Fiscal Space of Brazilian States

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Abstract

We estimate the fiscal space of Brazilian states defined as the difference between a state's actual debt and the theoretical debt limit implied by the historical behavior of its policymakers. Fiscal reaction functions and debt limits are estimated using publically available data between 2000 and 2011 for the 26 Brazilian states and the Federal District. The results suggest that after a decade of fiscal consolidation, a number of states have fiscal space but there remains significant heterogeneity across states. Going forward, enhancing the role of market incentives and strengthening rules-based approaches governing sub-national debt build-up would contribute to a prudent and effective use of existing fiscal space.

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1. Introduction

Brazilian States and Municipalities underwent a marked fiscal adjustment after 1999. In general, they have been able to stabilize nominal deficits at low levels and put their public debt ratios on a declining trajectory. This has been accomplished through strict discipline imposed by the Federal government over new sub-national borrowing and other key fiscal indicators. Along this process, the main fiscal adjustment variable for subnationals has been public investment, given rigidity of current expenditures and limitations for States to increase their own revenues. Sub-national fiscal consolidation is associated with years of low public investment, but was critical for improving the country's macroeconomic policy framework over the last decade.

The tension between fiscal consolidation and public investment at the sub-national level has been managed by the Federal Government through periodic revisions of debt accumulation limits. The revisions are discretionary, though informed by technical criteria. As the fiscal position of sub-nationals improves and infrastructure needs accumulates, the tendency to assume a less conservative bias on debt accumulation increases. In fact, subnational debt levels have started to increase again more recently, particularly in 2012. The debt build-up is associated to state-level investment needs, but also to fiscal stimuli promoted by the federal government. The trend should persist in the near-term, which will intensify the policy debate around sub-national fiscal sustainability and fiscal decentralization issues.

In this context, a policy-relevant analytical agenda on sub-national debt emerges centered around two questions. Firstly, how much fiscal space do sub-nationals actually have? Secondly, what is the best way of using any existing fiscal space? This paper deals with the first question by implementing one possible methodology to identify debt limits at the sub-national level. The paper is structured as follows. Section 2 discusses the concept of fiscal space and summarizes the associated literature. Section 3 presents the methodology and data. Section 4 presents the econometric results, and the final section concludes.

2. The Concept of Fiscal Space

"Fiscal space" is defined by Heller (2005) as *room in a government´s budget that allows it to provide resources for a desired purpose without jeopardizing the sustainability of its financial position or the stability of the economy.* The underlying idea is that fiscal space must exist if

extra resources are to be made available for worthwhile government spending without compromising macroeconomic stability and fiscal sustainability. In other words, making sure that governments have the capacity in the short and the longer term to finance its desired expenditure programs as well as to service its debt.

The concept of fiscal space is, thus, closely related to the concept of debt sustainability. When the debt of a country is deemed sustainable, additional room for government spending might be accommodated without jeopardizing the sustainability of its financial position.[1] However, when the debt ratio is considered unsustainable, policies to reduce it to a sustainable level are necessary indicating a limited or non-existent fiscal space. Fiscal space, in short, has been understood as the scope for further increases in public debt without undermining sustainability (IMF 2012, Ostry et al, 2010).

This concept of fiscal space, while intuitively appealing, has been measured in different ways. A first group uses the difference between the current fiscal balance and the medium-term debt-stabilizing balance to estimate the fiscal space or the adjustment needed (fiscal gap). These estimates are based on the projected debt-path determined by predefined assumptions for key variables –such as the overall fiscal balance, the discount rate, and the macroeconomic outlook. This methodology is frequently used by IMF's publications such as its *Fiscal Monitors*, the European Commission (2007), and different sustainability indexes –such as Blanchard and others (1990), Buiter, Corsetti, and Roubini (1993) and Auerbach and Gale (2011). The main advantage of this methodology is that is forward looking –just like the concept of debt sustainability- and therefore, it is able to incorporate fiscal plans announced by governments. Its main limitation is that its macroeconomic forecasts tend to rely on ad hoc assumptions rather than on formal, testable models. Furthermore, since it is forward looking, it implicitly ignores countries' track record of willingness to adjust while markets pay close attention to it.

A second group of methodologies uses stationarity and structural tests of fiscal sustainability. Hamilton and Flavin (1986) argue that sustainability is related to the stationarity of the primary deficit and debt levels. Hakkio and Rush (1991) argue that if debt and primary

[1] The IMF considers the fiscal stance of a country sustainable if the inter-temporal budget constraint is satisfied at all times, meaning that the current debt is less than or equal to the discounted value of future primary surpluses at all times (IMF 2013).

deficits are cointegrated, fiscal sustainability is maintained. Uctum and Wickes (2000) assume a time-varying discount factor and show that stationarity of the primary balance with zero mean is sufficient for fiscal sustainability.

Bohn (1998, 2005, 2007) adds a behavioral dimension to the assessments done by the "fiscal gap" methodologies by drawing implications on how countries' fiscal policies have reacted historically to increases in their public debt. The main idea of this approach is to define fiscal solvency as being fulfilled when the response of the primary surplus to debt is positive. A positive response intuitively means that countries increase their primary surplus when their debt load increases –because of shocks such as recessions, financial crises or natural disasters- or, conversely, run a lower surplus whenever debt is at a relatively lower level. Under this approach, sustainability is assured if primary fiscal balances increase sufficiently to match increases in debt-levels to avoid a Ponzi-scheme, ensuring the public debt is repaid in the long run.

Bohn's seminal contribution, however, has some drawbacks (Ostry et al, 2010, IMF 2012). First, it casts as sustainable infinitely growing debt ratios, as long as they are supported by infinitely growing primary balances implying a potentially unlimited fiscal space –which is clearly unrealistic since at some point primary surpluses would have to be as large as country's GDP itself. To address this shortcoming, a new group of papers refined Bohn's approach by testing for the possibility of a non-linear relationship between debt and the primary surplus. This could occur, for example, if countries find it more difficult to generate primaries balances that ensure sustainability when debts get very large (i.e. fiscal fatigue). A number of papers find evidence of a non-linear response. A stronger response of the primary surplus to greater debt levels is found for a large sample of industrialized countries in IMF (2003), while Abiad and Ostry (2005), IMF (2003), Celsun et al. (2006) and Mendoza and Ostry (2008) find that fiscal responses tend to weaken among emerging economics when debt exceeds 50% of GDP. Ostry et al. (2010) find that, for a large set of industrialized economies, fiscal reactions functions are better characterized by a cubic function, where at low levels of debt the primary surplus does not respond to debt increases, while at about 40 percent of GDP debt increases are followed by significant increases of the primary balance, but eventually, the response of the primary balance begins to flatten out and then actually decreases as debt rises further.

A second refinement to Bohn's framework done by Ostry et al. (2010) is conceptualizing the rise on the interest rates and the debt limits simultaneously. They do so by considering that, as a country's debt-to-GDP ratio increases, interest rates will raise since markets will factor in the higher probability that a country will be caught on the wrong side of the debt limit. The higher lending rates will then increase the probability that the debt load spirals out of control. In short, they integrate the modeling of the probability of default, the interest rate faced by the sovereign, and the debt limit.

A key advantage of the fiscal reaction framework is that it allows defining debt thresholds beyond which countries' will default unless policy-makers take fiscal steps which are outside of anything they have done historically. Current debts are evaluated against those thresholds to measure fiscal space. Consequently, those countries that have reacted more aggressively to debt increases will have higher debt limits and thus more fiscal space. In contrast, other countries that have shown less resolve will have lower debt limits and thus less fiscal space. As emphasized by Ostry et al. (2010) while countries' fiscal space and debt thresholds are not immutable, it does define a critical juncture beyond which a country's fiscal response to rising debt becomes insufficient to maintain fiscal sustainability. Policy makers must then break with the past practice or their government will default. Ostry et al. (2010) caution as well, that debt limits do not define an optimal level of public debt. Since the debt limit is the point at which a country's fiscal solvency is in jeopardy, prudence dictates that debt levels should remain well below those debt thresholds.

3. Methodology

We follow the approach of Ostry et al. (2010) to define fiscal space for Brazilian states as the difference between a state's actual debt and the theoretical debt limit implied by the historical behavior of its policymakers.[2] To determine a country's debt limit and fiscal space the first step is to determine a standard government budget constraint:

$$d_{t+1} - d_t = (r_t - g_t)d_t - pb_{t+1} \quad (1)$$

[2] A more detailed discussion of the specification is found in Gosh et al. (2011).

where *d* is one-period debt (as a share of GDP) at the end of the period, *g* is the growth rate of real GDP which is assumed to be exogenous and constant, *pb* is the primary balance (in percent of GDP), and r_t is the real interest rate on debt contracted in period t and due in period t+1 which we assumed to be exogenous and constant.[3] A country's growth adjusted interest payments is thus determined by $(r_t - g_t)d_t$.

It is then assumed that governments are generally responsible in managing their fiscal affairs. While at very low debt levels their primary surpluses might not respond to debt increases, they respond sensibly to rising deficits by tightening their fiscal policy once their debt levels start to approach moderate levels. Large increases on deb-stocks associated with shocks, thus, are stabilized since governments respond with fiscal discipline. Yet, there is a point when country's debt-to-GDP ratio and interest payments rise so much that policymakers are tempted to give up. This, for example, could happened when the share of national income going to paying taxes has become so onerous, or cuts in government have been so extreme, that further tax hikes or spending cuts become politically unfeasible.

This dynamic is characterized by the following cubic-shaped fiscal reaction function:

$$pb_{t+1} = \mu + f(d_t) + e_t \tag{2}$$

where μ captures all systematic determinants of the primary balance other than lagged debt.[4] Based on the above-described reaction of policymakers to changes in their debt load, the $f(d_t)$ term is assumed to be a cubic function.

The intersection between the primary balance reaction function and the growth-adjusted interest payment curve determine the debt limits as an equilibrium condition under which the debt ratios stabilizes:

$$(r_t - g_t)d_t = \mu + f(d_t) + e_t \tag{3}$$

[3] Ostry et al. (2010) assume the interest rate is endogenous and in equilibrium an increasing function of the probability of default. For the Brazilian states, however, we assume interest rates to be exogenous because above 90% of their debt-stock is with the federal government as a result of several round bail-outs and debt-renegotiations. The interest rate for these obligations is essentially politically determined and not market determined.

[4] The two most frequent determinants used in the literature are the output gap, to account for the business cycle, and the temporary component of public expenditure (i.e. military outlays during wars).

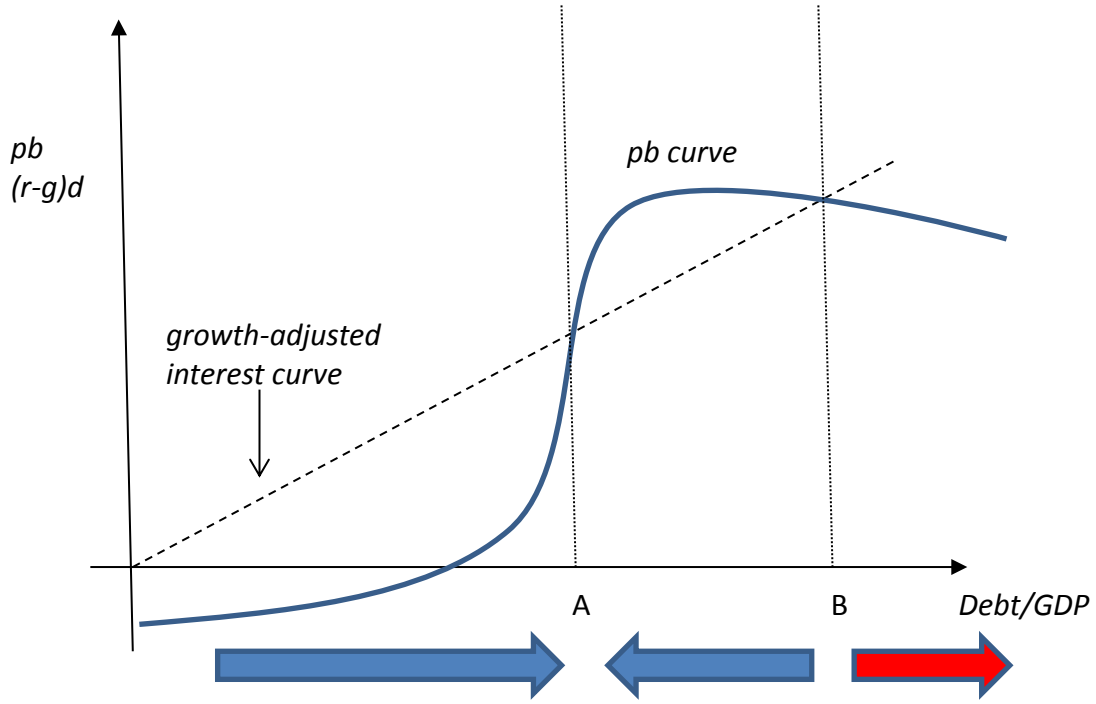
This equilibrium condition is illustrated in Figure 1. The solid curve represents the cubic (nonlinear) fiscal reaction function, while the dotted line represents the growth-adjusted interest payments. The different debt thresholds are given by the intersection between the two curves (A and B).[5] To exemplify this, suppose that a country's debt-ratio lies between A and B, which means that its primary balance is greater than the required growth-adjusted interest payments (the primary balance curve lies above the interest-payment curve). This corresponds to the case where policymakers are still able to match higher interest payments with higher primary surpluses. The excess of the primary surplus over the interest payments is used to pay down debt until point A is reached and the primary balance equals the interest payments.

In contrast, if a country's debt-to-GDP ratio lies to the right of B, the country is on the brink of becoming insolvent. From B onward, the primary balance curve is permanently lower than the interest-payment schedule, meaning that because a fiscal fatigue the government can no longer increase the primary surplus to honor interest payments. Consequently, the government would have to borrow increasing amounts just to service the debt, enlarging the future wedge between interest payments and the primary balance. As result the inter-temporal fiscal sustainability is compromised.

It follows that a country's debt-to-GDP ratio will be sustainable as long as it is lower than B. Furthermore, the fiscal space is the difference between the current debt-level and B. If the current debt level is higher than B then there is no fiscal space but a fiscal gap.

[5] Gosh et al. (2011) find that for industrial economies in general there will be two stationary equilibria, however, the number of equilibria can range between 1 and 3 depending on the particular shape of each cubic reaction function and the growth-adjusted interest payments.

Figure 1.



4. Estimation of the Fiscal Space

We apply the aforementioned methodology to the Brazilian States and its Federal District.[6] Fiscal reaction functions and debt limits are estimated using publically available data between 2000 and 2011. As a result, our database comprises a matrix of 27 x 11 (N x T) with a maximum number of observations of 297; however, the unavoidable presence of missing data usually leaves our regressions with a number of observations in the neighborhood of 270. A larger sample that included fiscal performance during the 1990s would allow a richer characterization of States' fiscal behavior. Unfortunately this information is not publically available. Additionally, it could be argued that fiscal institutions governing the behavior of sub-national governments during the 2000s are substantially different than the ones from the previous decade due to reforms in the late 1990s.

The main source of sub-national fiscal information was a dataset published by the National Treasury which provides consolidated and harmonized yearly information on the States' fiscal accounts. The dataset is fairly detailed, covering revenue, expenditure, assets and

[6] From this point onwards, we use the term States to refer to the Federal District as well.

liabilities. We adopted a concept of gross public debt constructed from the liability block of the dataset[7]. The gross debt includes contractual debt and bonds, but excludes debt associated to judicial disputes and other types of liabilities.[8] For a few States and years, we found data inconsistencies which we corrected by considering all liability line items in the dataset and by resorting to alternative publically available reports. When a solution was not possible, the information was dropped from the sample.[9]

State-level GDP was obtained from the National Statistics Office (IBGE) until 2010, last publically available data point. For the 2011 GDP, we used national GDP growth and constant State shares to extrapolate the State GDP. The national IGP-DI was used as the inflation measure.[10]

Following the fiscal reaction function specified in the previous section – equation (2) – the primary balance as share of GDP is the dependent variable while the cubic function of the lagged debt to GDP ratio provide the main explanatory variables. In line with the existing literature, systematic determinants of the primary surplus other than the lagged debt include[11]:

- output gap to account for the business cycle on fiscal policy;
- the cyclical component of government expenditure to account for tax-smoothing considerations in setting fiscal policy;
- inflation to control for potential inflation tax effects;
- a measure of fiscal vertical imbalances to account for the potential presence of moral hazard when the majority of sub-national spending is financed through transfers;

[7] In particular, we considered the domestic and external debt operations line items.
[8] Public debt is mostly contractual and states are forbidden to issue new bonds due to the 1997 sub-national debt renegotiation.
[9] The Central Bank of Brazil publishes sub-national debt information based on information from financial institutions. This provides a cleaner data, but information is only available from 2007 onwards. Comparisons between the Central Bank data and the gross debt calculated from the National Treasury dataset for the available years showed that the two measures are close after 2007.
[10] While there are a variety of inflation indexes for Brazil, the IGP-DI is used to estimate the real interest rates paid by the States to the Federal government in the context of the different rounds of debt-renegotiation.
[11] See Bohn (1998) and Mendoza and Ostry (2008) for a discussion on controlling for the effect of temporary fluctuations of GDP, government expenditures, and inflation. See Rodden (2004) and Bahl and Bird (2008) for a discussion on the potential impact of high level fiscal vertical imbalances on the fiscal effort of sub-national governments. See Arretche and Rodden (2004), Figuereido and Limongi (2008) and Miranda and Pereira (2011) for a discussion on how partisanship might affect the access Brazilian states have to federal transfers.

The fiscal reaction function is estimated through a fixed-effects panel-data regression assuming cluster robust standard errors. The Wooldrige Test for Autocorrelation rejected the presence of AR1 errors.[12] Results are presented below:

Table 1. Dependent variable: primary surplus to GDP

Specification	FE[1]		
	(1)	(2)	(3)
Lagged debt	-0.281 ***	-0.2792 **	-0.2746 **
	(-4.88)	(-4.55)	(-4.29)
Lagged debt square	1.2526 **	1.2535 **	1.3314 **
	(3.48)	(3.46)	(3.30)
Lagged debt cubic	-1.7539 **	-1.7575 **	-1.9463 **
	(-2.78)	(-2.78)	(-2.80)
Output gap	0.0001	0.0001	0.0002
	(1.08)	(1.11)	(1.71)
Government expenditure gap	-0.001 **	-0.001 **	-0.0011 **
	(-3.29)	(-3.28)	(-4.38)
Inflation		-0.00003	-0.00007
		(-0.36)	(-0.77)
Fiscal Vertical Imbalance			-0.0632 ***
			(-6.64)
Observations	272	272	272
Number of states	27	27	27
R-squared	0.3545	0.3548	0.3769

Source: Author's estimates
1. Fixed effects with cluster robust standard errors and time dummies
2. The Wooldrigde Test rejects the presence of AR(1) errors.
*** significant at 99%, ** significant at 95%, significant at 90%
t-statistis in parenthesis

The estimation indicates the existence of a cubic relationship between the primary surplus and public debt for the Brazilian States as Ostry et al (2010) found for developed countries. The primary surplus reaction to debt is very low – potentially negative – when debt ratios are

[12] The results of using alternative estimation methods, are shown in the Annex. The different specifications shown in the Annex largely confirm the results of Table 1.

sufficiently small. It becomes positive and continues to increase as debt levels rise, eventually reaching a fiscal fatigue point in which the reaction becomes negative. It is not necessary to observe a fiscal fatigue episode to determine its location; the coefficients of the cubic equation are sufficient.

Table 1 presents evidence that when revenue grows less than its trend, the primary surplus is stronger and vice-versa. Thus, negative revenue surprises leads to contemporaneous fiscal tightening – similarly, positive revenue surprises are contemporaneously consumed.[13] The estimation also suggests that States with a higher share of their total revenues coming from own revenues have a smaller fiscal surplus. One way to rationalize this result is to consider that such States are more developed and already have relatively high levels of own revenues. As a result, they would already be closer to the right-hand side of the Laffer curve so increasing state taxes would be more difficult. Alternatively, one could also expect that those States tend to face more complex challenges in dealing with large expenditure groups such as education and health.

Our focus is on the estimation of the debt limits. The variables output, revenue, and inflation, included in the estimation of (2) play the main role of mitigating omitted variable biases and help to achieve more reliable estimated coefficients which will be used to solve the cubic equation (3). In addition, the panel setting contributes to reducing possible biases as the estimated fixed effects pick up untreated cross-section heterogeneity and are also used when calculating the coefficients of the cubic equation.

Establishing the empirical validity of the cubic format of the fiscal reaction function enables the calculation of the debt limits as proposed by Ostry et al (2010). Before doing so, it is important to recall that the methodology we apply is fundamentally dependent on the observed history of fiscal performance. Thus, the findings are embedded in a specific context. For Brazil, this context involves a period of strong sub-national fiscal adjustment which greatly influences the results in favor of higher debt limits.

To derive the debt limits, the estimated coefficients from equation (2) are plugged into equation (3). The estimated constant and fixed effects not shown in table 1 are also incorporated.

[13] States had to adhere to strict fiscal plans between 2000 and 2011. This fact combined with current expenditure rigidity and inability to issue bonds indeed limited their ability to respond to smooth fiscal shocks.

The gap variables are set to zero. It is also necessary to assume a real interest rate-growth (r-g) differential, a critical parameter for the estimation of the debt limits as discussed below. Then one is left with a different cubic equation on the debt to GDP variable for each State. The largest root of each equation is the debt limit for that respective State.

Table 2. Long Run Debt Thresholds under different interest rate growth scenarios

	Highest observed Debt/GDP	Latest observed Debt/GDP	Debt limits	
			r-g=4.5	r-g=1
AC	35%	21%	29%	42%
AL	42%	27%	41%	47%
AM	11%	5%	9%	33%
AP	4%	3%	21%	41%
BA	20%	6%	32%	42%
CE	19%	7%	11%	37%
DF	3%	2%	3%	3%
ES	10%	3%	9%	33%
GO	30%	16%	31%	42%
MA	36%	10%	38%	45%
MG	26%	19%	23%	41%
MS	36%	12%	28%	41%
MT	31%	5%	36%	44%
PA	9%	4%	10%	36%
PB	26%	10%	22%	41%
PE	16%	6%	16%	40%
PI	38%	11%	37%	44%
PR	14%	5%	11%	37%
RJ	21%	13%	12%	38%
RN	11%	4%	10%	35%
RO	24%	9%	35%	44%
RS	23%	15%	15%	39%
SC	16%	7%	12%	38%
SE	16%	9%	18%	40%
SP	19%	13%	14%	39%
TO	14%	6%	33%	43%
Average	21%	10%	21%	39%

Source: Author's calculations

There is no clear cut way of choosing the (r-g) differential. As a principle, however, it needs to be a realistic average number that will be maintained over the long-term. Choosing an

excessively low real interest rate or excessively high growth parameter on the basis of temporary economic circumstances would generate artificially high debt limits.[14] In this paper we consider two possible values for r-g: 4.5 percent and 1 percent. The former case is more consistent with the Brazilian history (on average) between 2000 and 2011, but recent declines in the real interest rates have arguably approached the economy to the latter case.

The results indicate that the average debt to GDP limit across all States ranges from 21 to 39 percent depending on the scenario for the r-g differential. The actual average debt to GDP ratio observed in 2011 was 10 percent, so fiscal space for further borrowing ranges from 11 (21-10) percent to 29 (39-10) percent. There is a high dispersion of debt limits and actual debt ratios across States. This is explained by the States' different debt evolution profiles over the past decade. The history-dependent nature of the methodology tends to assign larger debt limits to those states that had higher debt ratios at one point in time and were able to bring it down substantially. This is a demonstration of the State's capacity to deliver a fiscal response. If a State, however, did not bring down its debt ratio substantially, even if the ratio was already low to start with, the methodology penalizes it in the derivation of its debt limit.

The lack of an actual track record of reducing debt (by choice or absence of necessity) limits inference on the State's tolerance and resolve to deal with debt overhangs. Except for the r-g choice, the methodology is eminently backward-looking. At the same time that this is a shortcoming, it is also a virtue in the Brazilian case. Firstly, it is objective and less prone to political or ideological dissent. Secondly, it provides a good benchmark for examining existence of fiscal space amongst highly indebted States that managed to bring down debt but are still facing non-trivial burdens. In those cases, it is possible to identify ballpark figures for fiscal space should the same resolve demonstrated in the past is maintained.

The table below shows the fiscal space for each State whose reduction in the debt to GDP ratio from between 2011 and 2000, exceeds 5 percent of GDP. The fiscal space is calculated as the difference between the debt limit - using the condition that r-g is equal to 4.5 percent - and the respective 2011 debt ratio.

[14] This is particularly relevant in the current context in which real interest rates are low influenced by a myriad of factors. One could also account for different growth rates across states, which we do not attempt in this paper.

Table 3. Fiscal Space and Past Debt Reductions

	Difference between Peak and 2011 Debt to GDP	Fiscal Space
AC	14%	8%
AL	15%	14%
AM	6%	4%
BA	14%	26%
CE	12%	4%
ES	7%	6%
GO	14%	15%
MA	26%	28%
MG	7%	4%
MS	24%	16%
MT	26%	31%
PA	5%	6%
PB	16%	12%
PE	10%	10%
PI	27%	26%
PR	9%	6%
RJ	8%	-1%
RN	7%	6%
RO	15%	26%
RS	8%	0%
SC	9%	5%
SE	7%	9%
SP	6%	1%
TO	8%	27%
Average	13%	12%

Some States have been able to promote drastic reductions of their debt ratios and, as a result, do have fiscal space. First of all, this is a testimony to the effective institutional framework governing sub-national finances over the last decade which acted as common factor across all states. Hence, consuming the existing fiscal space in a way that dismantles or neutralizes critical aspects of this institutional framework in place is risky. Moreover, the

methodology shows how critical country-level macroeconomic conditions are for the existence of fiscal space at the State level. This is captured by the r-g condition. A permanent deterioration of the country risk, which could be triggered by a *de facto* dismantling of fiscally-responsible practices, would make the r-g condition greater than 4.5 percent and significantly reduce the fiscal space amongst States regardless of their own commitment to sub-national finances.

5. Concluding Remarks

The results suggest that some states may have fiscal space to be used. Nevertheless, it is important to continue to enhance our ability to measure critical thresholds of debt build-up applying other methodologies as well. Only through this way it will be possible to identify reliable benchmarks for debt limits that could provide effective guidance for policymaking. Additionally, it is important to map potential sources of large persistent increases in public expenditure in the future when considering how close to debt limits the States should be.[15]

In this context, there may be scope for refining the strict government control model applied today meant to bring down subnational debt towards an institutional framework more reliant on market incentives. This does not mean that the Federal Government will facilitate debt build up and relax oversight. Instead, its role will be to enforce a strengthened and binding rules-based approach, in which States will bear the consequences of their fiscal policy decisions and compete against each other for market access without the expectation of relying on discretionary decisions at the federal level. This rules-based approach needs to have analytical foundations that integrate debt, revenue and expenditure issues.

Brazil's history of sub-national bail-outs requires that such framework is designed carefully with attention to both political factors and to the feasibility of disciplining mechanisms when a State threatens to default. Additionally, it may require legislative changes, particularly to limit the use of waivers and exceptions to Treasury's technical assessments. Notwithstanding the difficulties, the time is right for this discussion since there is already a debt build-up momentum in place. The federal government succeeded in bringing down subnational debt levels through discretionary behavior over the past decade. There is now fertile grounds for steering the

[15] A case in point is the demographic transition that Brazil is experiencing. The expected fiscal burden of pensions and health expenditures over the next decades, particularly after 2020, could put an important claim over what looks like a fiscal space today.

framework towards a more appropriate dynamics, and contribute to the prudent and effective use of existing fiscal space in some States.

Table A1. Variable Definitions and Data Sources

Variable	Description	Source
Dependent variable		
Primary balance to GDP ratio	In percent	Brazil's National Treasury
Explanatory variables		
Lagged debt to GDP ratio	In percent	Brazil's National Treasury and National Statistics Office (IBGE)
Output gap	Difference between actual and potential real GDP using a Hodrick-Prescott filter	Author's calculations based on IBGE statistics
Government expenditure gap	Difference between actual and potential government consumption using a Hodrick-Prescott filter	Author's calculations based on National Treasury Statistics
Inflation	Annual inflation national CPI	National Statistics Office (IBGE)
Fiscal Vertical Imbalance	Ratio of Own Revenues to total Current Revenues	Brazil's National Treasury

Table A2. Alternative Estimation Methods of the Fiscal Reaction Function

Specification	FE[1]		FE[2]		RE[3]		PCSE[4]	
	(1)		(2)		(3)		(4)	
Lagged debt	-0.2746	**	-0.3111	***	-0.1999	***	-0.2007	***
	(-4.29)		(-3.10)		(-2.64)		(-4.61)	
Lagged debt square	1.3314	**	1.5647	***	1.1631	**	1.1762	***
	(3.30)		(2.73)		(2.56)		(4.10)	
Lagged debt cubic	-1.9463	**	-2.5555	***	-1.7552	**	-1.7835	***
	(-2.80)		(-2.66)		(-2.27)		(-3.43)	
Output gap	0.0002		0.0001		0.0002		0.0002	
	(1.71)		(0.49)		(1.24)		(1.54)	
Government expenditure gap	-0.0011	**	-0.001	***	-0.0011	***	-0.0011	***
	(-4.38)		(-7.06)		(-8.76)		(-11.07)	
Inflation	-0.00007		0.00004		-0.00003		-0.00002	
	(-0.77)		(0.18)		(-0.30)		(-0.61)	
Fiscal Vertical Imbalance	-0.0632	***	-0.00156		-0.027	***	-0.0272	***
	(-6.64)		(-0.07)		(-5.05)		(-5.69)	
Observations	272		272		272		272	
Number of states	27		27		27		27	
R-squared	0.3769		0.3687		0.3495		0.3962	

Source: Author's estimates

1. Fixed effects with cluster robust standard errors and time dummies

2. Fixed effects assuming an AR(1) error structure.

3. Random effects assuming an AR(1) structure and time dummies

4. Panel Corrected Standard Errors assuming an AR(1) structure and time dummies

*** significant at 99%, ** significant at 95%, significant at 90%

t-statistics in parenthesis

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