flowing as promised or desired.

Consequently, Brazilian state governments can try to use three sources of funds: accessing domestic borrowing, supplementing with external commercial borrowing, and covering the resulting gap with tax increases and/or spending cuts. The average (concessional and nonconcessional, external and internal) borrowing value over the period from 2015 to 2021 reached an annual level of R$ 16.0 billion, which is almost 32% of investments. According to Buffie et al. (2012), the financing of investments with own resources requires sharp macroeconomic adjustments, crowding out private investment and consumption and delaying the growth benefits of public investment, while nonconcessional external borrowing can smooth away difficult fiscal adjustments, reconciling scaling up of public investment with feasible constraints. They also argue that borrowing in the domestic debt market is ineffective in smoothing the path of fiscal adjustment and avoiding private sector crowding out. Moreover, commercial borrowing can make the economy more vulnerable to macroeconomic instability in the presence of persistent unexpected shocks. In this scenario, how are public investments by Brazilian government states reacting to the previous change in available cash and in debt? Are these public investments sustainable? Our work helps answer these two questions.

This paper is structured as follows. In Section 2 we discuss recent fiscal situation. Section 3 illustrates the setup of the empirical model, and reports main findings. Section 4 is devoted to the final discussion.

2. Brazilian cross-state fiscal situation

Summarizing the situation in terms of public investments in Brazil, the participation of state and municipal governments in the composition of public investment in Brazil is very significant and growing in recent years. According to Bonomo et al. (2021), over the period from 2015 to 2019, on average, municipal governments invested 0.54% of GDP, while state governments invested 0.48%, and the federal government invested 0.43%.

Regarding only real public investments by state governments, after this variable remained around R$ 50 billion over the period from 2015 to 2018, and subsequent reduction to the level of R$ 40 billion in 2019 and 2020, such investments reached almost R$ 76 billion in 2021, and R$ 114 billion in 2022 (Figure 1). It is important to identify in terms of financing, that the borrowing participation, which has already reached almost 58% in 2015, has shown successive reductions, with such participation reaching 12% in 2021. Among all 27 state governments, three have financed more than 50% of their respective investments through borrowing on average over this period: Piauí, Rio de Janeiro and Ceará. At the other extreme, Rondônia, Mato Grosso do Sul and Roraima showed the lowest levels of borrowing-to-investment ratio.

Fig. 1: Real Public investments, cash and debt (external and domestic) measured from the aggregation of the respective values of the 27 state governments (billion Dec/2022 R$) [a, b, c]

Source: Budget Execution Summary Report (RREO), Annex 1, and Tax Management Report (RGF), Annex 2, both available at SICONFI/STN. [a] We use investments committed each year. [b] Cash means the relative balance between financial assets (available cash and other financial assets) and processed remaining payables (except precatory). [c] We use the "gross" consolidated debt of state governments broken down into its external and internal components.

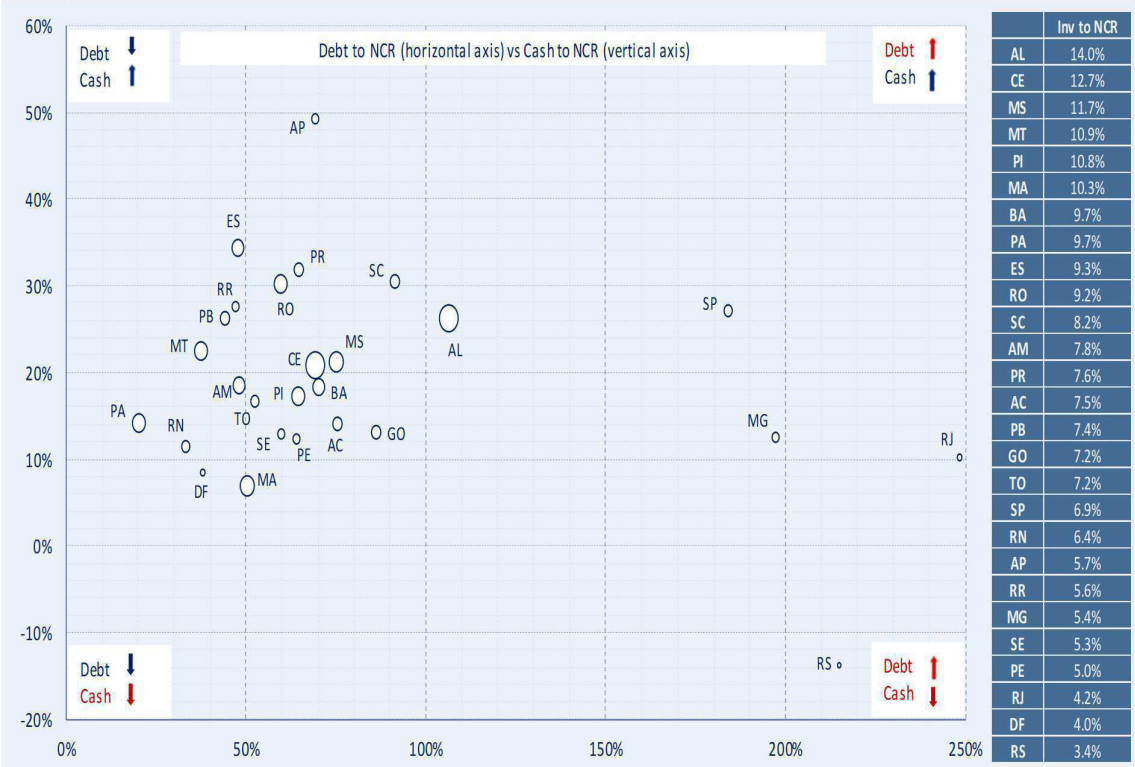
Observing the aggregate cash in Figure 1, there is a cyclical behavior in the first years of the sample, with continuous growth between 2018 and 2022. Over these 8 years, the real growth was almost 114%. In the same period, the aggregate consolidated debt of the states ranged only

-5% from R$1.084 trillion (2015) to R$1.030 (2022). As a result, the cash-to-debt ratio has ranged from 10.9% in 2015 to 24.5% in 2022. Regarding the composition of the consolidated debt of the states, the external component has ranged between 11.3% in 2017 and 14.2% in 2021.

The scatter plot (Figure 2) allows you to summarize the investment-cash-debt linkage, based on the average values between 2015 and 2022 of each of these variables, as a ratio of the respective Net Current Revenue (NCR). The four richest states in the country show such behavior that they appear distant from the other states in a worrying area, because they have high indebtedness. It is true that these states do not appear among those that invest the most. Even more worrying is the situation in Rio Grande do Sul, as it still has a negative average cash position. In addition to these four rich and indebted states, only Alagoas has debt-to-NCR above 100%. Alagoas, however, leads the committed investment-to-NCR ranking between 2015 and 2022 with an average of 14.0%. In this ranking, we see next Ceará and Mato Grosso do Sul, both with cash-to-NCR close to 20%, and debt-to-NCR of 69.3% and 75.4%, respectively.

Figure 3 makes use of the same data used in Figure 2, but associating investments versus cash (left side) and versus debt (right side). There is considerable and visible dispersion in both cases, but it is intuitive to see a positive linear trend in the investments-to-NCR and cash-to-NCR ratio as well as a negative trend between investments-to-NCR and debt-to-NCR. Obviously, we know that a more robust answer to these relationships requires the use of a framework that allows statistical inference, like a dynamic balanced panel, for instance.

Fig. 2: Real debt, cash and public investments of government states (ratios calculated from the average of the respective values over the period from 2015 to 2022) [a, b, c, d, e]

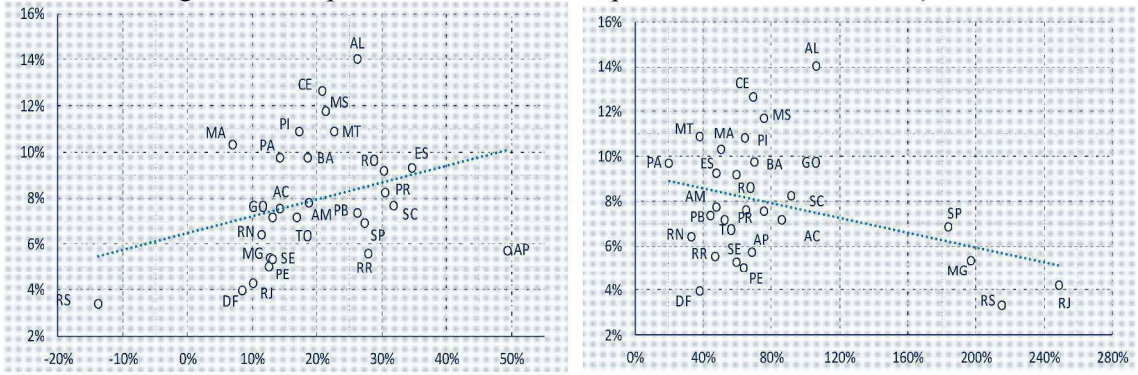


	Inv to NCR
AL	14.0%
CE	12.7%
MS	11.7%
MT	10.9%
PI	10.8%
MA	10.3%
BA	9.7%
PA	9.7%
ES	9.3%
RO	9.2%
SC	8.2%
AM	7.8%
PR	7.6%
AC	7.5%
PB	7.4%
GO	7.2%
TO	7.2%
SP	6.9%
RN	6.4%
AP	5.7%
RR	5.6%
MG	5.4%
SE	5.3%
PE	5.0%
RJ	4.2%
DF	4.0%
RS	3.4%

Source: Budget Execution Summary Report (RREO), Annex 1, and Tax Management Report (RGF), Annex 2, both available at SICONFI/STN. [a] We use investments committed each year. [b] Cash means the relative balance between financial assets (available cash and other financial assets) and processed remaining payables (except precatory). [c] We use adjusted NCR, for the purpose of weighting the indebtedness. [d] The size of the circles on the

scatterplot is proportional to the value of investments to NCR ratio reported in the table (right side). [e] We use the "gross" consolidated debt of state governments.

Fig. 3: Relation between public investments by state governments (% NCR) – vertical axis of each scatter plot – versus the respective cash (% NCR) – horizontal axis (left scatter plot) – and versus the respective debt (% NCR) – horizontal axis (right scatter plot) – (ratios calculated from the average of the respective values over the period from 2015 to 2022) [a, b, c, d, e]



Source: Budget Execution Summary Report (RREO), Annex 1, and Tax Management Report (RGF), Annex 2, both available at SICONFI/STN. [a] We use investments committed each year. [b] Cash means the relative balance between financial assets (available cash and other financial assets) and processed remaining payables (except precatory). [c] We use adjusted NCR, for the purpose of weighting the indebtedness. [d] We use the "gross" consolidated debt of state governments.

3. Empirical Exercise

We propose estimating dynamic panel model to assess the role of cash and debt as investment drivers, according to the following set of regressions:

$$\left(\frac{INV}{NCR}\right)_{i,t} = \alpha\left(\frac{INV}{NCR}\right)_{i,t-1} + \delta\left(\frac{DEBT}{NCR}\right)_{i,t-1} + \gamma\left(\frac{CASH}{NCR}\right)_{i,t-1} + \varepsilon_{i,t}, \quad (1)$$

$$\left(\frac{INV}{NCR}\right)_{i,t} = \alpha\left(\frac{INV}{NCR}\right)_{i,t-1} + \vartheta\left(\frac{EXT\ DEBT}{NCR}\right)_{i,t-1} + \varphi\left(\frac{DOM\ DEBT}{NCR}\right)_{i,t-1} + \gamma\left(\frac{CASH}{NCR}\right)_{i,t-1} + \varepsilon_{i,t} \quad (2)$$

$$INV_{i,t} = \alpha INV_{i,t-1} + \delta DEBT_{i,t-1} + \gamma CASH_{i,t-1} + \varepsilon_{i,t}, \text{ and} \quad (3)$$

$$INV_{i,t} = \alpha INV_{i,t-1} + \vartheta EXT\_DEBT_{i,t-1} + \varphi DOM\_DEBT_{i,t-1} + \gamma CASH_{i,t-1} + \varepsilon_{i,t} \quad (4)$$

In all regressions, the subscript i refers to each Brazilian state government among 27 states, and t to each year of our sample, from 2015 to 2022. Following this literature, in the regressions (1) and (2), we use all variables as a ratio of the respective Net Current Revenue (NCR), while in regressions (3) and (4), real values. As usual, ε refers to the residual.

To control for endogeneity and omitted variable biases, our main conclusions are based on an instrumental variable difference-in-difference regression. We also use Arellano and Bond's (1991) efficient GMM estimate with fixed effects in the cross section and White's variance-covariance matrix in the temporal dimension. Concerning the dynamic panel instruments, we use Eviews default, by specifying a set of dynamic instruments associated with all series in each regression. Since the default set of instruments grows very quickly as the number of periods increases, and our sample is not so large ($T = 8$), we limit the number of lags to be used.

First, as a type of preliminary test we can see that not all variables are stationary at 5%, (Table 1). We address this issue by applying the transformations suggested in Arellano and

Bond (1991). Thus, we estimate growth regressions in difference, i.e., we take the first difference of the equations (1) to (4).

Table 1. Panel unit root test [a, b]

	Variables as a ratio to NCR (%)	Real variables (R$ dec/2022)
Investments	0.4816 (0.6866)	10.6313 (1.0000)
Cash	-13.4758 ** (0.0000)	-5.3985 ** (0.0000)
Total Debt	4.7574 (1.0000)	-1.3686 (0.0856)
External Debt	-0.6422 (0.2604)	-3.5960 ** (0.0002)
Domestic Debt	3.7009 (0.9999)	-1.5890 (0.0560)

Notes: [a] Levin et al. (2002) panel unit root test with intercept over the period from 2015 to 2022 (H0: common unit root). [b] Respective p-values are reported in the parentheses. * p-value<0.05. ** p-value<0.01.

Our main findings are reported in Table 2.

Table 2. Results on investments reaction [a, b, c, d]

	Variables as a ratio to NCR (%)		Real variables (R$ dec/2022)	
	[1]	[2]	[3]	[4]
Main results - lagged explanatory variables				
Investments	0.0957 ** [0.0149]	0.0363 [0.0543]	0.4797 ** [0.0015]	0.5650 ** [0.0050]
Cash	0.1658 ** [0.0032]	0.1606 ** [0.0046]	0.2792 ** [0.0002]	0.1763 ** [0.0015]
Total Debt	-0.1044 ** [0.0089]		-0.0268 ** [0.0001]	
External Debt		-0.0516 [0.0296]		0.4915 ** [0.0035]
Domestic Debt		-0.1215 ** [0.0117]		-0.0496 ** [0.0007]
Complementary results				
Arellano-Bond test - AR(2)	-0.4878 (0.6257)	-0.9304 (0.3522)	0.7006 (0.4836)	0.3432 (0.7315)
Instrument rank	27	27	27	27
Sargan-Hansen test	25.4689 (0.3807)	24.9249 (0.3542)	23.8952 (0.4676)	21.7888 (0.5330)

Notes: [a] Dynamic balanced panel with the 26 states and Federal District, from 2015 to 2022. [b] Arellano and Bond's (1991) efficient GMM estimate with fixed effects in the cross section and White's variance-covariance matrix in the temporal dimension. [c] Instrument set: lagged dependent and exogenous variables (dynamic). [d] Respective standard errors are reported in the brackets, and p-values are reported in the parentheses. * p-value<0.05. ** p-value<0.01.

In all regressions, except for second model, we find a robust and significant values of the parameter associated with the investment's reaction in relation to its own lag. This positive reaction with this order of magnitude may suggest that there is an inertial behavior.

Regarding the role of the drivers able to explain the investments sustainability, the estimations of the cash to NCR parameter range from 0.161 to 0.166, while the values of real investments parameters range from 0.176 to 0.279. We find a robust finding on the positive reaction of investment to lagged available cash.

In models (1) and (3), which consider the effect of total debt, we again have a robust intuitive result, given by negative and significant (at 5%) parameters.

When we disaggregate the total debt into its internal and external components, according to the results of models (2) and (4), there is robustness on the negative impact of internal or domestic debt. The effect of the external debt (which represents less than 14% of the total debt in this period) was only significant in model (4), which considers the variables in real terms. This effect was positive, counterintuitively.

As complementary results, we also report in **Table 2** the results for Sargan–Hansen test for the overall validity of the instruments by analyzing the sample of the moment conditions used in the estimation process. We fail to reject the null hypothesis that such restrictions are valid for all specifications. Moreover, following Arellano and Bond's (1991) test we fail to reject the null hypotheses of no autocorrelation of the error term for autoregressive process in the models (1) to (4). [1]

4. Conclusion

Our first conclusion is that the empirical literature on public investments in Brazil is scarcer than it should be. Given the evolution of theoretical frameworks developed for public finance management, and the recent 2014 fiscal crisis, we observe that the indebtedness of state governments began to worry policy makers and researchers. In addition, we have also observed a literature on subnational tax revenue and payroll expenditure forecasting. The concepts of transparency, in the sense of mistaken predictability with intention or not, and resilience are even more recent and remains unexplored. Specifically on public investments, there is a research agenda relating investments or capital expenditures and growth. However, the agenda relating investments and other fiscal variables is very limited, and some recent contributions applied to Brazilian government states are Simonassi et al. (2021) and Bonomo et al. (2021). Our results allow us to add to this specific debate.

Second, we show a robust reduction of funding through borrowing of state government public investments over the period from 2015 to 2021: in 2015 this dependence was 57.9%, and in 2021, 12.1%. Since states' ability to invest autonomously — that is, with their own resources — is directly dependent on current savings, the significant improvement in the primary result in 2021 (after the pandemic) suggests that public investments by state governments may be sustainable in the short term.

Third, we show that Brazilian richest states appear distant from the other states in a worrying area, with high indebtedness. It is true that these states do not appear among those that invest the most. The states that invest the most appear to be in a comfortable situation in terms of debt versus cash. There are, however, states that could and should invest much more, considering their fiscal situation: Amapá, Roraima and the Federal District. The latter, despite its low cash value, has very low indebtedness, 38.2%.

Finally, our main findings based on a dynamic panel over the period from 2015 to 2022 suggest that state investment is not inertial or explosive, but cyclical, and it seems to be

[1] While subject to the usual caveats of cross-state instrumental variable regression – bias due to lagged dependent variable, potentially weak instruments, weak tests of overidentifying restrictions and lack of instruments for other

sustainable, given its positive reaction to lagged change in cash, and its negative reaction to lagged changes in domestic and external debt.

It is important to reconcile our evidence with the conduct of public policies. Brazil has a set of fiscal rules that constrains government spending at the federal and subnational levels, and according to Bonomo et al. (2021), those fiscal rules are not seem to blame for the collapse of public investment, but the sharp public investment contraction rather reflected the lack of fiscal discipline and uncontrolled fiscal expansion. Consequently, our research agenda can certainly be useful to redesign the fiscal framework with alternative fiscal rules and risk management framework, revisiting for instance, Constitutional Amendment 95/2016, entitled the "ceiling rule" of federal government spending, and he CAPAG's methodology. Moreover, we claim that we need to examine how fiscal policy can be retooled for the post-pandemic scenario to deliver sustainable investment. We are aligned to Blanchard et al. (2021) in the sense of proposing a replacement of old, fixed, constant and universal fiscal rules by dynamic state-specific assessments based on stochastic analysis to aiming to monitor public investment and debt sustainability[2].

Conflict of Interest

The authors declare that he has no conflict of interest.

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