Online Appendix to
"Public Financing Under Balanced Budget Rules"

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A Data Details

Data Cleaning. We start data cleaning by omitting observations with any missing values for price, yield or yield spreads, and those with coupon rates greater than 20%, yield to maturity greater than 50% or less than 0%, price less than 50 or greater than 150, years to maturity less than 0, or maturity less than 0 or greater than 99.

Construct the spread measure. We calculate the state bond spread as the difference in yields between a municipal bond and a synthetic treasury bond with equivalent coupon and maturity date as follows. First, for each municipal bond, we solve the theoretical price on a synthetic treasury bond with the same maturity date and coupon rate by calculating the present value of its coupon payments and face value using the US Treasury yield curve:

$$P_N^T = \sum_{n=1}^{N} \frac{C/2}{(1 + r_n^T/2)^n} + \frac{100}{\left(1 + r_N^T/2\right)^N}$$

where r_n^T is the set of treasury spot rates estimated in Gürkaynak et al. (2007). Then we calculate the yield to maturity of the synthetic Treasury bond using this price, the given coupon payments, and the face value. Finally, we take the difference between the municipal bond yield and the synthetic Treasury bond yield. This procedure is similar to the calculation of the yield spread in Longstaff et al. (2005) and Ang et al. (2014), among others.

The tax-adjusted synthetic price is constructed based on Section 3.4 of Ang et al. (2014) as:

$$P_N^{T\prime} = \sum_{n=1}^{N} \frac{C(1 - \tau_{s,t})/2}{(1 + r_n^T/2)^n} + \frac{100}{\left(1 + r_N^T/2\right)^N}$$

with $\tau_{s,t}$ defined in the main text.

B Additional Empirical Results

B.1 First-Stage Estimates

Table B.1 reports the first-stage estimation results of the IV regressions reported in Table 4. There are three takeaways from this table. First, past state budget surpluses (deficits) predict looser (tighter) BBRs in the future. Second, the R^2 of the first-stage estimations are very large especially when both state and time fixed effects are taken into account. These two results provide evidence for the claim that BBRs are likely to be endogenous to state-level budget conditions. Lastly, all the four specifications pass the weak IV tests in which the Cragg-Donald F-Stats are always larger than the Stock-Yogo critical value at the 10% level.

Table B.1: 2SLS First-Stage Results

	Panel A: *No Deficit Carryover*		**Panel B**: *ACIR Index*	
	(1)	(2)	(3)	(4)
	First-Stage Estimates			
State Budget Surplus	-0.113*	-0.117*	-0.561	-0.664
	(0.060)	(0.064)	(0.460)	(0.420)
State Fixed Effect	No	Yes	No	Yes
Time Fixed Effect	Yes	Yes	Yes	Yes
adj. R^2	0.171	0.505	0.127	0.551
	Weak IV Test			
Cragg-Donald Wald F-Stat	69.4	22.6	36.9	18.3
Stock-Yogo 10% Critical Values	16.4	16.4	16.4	16.4

Notes: This table reports the first stage estimates of the 2SLS IV regression in Panel C of Table 4. The coefficients of other regressors are omitted. Robust standard errors (clustered by states) are reported in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Columns (1)–(4) in this table correspond to (9)–(12) of Table 4.

B.2 Robustness Tests

Table B.2: Robustness Tests

	Controlling for State Political Factors				*Controlling for the Dependency Ratio*				*An Alternative Measure of BBR*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
BBR	-0.174**	-0.167**	-0.024	-0.022*	-0.175**	-0.167**	-0.024*	-0.022*	-0.135	-0.148*
	(0.079)	(0.072)	(0.014)	(0.013)	(0.076)	(0.071)	(0.014)	(0.013)	(0.088)	(0.083)
Debt/GDP	3.700**	3.357**	3.678**	3.331**	3.190**	2.889**	3.170**	2.864*	3.862**	3.505**
	(1.512)	(1.415)	(1.569)	(1.470)	(1.505)	(1.382)	(1.568)	(1.446)	(1.609)	(1.444)
ΔGDP	-0.071	-0.925	-0.067	-0.926	-0.082	-0.809	-0.075	-0.807	-0.176	-1.150
	(1.567)	(1.726)	(1.595)	(1.763)	(1.623)	(1.753)	(1.652)	(1.791)	(1.641)	(1.757)
Maturity	0.067***	0.067***	0.068***	0.067***	0.067***	0.067***	0.067***	0.067***	0.068***	0.067***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Coupon	0.089***	0.091***	0.088***	0.090***	0.089***	0.091***	0.088***	0.091***	0.092***	0.095***
	(0.028)	(0.028)	(0.027)	(0.028)	(0.028)	(0.028)	(0.027)	(0.028)	(0.027)	(0.028)
Democratic	-0.011	-0.012	-0.012	-0.013						
	(0.085)	(0.080)	(0.085)	(0.081)						
Republican	0.067	0.076	0.069	0.078						
	(0.113)	(0.111)	(0.116)	(0.114)						
Dependency Ratio					-2.389	-2.149	-2.361	-2.123		
					(2.195)	(2.059)	(2.222)	(2.083)		
Fiscal Controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
State Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	977	977	977	977	977	977	977	977	969	969
adj. R^2	0.436	0.438	0.434	0.436	0.436	0.438	0.435	0.436	0.434	0.437

Notes: This table reports the coefficient estimates and their standard errors (all clustered by state) of three different robustness tests. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Columns (1)–(4) control for variables that measure state-level political party presences at the legislatures. Columns (5)–(8) present the estimates when we control for the aged dependency ratio. Columns (9) and (10) replicate our baseline regression results using Urban Institute's definition of the highest level of stringency of state-level BBRs, that is, BBR equals to 1 if "the governor must ultimately sign a balanced budget, and no deficit carryover is permitted". Two-way fixed effects are accounted for. Adjusted R^2 are reported in the last line.

Table B.3: Including the Legal Criteria of BBR

	Panel A: *Time Fixed Effect Only*		**Panel B**: *State and Time Fixed Effects*	
	(1)	(2)	(3)	(4)
"No Deficit Carryover" Dummy	-0.108*	-0.128**	-0.173*	-0.165**
	(0.063)	(0.059)	(0.089)	(0.081)
Legislature Dummy	0.063	0.062	0.160	0.163
	(0.087)	(0.084)	(0.108)	(0.106)
Constitution Dummy	0.036	0.060	-0.060	-0.064
	(0.075)	(0.071)	(0.082)	(0.079)
Debt and GDP	Yes	Yes	Yes	Yes
Bond Characteristics	Yes	Yes	Yes	Yes
Fiscal Controls	No	Yes	No	Yes
State Fixed Effect	No	No	Yes	Yes
Time Fixed Effect	Yes	Yes	Yes	Yes
N	978	978	977	977
adj. R^2	0.385	0.393	0.437	0.439

Notes: This table reports the coefficient estimates and their standard errors (all clustered by state) when both the legal and "no carryover" criteria are included as separate regressors. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. The "No Deficit Carryover" dummy is defined in the baseline regressions. The "Legislature" dummy take a value of 1 if the legislature must pass a balanced budget. The "Constitution" dummy take a value of 1 if the rule is constitutional (or both constitutional and statutory). The other control variables are the same as in Table 4. Panel A reports the results with only year fixed effects. Panel B reports the results with both state and year fixed effects. Adjusted R^2 are reported in the last line.

Table B.4: Sensitivity Analysis Using Different Measures of Expenditure

	Panel A: *No Deficit Carryover*			**Panel B**: *ACIR Index*		
	(1)	(2)	(3)	(4)	(5)	(6)
BBR	-0.166**	-0.181**	-0.172**	-0.022*	-0.025*	-0.023*
	(0.071)	(0.075)	(0.073)	(0.013)	(0.013)	(0.013)
Debt and GDP	Yes	Yes	Yes	Yes	Yes	Yes
Bond Characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Fiscal Controls	Yes	Yes	Yes	Yes	Yes	Yes
State Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
N	977	977	977	977	977	977
adj. R^2	0.438	0.438	0.436	0.436	0.436	0.434

Notes: This table reports the coefficient estimates and their standard errors (all clustered by state) when we include different types of government expenditures. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. The "No Deficit Carryover" dummy and the "ACIR Index" are defined in the baseline regressions. Columns (1) and (4) use total expenditure (as a fraction of GDP, same for other columns) as one of the fiscal controls. Columns (2) and (5) use total construction expenditures; columns (3) and (6) use total highway direct expenditures. Other control variables are the same as in Table 4. All specifications include both state and year fixed effects. Adjusted R^2 are reported in the last line. Data source for the expenditure variables: Annual Survey of State Government Finances.

Table B.5: The Impact of Rainy Day Funds

	(1)	(2)	(3)	(4)	(5)	(6)
Rainy Day Fund Ratio	-0.121	-0.216***	0.312*	-0.225**	0.306	-0.229***
	(0.134)	(0.063)	(0.182)	(0.084)	(0.182)	(0.084)
BBR			-0.181**	-0.144**	-0.026*	-0.019*
			(0.080)	(0.063)	(0.015)	(0.010)
Debt and GDP	Yes	Yes	Yes	Yes	Yes	Yes
Bond Characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Fiscal Controls	Yes	Yes	Yes	Yes	Yes	Yes
State Fixed Effect	Yes	No	Yes	No	Yes	No
Time Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes
N	5912	5912	834	837	834	837
adj. R^2	0.370	0.339	0.425	0.389	0.424	0.387

Notes: This table reports the coefficient estimates and their standard errors (all clustered by state) when we include rainy day funds as a regressor. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Rainy day fund ratio is defined as the state government rainy day funds as a fraction of general fund expenditures. Columns (3) and (4) use the "no deficit carryover" dummy for BBR; in columns (5) and (6), the ACIR Index is used. Data source for rainy day funds and general fund expenditures: "The Fiscal Survey of the States" published by NASBO.

B.3 CDS and BBRs

Table B.6 repeats the exercise of Table 6 under alternative empirical specifications and implementing robust standard errors, using all three years' data.

Table B.6: CDS and BBRs: Alternative Specifications

	Panel A: *No Deficit Carryover*		**Panel B**: *ACIR Index*	
	(1)	(2)	(3)	(4)
BBR	-0.435	-0.434*	-0.072	-0.072*
	(0.283)	(0.246)	(0.048)	(0.041)
Debt and GDP	Yes	Yes	Yes	Yes
Other Fiscal Controls	No	Yes	No	Yes
N	48	48	48	48
adj. R^2	0.142	0.344	0.140	0.341

Notes: This table reports the parameter estimates and their robust standard errors shown in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Effective sample period: 2009, 2014 and 2020. BBR takes the "No Deficit Carryover" dummy variable in Panel A, and the "ACIR Index" in Panel B. All specifications include debt-to-GDP ratio and GDP growth as control variables. Other fiscal controls include revenue-to-GDP ratio and expenditure-to-GDP ratio. The estimations are pooled OLS regressions of all observations. CDS data source: Bloomberg.

B.4 Panel Error-Correction Model Estimation

Similar as the example given in Westerlund (2007), we postulate a relationship between state-level GDP (denoted by Y_i) and federal transfers (denoted by H_i) as follows:

$$\ln H_{it} = \Psi_i \ln Y_{it} + \mu_i + k_i t + e_{it}$$

We implement cointegration tests based on an error-correction model. This is done with the `xtwest` command in Stata. The optimal lag is selected using the AIC. Our test result presents strong evidence that the two variables are cointegrated in our panel data.

We proceed to estimate various specifications of error-correction models to examine the short run impact of local GDP on transfers from the federal government. In particular, we consider whether there is a deterministic trend in the cointegration relationship and whether a lagged GDP growth term is included in the model. The results are presented in Table B.7.

Table B.7: Error Correction Model Estimation

	(1)	(2)	(3)	(4)
$\ln H_{i,t-1}$	-0.201***	-0.207***	-0.133***	-0.140***
	(0.014)	(0.014)	(0.012)	(0.012)
$\ln Y_{i,t-1}$	0.100***	0.103***	0.152***	0.155***
	(0.016)	(0.016)	(0.015)	(0.015)
$\Delta \ln H_{i,t-1}$	0.039	0.039	-0.011	-0.010
	(0.024)	(0.024)	(0.024)	(0.024)
$\Delta \ln Y_{it}$	-0.173***	-0.097*	-0.172***	-0.093
	(0.057)	(0.059)	(0.058)	(0.060)
$\Delta \ln Y_{i,t-1}$		-0.293***		-0.305***
		(0.057)		(0.058)
Year	0.007***	0.007***		
	(0.001)	(0.001)		
State Fixed Effect	Yes	Yes	Yes	Yes
Constant	-13.070***	-12.766***	0.300***	0.391***
	(1.641)	(1.632)	(0.044)	(0.047)
N	2100	2100	2100	2100

Notes: This table reports the parameter estimates and their standard errors (shown in parentheses) in an error-correction regression. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Columns (1)–(4) report the estimation results with time trend but without lagged GDP growth, with both a time trend and lagged GDP growth, without a time trend or lagged GDP growth, and with GDP growth but without a time trend.

C Additional Quantitative Results

C.1 Computational Methods

This appendix describes the algorithm for computing the model. We first discretize the shock processes and state variables. We then solve the model via value function iteration. We discretize the AR(1) processes for the productivity A using 21 equally spaced grid points with Tauchen's method. For the bonds B we use a grid with 100 equally spaced points on $B \in [0, 0.6]$. For the capital K we use a grid with 100 equally spaced points on $K \in [1.0, 3.0]$. We then interpolate the decision rules. We have tested that the range is not bounded in the model simulations. The government makes decisions for next period debt B' and next period capital K'.

Here is a more detailed description of our algorithm:

1. Create grids and discretize the Markov processes for productivity A. Create grids for debt B and capital K.

2. Guess the value function $V_0(A, K, B)$ and the price function for long-term debt $q_0(A, K, B)$.

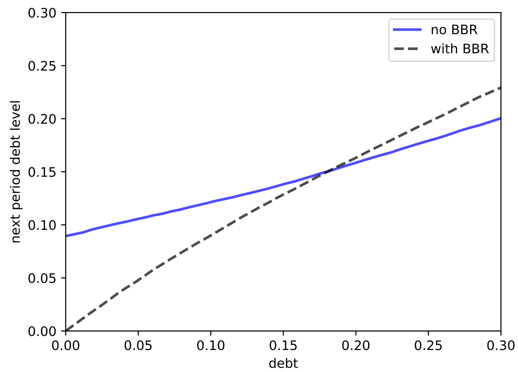
3. Update the value of repayment $V_c(A, K, B)$ and the value of default $V_d(A, K)$.

4. Compare $V_c(A, K, B)$ and $V_d(A, K)$, update the default rule, price function $q(A, K, B)$, and the value function $V(A, K, B)$.

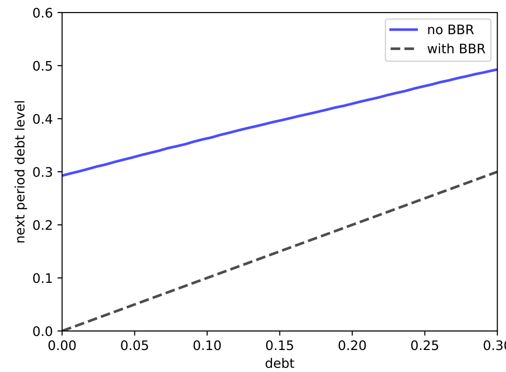
5. Check the distance $dist_v$ between the updated and prior value functions, and the distance $dist_q$ between the updated price function for long-term debt and the ones from last iteration. If either of the distances is larger than the tolerance 1e-5, then go back to step 3. Otherwise, stop.

C.2 The role of default risk

A unique contribution of our paper is that we consider default risk along with a BBR, which is crucial to understanding the debt decisions across policy regimes with and without a BBR. The difference in default risks in these regimes leads to different costs of government financing, which in turn feeds back into different debt decisions. This difference is more pronounced at higher debt levels where the difference in debt spreads is larger, which explains why we observe lower B' without than with BBRs, when current debt B is very large.



(a) With default risk (our model)



(b) Without default risk

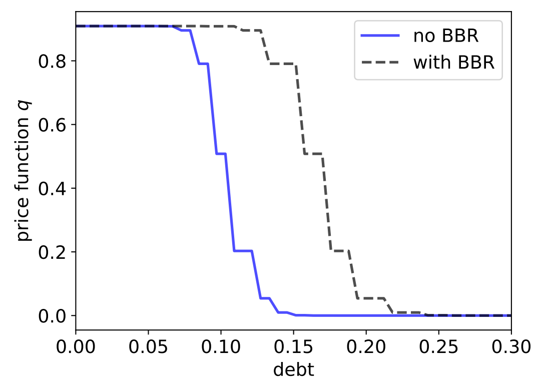
Figure C.1: Next period debt with and without default risk

To highlight the role played by default risk, we show in Figure C.1 a comparison of the next period debt schedule with default risk (Panel (a)) and without default risk (Panel (b)). Panel (a) is identical to Figure 5 in Panel (e). In the model without default risk, interest rates are the same across the two policy regimes, therefore imposing a BBR results in lower next period debt at all current debt levels. Moreover, absent the endogenous response to default risk, optimal debt level without BBR is always higher in the model without default risk.

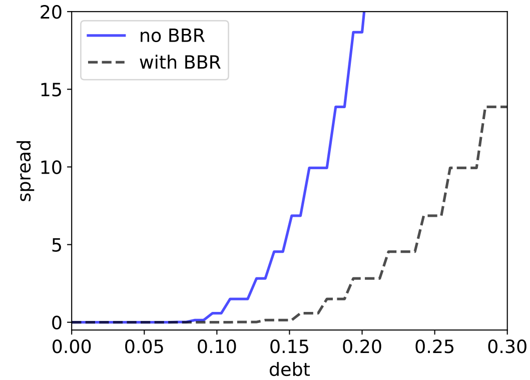
C.3 Bond Spreads and Policy Functions with Federal Transfers

In Section 5.5, we incorporate a notion of federal government in the model. To show the impact of a BBR, we compare the bond price and spread schedules with and without a BBR, as well as the policy functions for next-period debt and capital. Figure C.2 plots the price function in Panel (a), spreads in Panel (b), next-period debt in Panel (c), and next-period capital in Panel (d). The methods are the same as those used in generating Figure 5 in the main text. Figure C.2 shows that adding federal transfers do not change the qualitative impacts of a BBR.

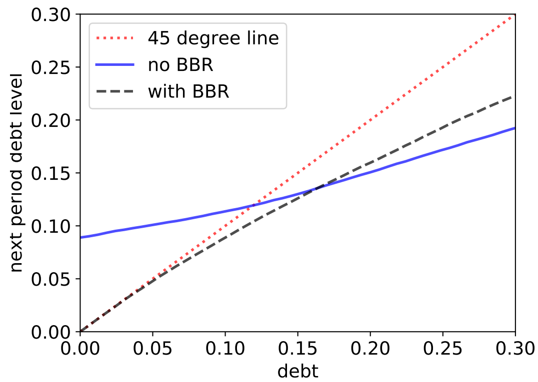
Table C.8 reports the regression results using simulated data from the model with a federal transfer rule. Across all specifications, the coefficients associated with BBR are negative. This indicates that the implementation of a BBR is associated with lower government spreads, again aligning with the our benchmark model results and empirical findings.



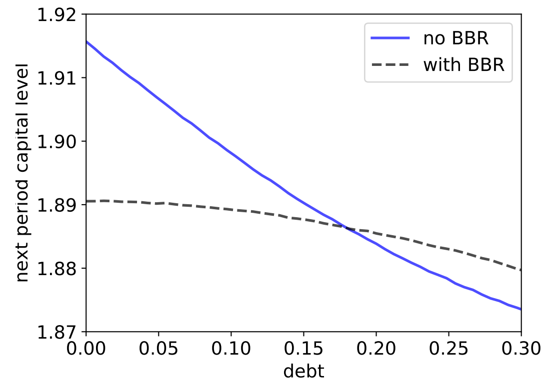
(a) Price function



(b) Spreads



(c) Next period debt



(d) Next period capital

Figure C.2: Bond Spreads and Policy Functions (with Federal Transfers): Impacts of a BBR

Notes: This figure plots the impact of a BBR for the model with federal transfers. Panel (a) and (b) plot bond prices and bond spreads as a function of debt without and with a BBR given productivity and capital level. Panel (c) and (d) plot the average decision rules for next period's debt and capital as a function of debt.

Table C.8: Regression Results in the Model with Federal Transfers

	(1)	(2)	(3)	(4)	(5)	(6)
BBR	-1.964***	-1.749***	-1.749***	-2.015***	-1.904***	-1.907***
	(0.014)	(0.012)	(0.012)	(0.014)	(0.028)	(0.028)
Debt and GDP	No	Yes	Yes	No	Yes	Yes
Other Fiscal Controls	No	No	Yes	No	No	Yes
N	200	199	199	200	199	199
adj. R^2	0.990	0.997	0.997	0.990	0.997	0.997

Notes: This table reports the regression results and their robust standard errors (in parentheses) using data simulated from the model with federal transfers. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Columns (1)–(3) utilize the complete simulated sample, whereas Columns (4)–(6) exclude observations in default prior to computing the average across simulations. Columns (1) and (4) do not include any controls. Columns (2) and (4) include debt-to-GDP and GDP growth as control variables. Columns (3) and (6) further control for revenue-to-GDP and spending-to-GDP.

C.4 Alternative Fiscal Rules

While the notion that borrowing limit can reduce default risk in a model of sovereign default is certainly not unique to our paper, how this "limit" is specified may have different implications. In this section, we evaluate the effects of alternative fiscal rules that exist in the literature and compare them with that of the BBR.

In their study, Alfaro and Kanczuk (2017) examine the effects of two types of fiscal rules on government debt using a one-period debt sovereign default model. The first type of rule is a debt rule, which sets a cap on the total level of government debt (relative to income) that forbids the government from surpassing a pre-determined threshold $\bar{x}_1$ (i.e., $B/y \leq \bar{x}_1$). A low value of $\bar{x}_1$ implies a restrictive debt ceiling.[1] The second type of rule is a deficit rule, which controls the rate of increase in debt (i.e., $\Delta B \leq \bar{x}_2$). If $\bar{x}_2$ is small, the deficit rule implies debt is restricted to very slow increases.

We solve and simulate the model under two different rules: a debt rule and a deficit rule. We select various thresholds for $\bar{x}_1$ and $\bar{x}_2$ and then analyze the corresponding model moments derived from the simulations. The outcomes of our simulations are presented in Table C.9. In Panel A, we present the simulated moments for the model incorporating a debt rule that limits the debt-to-GDP ratio. Panel B shows the simulated moments for the model with a deficit rule that controls the rate of change in debt.

Panel A presents the results of simulations conducted with different levels of the debt-to-GDP

[1] This definition of debt rule is close to one under the Maastricht Treaty. Some papers express the debt rule as $B \leq \bar{b}$. That is, they consider the debt level instead of debt-to-GDP ratio.

ratio cap (2%, 5%, 10%, 15%, 20%, 30%, 40%, and 50%). When the cap is set at a low level, it acts as a binding constraint which significantly restricts the debt level. As the cap increases, both the average debt-to-GDP ratio and spread increase. For instance, with a cap of 2%, the average debt-to-GDP ratio is only 1.64%, and the average spread is merely 0.18%. However, when the cap is raised to 10%, the average debt-to-GDP ratio rises to 7.84%, and the average spread increases to 1.65%. Nevertheless, when the cap is set at a very high level, say 30%, the simulated moments remain unchanged as the cap goes up. This indicates that the constraint is no longer binding. In other words, as the cap increases, the average debt-to-GDP ratio continues to rise until the cap is no longer restrictive. Similarly, the average spread also increases with the cap until the cap becomes non-restrictive.

In Panel B, we impose a deficit rule in the form of $\Delta B \leq \bar{x}_2$. We set $\bar{x}_2$ to be 1%, 2%, 5%, 10%, 20%, 30%, 40%, and 50%. When the limit is low, the simulated maximum ΔB reaches the limit. For example, with a limit of 1%, the maximum simulated deficit is also 1%. When the limit is low (1%), the average spread is also lower (1.84%). As the limit increases, the average spread also increases until the limit is not binding.

To evaluate the dynamic impact of alternative fiscal rules and compare them to the BBR, we present the predicted government spreads and debt-to-GDP ratio for Illinois after implementing each fiscal rule. In Table C.10, we show the predictions after imposing a BBR or a debt rule ($B/y \leq \bar{x}_1$) with $\bar{x}_1 = 2\%, 5\%, 10\%, 15\%, 20\%$. Implementing debt rules with low debt ceilings ($\bar{x}_1 = 2\%, 5\%, 10\%$) results in a significant reduction in government spreads in the first two years, as the government takes aggressive measures to meet the debt rule (as shown in Panel B).[2] However, after that, the debt-to-GDP ratio gradually increases, so does the government spread. If we compare across debt rules with different limits, we observe that at year 10, both the debt-to-GDP ratio and government spread are higher with higher debt ceiling limits.

Table C.11 reports the predicted government spreads and debt-to-GDP after implementing a BBR or a deficit rule that requires $\Delta B \leq \bar{x}_2$. We report results for $\bar{x}_2 = 1\%, 2\%, 5\%, 10\%, 30\%$. Panel A reports the predicted government spread and Panel B reports the predicted debt-to-GDP ratio. The predictions presented in Table C.11 suggest that the deficit rules are less restrictive compared to the BBR, and as a result, they generate higher spreads and debt-to-GDP ratios

[2]It is important to note that some research has shown that fiscal rules, although implemented, have not always been closely followed in practice (see for example, Larch et al., 2021 and Davoodi et al., 2022). In this paper, however, we assume that the fiscal rule serves as a hard constraint. Therefore, the estimated benefits of the fiscal rule presented in this paper should be considered an upper bound.

Table C.9: Model Simulated Moments: Alternative Fiscal Rules

Panel A: debt rules ($B/y \leq \bar{x}_1$)				**Panel B**: deficit rules ($\Delta B \leq \bar{x}_2$)			
$\bar{x}_1$	Max (B/y) (%)	Avg (B/y) (%)	Avg (spread) (%)	$\bar{x}_2$	Max (ΔB) (%)	Avg (B/y) (%)	Avg (spread) (%)
2%	2	1.64	0.18	1%	1	9.99	1.84
5%	5	4.45	0.57	2%	2	9.54	2.34
10%	10	7.84	1.65	5%	5	9.16	2.34
15%	15	8.90	2.25	10%	10	9.05	2.35
20%	20	9.03	2.35	20%	19	9.03	2.35
30%	23	9.05	2.36	30%	19	9.03	2.35
40%	23	9.04	2.36	40%	19	9.03	2.35
50%	23	9.04	2.36	50%	19	9.03	2.35

Notes: This table presents the results of simulations run on a model with two different types of rules: a debt rule in Panel A, which sets a cap on the debt-to-GDP ratio, and a deficit rule in Panel B, which sets a limit on the change in debt. For each rule, we test different levels of limits ($\bar{x}_1$ and $\bar{x}_2$, respectively). "Max (B/y)" represents the highest simulated debt-to-GDP ratio, "Max (ΔB)" represents the highest simulated change in debt, "Avg (B/y)" represents the average simulated debt-to-GDP ratio, and "Avg (spread)" represents the average simulated government spread. When the cap is low, the simulated maximum debt-to-GDP ratio (Panel A) or change in debt (Panel B) reaches the cap. As the cap increases, the average debt-to-GDP ratio and spread also increase until the cap is not binding.

across all thresholds. This is primarily due to the fact that the BBR, when combined with the government budget constraint, implies $B' - B \leq 0$, i.e. $\Delta B \leq 0$, which is more restrictive than a deficit rule with positive $\bar{x}_2$. As the limit of the deficit rule $\bar{x}_2$ increases, the government spread and debt-to-GDP ratio also increase, suggesting that the stringency of fiscal rules matter for their effects on government balance sheet.

In summary, the dynamics of the impacts of these rules can be quite different. A BBR reduces spreads dramatically and the debt level gradually. In contrast, after a debt rule is implemented, debt initially falls dramatically to meet the debt limit, before reverting back (but still within limit). Similarly, government spreads fall in the initial periods and then gradually return to and may even end up higher than their initial levels. Deficit rules, however, do not reduce spread or debt level significantly, especially when they are less stringent. Taken together, balanced budget and debt rules are more effective in improving government balance sheet, especially when they are more stringent. From a policymaker's point of view, BBRs may be preferred because they reduce debt in a less dramatic way, whereas the sudden and sharp fall in the ability to borrow in the initial periods after imposing a debt rule may have dire implications for the economy.

Table C.10: Predicted Government Spreads and Debt: Debt Rules

Panel A: Government Spread (%)						
Year	BBR	$\bar{x}_1 = 2\%$	$\bar{x}_1 = 5\%$	$\bar{x}_1 = 10\%$	$\bar{x}_1 = 15\%$	$\bar{x}_1 = 20\%$
0	2.345	2.327	2.289	2.298	2.388	2.300
1	0.618	0.034	0.343	1.451	2.177	2.295
2	0.454	0.045	0.298	1.443	2.124	2.156
3	0.310	0.074	0.312	1.388	2.116	2.246
4	0.283	0.072	0.379	1.513	2.179	2.303
5	0.294	0.081	0.443	1.512	2.081	2.279
6	0.347	0.088	0.405	1.508	2.144	2.275
7	0.354	0.085	0.500	1.515	2.136	2.238
8	0.293	0.145	0.533	1.539	2.252	2.332
9	0.317	0.172	0.508	1.545	2.161	2.297
10	0.345	0.138	0.513	1.594	2.152	2.303
Panel B: Debt-to-GDP (%)						
Year	BBR	$\bar{x}_1 = 2\%$	$\bar{x}_1 = 5\%$	$\bar{x}_1 = 10\%$	$\bar{x}_1 = 15\%$	$\bar{x}_1 = 20\%$
0	9.236	9.185	9.101	8.992	9.182	9.079
1	9.221	9.433	9.339	9.074	9.140	9.101
2	7.684	0.033	0.336	3.458	7.685	8.971
3	6.442	0.067	0.396	3.574	7.699	8.958
4	5.450	0.462	1.389	4.729	7.965	8.909
5	4.644	0.760	2.184	5.583	8.284	8.957
6	4.030	0.987	2.730	6.127	8.405	9.017
7	3.545	1.145	3.181	6.558	8.501	9.035
8	3.152	1.271	3.525	6.903	8.596	9.031
9	2.839	1.363	3.739	7.189	8.578	9.052
10	2.615	1.443	3.919	7.323	8.589	9.053

Notes: This table reports predicted government spreads and debt-to-GDP ratio after imposing a BBR or a debt rule in year 1. Debt rules refer to $B/y \leq \bar{x}_1$. We show various specifications with $\bar{x}_1 = 2\%, 5\%, 10\%, 15\%, 20\%$. Panel A reports the predicted government spread and Panel B reports the predicted debt-to-GDP ratio.

Table C.11: Predicted Government Spreads and Debt: Deficit Rules

Year	BBR	$\bar{x}_2 = 1\%$	$\bar{x}_2 = 2\%$	$\bar{x}_2 = 5\%$	$\bar{x}_2 = 10\%$	$\bar{x}_2 = 30\%$
Panel A: Government Spread (%)						
0	2.345	2.336	2.308	2.377	2.291	2.282
1	0.618	1.063	1.931	2.281	2.307	2.305
2	0.454	1.393	2.239	2.274	2.238	2.172
3	0.310	1.751	2.471	2.275	2.293	2.232
4	0.283	1.786	2.406	2.303	2.350	2.301
5	0.294	1.874	2.497	2.368	2.240	2.284
6	0.347	1.922	2.506	2.303	2.281	2.287
7	0.354	2.044	2.446	2.314	2.230	2.241
8	0.293	1.863	2.417	2.295	2.317	2.341
9	0.317	1.914	2.404	2.449	2.261	2.313
10	0.345	1.961	2.439	2.373	2.265	2.338
Panel B: Debt-to-GDP (%)						
Year	BBR	$\bar{x}_2 = 1\%$	$\bar{x}_2 = 2\%$	$\bar{x}_2 = 5\%$	$\bar{x}_2 = 10\%$	$\bar{x}_2 = 30\%$
0	9.236	9.263	8.960	9.079	9.053	9.089
1	9.221	9.314	8.958	9.088	9.049	9.076
2	7.684	9.749	9.417	9.190	9.063	9.068
3	6.442	10.039	9.599	9.179	9.060	9.046
4	5.450	10.227	9.641	9.198	9.051	8.995
5	4.644	10.354	9.587	9.185	9.035	9.021
6	4.030	10.428	9.574	9.168	9.093	9.068
7	3.545	10.468	9.589	9.148	9.084	9.079
8	3.152	10.459	9.541	9.165	9.082	9.029
9	2.839	10.465	9.512	9.171	9.077	9.010
10	2.615	10.458	9.468	9.201	9.057	9.001

Notes: This table reports predicted government spreads and debt-to-GDP ratio after imposing a BBR or a deficit rule in year 1. Deficit rules refer to $\Delta B \leq \bar{x}_2$. We show various specifications with $\bar{x}_2 = 1\%, 2\%, 5\%, 10\%, 30\%$. Panel A reports the predicted government spread and Panel B reports the predicted debt-to-GDP ratio.

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