Public Financing Under Balanced Budget Rules*

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Abstract

This paper analyzes the impact of a balanced budget rule (BBR) on government financing costs. Exploiting cross-state variation in the implementation of BBRs, we find that states with tighter BBRs have significantly lower debt spreads and credit default swap spreads, indicating the importance of the default risk channel. A simple sovereign default model with BBRs is consistent with the empirical results. Our quantitative analysis projects that the debt spreads for Illinois would fall by 50% and its debt burden would decline by 33% in ten years if it imposed a BBR today.

Keywords: Public financing, balanced budget rule, sovereign default risk, US state government

JEL classification: E62, F34

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1 Introduction

Following fiscal expansions during the COVID-19 crisis, the increased debt burdens of many countries and regions have led to a new wave of policy interest in imposing fiscal rules like the balanced budget rule (BBR). A strict BBR requires that a government not be allowed to carry over its deficits into the next fiscal year or biennial budget cycle. In practice, however, BBRs vary in stringency and design between governments. Along with other fiscal rules, such as debt limit rules, a BBR is designed to limit excessive borrowing and maintain a healthy government balance sheet. However, the ex post impact of imposing BBRs is yet not well known.

In this paper, we focus on the impact of BBRs on government financing cost. Previous studies have pointed out that BBRs can reduce governments' propensity to run deficits and lead to more sustainable public finances. However, little is known about the nexus between BBRs and government debt spreads. Data show that government bond spreads vary substantially between states. Understanding the determinants of government borrowing costs is important to understand the heterogeneity in fiscal and economic conditions across regions. For example, high borrowing costs have ramifications of high future debt burdens. High borrowing costs could also discourage current borrowing, leading to greater volatility in the business cycle. Differences in borrowing costs between states could also affect public finances, taxation, and government services. In this paper, we find whether imposing a BBR and the tightness of BBR can play an important role in government spreads.

The state governments in the US are treated as sovereign entities—they can design their own fiscal rules, issue bonds, and may also default on their bonds. Unlike most previous studies that treat BBRs as a time-invariant factor (generally due to limited data), we compile a new dataset on state government BBRs that covers multiple years and a number of BBR policy changes. Our dataset shows that there is a substantial variation in BBRs across states at both the extensive and intensive margins: 20-30% of the states have not imposed any deficit carryover restriction, and for those that do have a BBR in place, there is substantial variation in their nature, e.g., whether the rule is constitutional or statutory. Furthermore, there is also a large variation in government spreads across states, with magnitude comparable to those of European countries. We then identify the link between BBRs and government debt spreads by exploiting the policy variation both across US states and across time, an approach more favorable than cross-sectional or time-series studies because some of the potential factors driving debt spreads can be captured by the fixed effects.

We start by constructing state government bond spreads, our primary measure of financing costs for state governments, together with a new dataset of different measures of state government BBRs. In the empirical exercise, we control for bond-specific characteristics, state-level economic and fiscal conditions, as well as time and state fixed effects. We consider both an OLS approach and an instrumental variable (IV) approach. We use the past state government surpluses as the IV with the identification assumption that changes in BBRs are correlated with past government budgets (because policies react to previous budget conditions) that are arguably not related to the residual factors that drive current government bond prices (because bond prices are forward-looking). Estimation results of both approaches show that BBRs are significantly *negatively* correlated with state bond spreads. This result holds across different measures of BBRs and is robust to adding additional control variables that may correlate with both the time-varying BBRs and government debt spreads. We then provide evidence that default risk is likely to be an important channel through which BBR affects state bond spreads: Our BBR measures are also significantly negatively associated with state government credit default swap (CDS) spreads, a direct measure of the default risk component of state government bond spreads.

To better understand the empirical results, we introduce a BBR in a quantitative sovereign default model à la Arellano (2008). In our framework, the government borrows by issuing state-uncontingent bonds and can choose to default on these bonds. The bond price reflects the magnitude of the government default risk. We then add to this canonical default model by considering an institutional setup in which there is a constitution that requires local governments to execute a BBR. We model a BBR as a requirement that revenues must be sufficient to cover spending and the expected interest payment. Under this BBR, when the government issues bonds, it knows that a large debt increases future interest payments. To avoid violating its BBR, the government borrows less. Lenders also know that BBRs constrain the government. With a lower default risk, lenders offer the government a more favorable debt price. Through this model, we numerically show that imposing a BBR can lower government default risk, thus lowering government debt spreads and reducing the debt burden.

Finally, we conduct a quantitative analysis using data on the state of Illinois. The general fiscal situation in Illinois has been worrying and worsened even further during the pandemic. The government debt spread for Illinois is much higher than that for most states, with an average of 237bps between 2009 and 2020, which is much higher than the average of 67bps for all other states. In 2020, the average spread for Illinois increased even further to 327bps. To quantify the impact of introducing a BBR on government spreads in Illinois, we first simulate the model without a BBR, and then introduce a BBR to quantify its impact on government financing costs and indebtedness. The introduction of a BBR restricts new borrowings and reduces government default risk. With lower default risk, the government enjoys lower spreads. We estimate that 10 years after the BBR is implemented, the government spread would decrease by 50%. The debt burden is projected to also fall, dropping by 33% within 10 years.

We make two primary contributions to the literature. First, we are the first to link time-varying BBRs with government financing costs at the US state level using a novel dataset of different measures of BBR and comprehensive data on state government bond markets.[1] By doing so, we show that government fiscal rules can be an important factor in affecting asset prices in the government bond market. Second, we establish a new quantitative framework that incorporates both BBR and default risk—a feature that distinguishes this paper from the existing literature on the quantitative analysis of BBRs—to explain the empirical finding on this link, and show how it can be applied to simulate

[1] Poterba and Rueben (1999) study the effect of fiscal rules on the yields of state general obligation bonds, using survey data on the estimates of bond yields by bond traders at major brokerage houses instead of actual realized data. In addition, they focus on constant BBRs rather than time-varying ones. Feld et al. (2017) conduct a similar exercise for Swiss cantons. They empirically document that strong and credible BBRs in Swiss cantons contribute to lower risk premia. By restoring financial market confidence, a BBR contributes to a decrease in risk premia by more than 10 basis points.

the path of debt and borrowing cost should a government introduce a BBR.[2]

Literature. Empirically, this paper contributes to the literature on the impacts of BBRs at the state level. This literature mostly focuses on the effects of BBRs on a state's budget surplus or deficit. BBRs have significant positive effects on a state's budget surplus (Bohn and Inman, 1996). When deficits occur, a BBR leads to more rapid fiscal adjustments by tax increases and spending cuts to restore fiscal balance (Poterba, 1994, 1996; Hong, 2015). However, the benefits of fiscal balance must be weighed against the possible costs of compromising fiscal policy's ability to stabilize business cycle fluctuations (Eichengreen and Bayoumi, 1994). Empirical evidence for the adverse effects of BBRs on a state's stabilization policy is mixed. A lower cyclical variability of the budget balance does not necessarily lead to higher volatility in output (Alesina and Bayoumi, 1996; Krol and Svorny, 2007), and BBRs can reduce fluctuations in output, compensating for less responsive fiscal policy with reduced volatility in fiscal policy (Fatás and Mihov, 2006). We focus on the effects of BBRs on state borrowing costs measured by state government spreads beyond indebtedness or deficits. Our argument that BBRs can lower the required return on state bonds by reducing default probabilities is in line with Eichengreen and Bayoumi (1994), who show that fiscal restraints lower the required return on general obligation bonds by nearly 50 basis points. Relatedly, Poterba and Rueben (2001) show that while unexpected deficits are correlated with higher state bond yields, the effect is smaller for states with tight anti-deficit rules. Recent literature also explores government default risk and borrowing costs using state-level spreads (Arellano et al., 2016; Deng, 2019), while our paper investigates how they are driven by fiscal rules.

Our research also relates to the literature on how BBRs impact financial outcomes of national governments. In earlier studies, national fiscal rules among Eurozone and OECD countries show a very weak effect on bond spreads (see, e.g., Iara and Wolff, 2014; Heinemann et al., 2014; Kumar et al., 2009), which implies that these fiscal rules are either not strong or not sufficiently credible to affect investor risk assessments. Asatryan et al.

[2] Azzimonti et al. (2016) study the impact of BBR on debt, taxes, expenditures, and welfare in a political economy framework. We show that default risk is an important channel through which BBR has an impact, and therefore build a model incorporating default risk.

(2018) finds that the introduction of a constitutional BBR reduces the probability of a sovereign debt crisis. Our contribution is to expand the study to a subnational level by constructing new measures of state government BBRs, and investigating their impact on state government borrowing costs. A cross-state analysis is more desirable than a cross-country study because nationwide factors can be absorbed in time-fixed effects in the former, while heterogeneity across countries is harder to control for in the latter. Nonetheless, our result has clear implications for national fiscal policies as well.

Theoretically, our framework is related to the literature exploring the welfare implications of alternative fiscal rules in the context of sovereign debt and default (e.g., Alfaro and Kanczuk, 2017; Hatchondo et al., 2020). Alfaro and Kanczuk (2017) find that a simple debt limit yields a welfare gain close to that of optimal fiscal policy and performs better than a deficit rule. Hatchondo et al. (2020) show that a common spread brake generates larger welfare gains than a common debt brake in a union of heterogeneous economies. Although our work does not focus on comparing different fiscal rules or studying their welfare implications, we provide solid empirical evidence on the impact of a widely adopted fiscal rule among US states on their borrowing costs, a specific mechanism which could affect welfare.

The remainder of this paper proceeds as follows. Section 2 constructs and describes our measures of BBR and state government bond spreads. Section 3 conducts empirical studies on the impact of BBRs on government spreads. Section 4 presents a sovereign default model with a BBR. Section 5 parameterizes the model using Illinois data and quantitatively studies the impact of introducing a BBR. Section 6 concludes and discusses various implications of lower government financing costs.

2 Data and Summary Statistics

2.1 Data Construction

Measuring BBRs. Our first contribution is to build a consistent dataset capturing several measures of state government BBRs. While there is no consensus on how to measure the tightness of state-level BBRs, there are two general approaches: examining deficit carryover restrictions or legal requirements. The former is more clear-cut, simply requiring that the state cannot carry over any deficit. Legal requirements, however, take various forms. For example, in the 2021 *Budget Processes in the States* report published by the National Association of State Budget Officers (NASBO), legal restrictions include "governor required to submit balanced budget", "legislature required to pass balanced budget", and "budget signed by governor required to be balanced". Furthermore, in each category, the requirement can be "constitutional" or "statutory", which carry different legal weight. Measurement of BBRs, both by the public media and by academic literature, focuses on different aspects of the two categories. For example, the Urban-Brookings Tax Policy Center defines a "strong" balanced budget requirement for a state as meeting one or more of the following criteria: governor required to sign a balanced budget, prohibited from carrying a deficit into the following year, or the legislature required to pass a balanced budget accompanied by within-year fiscal controls or limits on supplemental appropriations.[3] Costello et al. (2017), however, simply defines a BBR as a dummy variable equal to 1 if the state has "no-carry-forward" rules and 0 otherwise, citing that deficit carryover restrictions are the most rigorous and effective means of reducing deficit spending.

Our primary measure of BBRs follows the baseline measure in Costello et al. (2017): states are considered to have a BBR if they are not allowed to carry over a deficit from one fiscal year to another. We collect this information from NASBO's *Budget Processes in the States* report, published in 1987, 1989, 1992, 2008, 2015, and 2021.[4] This report is also the standard reference source for BBR information in the *Book of the States* for most years.[5] Because of the lag between the survey and publication, we use the information in each publication to measure the BBR of the previous year. The first line of Table

[3]https://www.taxpolicycenter.org/briefing-book/what-are-state-balanced-budget-requirements-and-how-do-they-work

[4]The 1997, 1999, and 2002 reports do not contain information on whether a state can carry forward its deficit, so are excluded from our sample.

[5]In the 1992, 1995 and 1997 editions of the *Book of the States*, "State Balanced Budgets" are updated by The Council of State Governments, reflecting literal readings of state constitutions and statutes. To build a consistent sample using a unified definition, we omit these updates from our BBR sample. However, adding these years does not alter the significance of our baseline results.

Table 1: BBR Across US States

	1986	1988	1991	2007	2014	2020
No Deficit Carryover (#)	40	41	37	43	39	36
ACIR Index 0-10 (avg)	8.33	8.54	8.04	8.84	8.22	8.12
Correlation	0.93	0.97	0.97	0.96	0.95	0.97

Notes: The first line summarizes the number of states that imposed a no-carryover rule in each year. The second line presents the average ACIR index across states. The third line shows the correlation of our two measures of BBRs: dummy and index.

1 summarizes the number of states that imposed a BBR requirement in each observed year. Most states had a no-carryover rule in place, but the number is not invariant over time—fewer states imposed this rule in the last decade than the previous ones.

Our second measure of BBR borrows from the approach of *Fiscal Discipline in the Federal System: National Reform and the Experience of the States* published by the Advisory Commission on Intergovernmental Relations in 1987, which establishes a point system to construct an index for each state's BBR conditions. Our ACIR-inspired index calculates the degree of BBR stringency based on the total number of points assigned to each category of the aforementioned balanced budget requirements. With only slight variation from the original publication, our index awards points for whether the governor must submit a balanced budget (1 point), the legislature must pass a balanced budget (2 points), or if the state cannot carry a deficit into the next fiscal year (8 points). The index value is then set equal to the points from the "highest-ranked" requirement among these three, plus 1 point if the rule is statutory or 2 points if the rule is constitutional, generating scores from a minimum of 0 if a state has no BBR legislation, to 10 points if a state does not allow for deficit carryover and this requirement is constitutional, or both statutory and constitutional.

Table 1 shows that, consistent with the first measure, the index measure has a high average, indicating that most states have some form of BBR. This average has tendered to be smaller in the recent decade, indicating a general relaxation of BBRs among states. The third line also shows that our two BBR measures are highly correlated. Figure 1 presents a snapshot of the geographical distribution of BBRs in 2020. While many states have very tight BBRs—an index of 10 or close to 10—there are a number of states with very loose requirements. For example, the state of Illinois does not forbid carryover of deficit into the next fiscal year, and only required that the legislature must pass a balanced budget. In Section 5, we model the impact of tighter BBR legislation in Illinois.

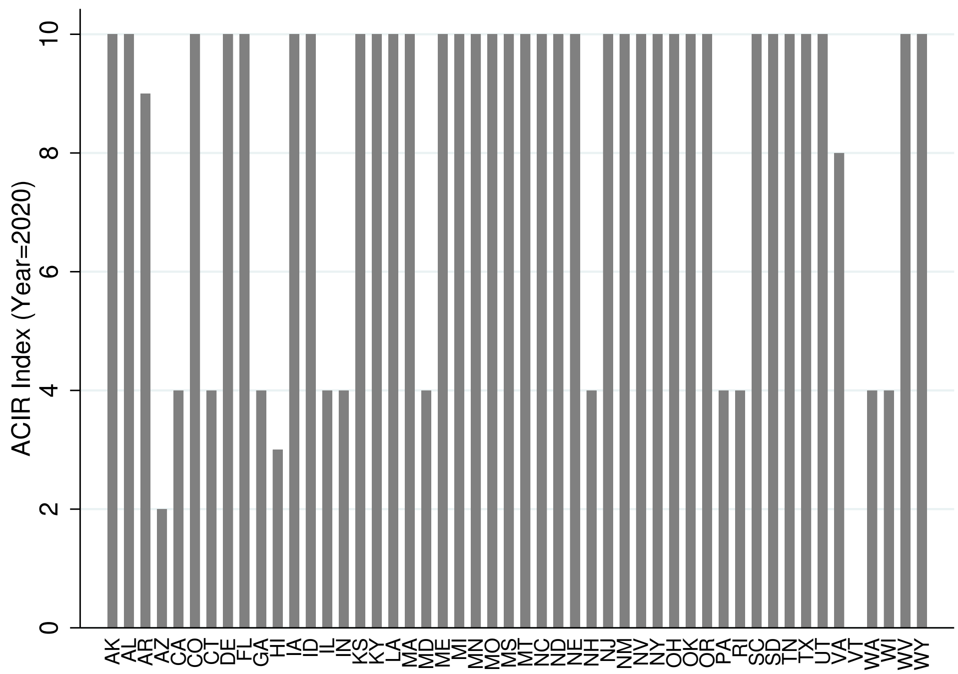


Figure 1: ACIR Index in 2020

Notes: ACIR Index in the year of 2020 by state, from 0 (no BBR) to 10 (strictest form of BBR).

Measuring State Government Bond Spreads. Our data on municipal bond issues come from the Securities Data Company's (SDC) Global Public Finance US Municipal New Issues database, which contains detailed information on various characteristics of newly issued bonds at the state and local levels, including issuer information, size of issue, years to maturity, coupon, prices, yields, and credit ratings, among others. Unlike transaction-level municipal bond price data, such as the Municipal Securities Rulemaking Board (MSRB) dataset used in Ang et al. (2014) and Schwert (2017), our SDC data contain only newly issued municipal bonds.

To construct a clean and reliable dataset, we follow common data selection steps documented in the literature such as those promulgated by Novy-Marx and Rauh (2012), Schwert (2017) and Butler and Yi (2022). First, we omit observations that are most likely to contain data errors. Second, we focus on only general obligation bonds that are unsecured by any special-purpose revenue. Third, we include only bonds with fixed coupon rates to accurately calculate bond spreads. Fourth, we winsorize all yield and yield spread variables at 1% and 99% over the sample period to mitigate the impact of outliers. More details on our data cleaning methods are relegated to Appendix A.

Following the procedures above, our dataset contains general obligation bonds issued by US states (including DC), counties, cities, and other government entities from 1976 to 2020. As this paper focuses on the relationship between state government fiscal rules and financing costs, we keep only the state government bonds. Additionally, as most municipal bonds are exempt from federal and state taxes, it is important to account for tax rates as a source of variation in bond yields in the cross section. Therefore, we adjust the state bond yields by a tax adjustment factor $\tau_{s,t}$ specified as $1 - \tau_{s,t} = (1 - \tau^{fed}_{s,t})(1 - \tau^{state}_{s,t})$, where $\tau^{fed}_{s,t}$ and $\tau^{state}_{s,t}$ denote the top federal and maximum state income tax rates using data from NBER TAXSIM.

State bond spreads are calculated as the difference between the tax-adjusted yield of a state government bond, readily available from our dataset or calculated from the raw price if the information on the yield is missing, and a tax-adjusted synthetic yield, constructed using the corresponding term structure together with the treasury spot rates estimated in Gürkaynak et al. (2007), following the method described in Butler and Yi (2022). The result of this approach is a tax-adjusted spread that depends on the term and coupon structure of each bond issue. In the empirical analysis, we account for the spread variation caused by this difference by controlling for coupon and maturity in our regressions.

Table 2 provides a description of the dataset used in the empirical analysis. Our sample consists of more than 7,000 observations of bonds issued by state governments, mostly from 1980 to 2020 (with only 3 in 1977, 2 in 1978 and 2 in 1979). There is significant variation in all the variables that we consider. In particular, the key dependent variable, State Bond Spread, has a mean of 0.772% and a standard deviation of 0.788%.

Table 2: Descriptive Statistics of State Government Bonds

	(1) Mean	(2) Median	(3) S.D.	(4) P1	(5) P99	(6) N
Maturity	2.679	1.000	4.315	0.250	24.083	7027
Coupon	4.470	4.500	2.159	0.350	11.000	7,027
Amount (million $)	179.935	63.000	458.433	0.760	1,968.930	7,027
Taxable Bonds (%)	11.755	0.000	32.209	0.000	100.000	7,027
Price	102.510	100.937	4.365	99.283	124.398	7,027
Yield (%)	3.107	3.099	2.023	0.150	8.750	7,027
Tax-Adjusted Yield (%)	2.332	2.121	1.739	0.033	6.995	7,027
State Bond Spread (%)	0.772	0.567	0.788	-0.696	3.776	7,027
Fitch Rating	1.038	1.000	0.340	1.000	3.000	453
Moody's Rating	1.072	1.000	0.481	1.000	4.000	512
S&P Rating	1.152	1.000	0.596	1.000	4.000	488
Overall Rating	0.014	0.000	0.052	0.000	0.222	537

Notes: This table presents the mean, median, standard deviation, 1st percentile, 99th percentile and total number of observations (excluding missing data) of each variable. We map rating notches into numerical values, where 1 is the highest rating (Aaa or AAA), 2 the second highest (Aa1 or AA+), and so on. "Overall Rating" is the average of the three normalized rating scores (Fitch, Moody and S&P). We use the average of the three normalized rating scores to represent the final rating score of each bond, though only about 1/5 of our sample bonds are rated.

The primary goal of this paper is to understand this considerable variation in state government borrowing costs across states and over time.

Other State-Level Variables. We also include state-level economic, fiscal, and political variables as controls in our regressions. Annual state-level GDP data are taken from the BEA Regional Economic Accounts, and are divided by state total population. The fiscal variables of the state government—debt at the end of the fiscal year, total revenue, and total expenditure—are all from the Annual Survey of State Government Finances.

2.2 BBR and State Government Bond Spreads

Before moving on to regression analysis, we start by presenting the comparison of average state bond spreads for states with and without BBR, based on our primary BBR measure defined as "No Deficit Carryover". With the caveat in mind that there may

Table 3: Average Spread: BBR States v.s. No-BBR States

	1986	1988	1991	2007	2014	2020
No Deficit Carryover	1.35	0.32	0.74	1.06	0.21	0.52
Deficit Carryover Allowed	1.60	0.12	0.92	1.01	0.66	0.80

Notes: Line 1 presents the average state bond spread (in %) across states with BBR (based on the "No Deficit Carryover" measure). Line 2 shows the average state bond spread across states without BBR.

be confounding factors that determine the difference in spreads across states, Table 3 reflects that among the six years when we have BBR data, in four of them the average spread for BBR states is much lower than for their no-BBR counterparts, while the year 1988 is an exception and in 2007 the two groups are quite close.

3 Empirical Study

In this section, we present our main empirical results on whether imposing a BBR would affect the financial cost of a state government. We further provide evidence of the important role that default risk plays in driving this relationship.

3.1 Empirical Specification

Our baseline estimation is specified as follows:

$$\text{Spread}_{i,s,t} = \text{constant} + \beta^{\text{BBR}} \times \text{BBR}_{s,t} + \boldsymbol{\beta}^{\text{control}} \times \boldsymbol{X_{i,s,t}} + \gamma_t + \theta_s + \varepsilon_{i,s,t} \tag{3.1}$$

where $\text{Spread}_{i,s,t}$, the state government bond spread for state s and year t at each issuance i, is our primary dependent variable. In our baseline regressions, $\text{BBR}_{s,t}$ denotes either the dummy variable of whether a state can carry over its deficit (examining the extensive margin) or the ACIR index described in Section 2.1 (examining the intensive margin). In the appendix, we also consider another BBR measure as a robustness check.

$\boldsymbol{X_{i,s,t}}$ is a vector of control variables that includes the characteristics of bond issuance (maturity and coupon) and state-level variables (debt-to-GDP ratio, GDP growth, total revenue-to-GDP ratio and total expenditures-to-GDP ratio). Because our construction of $\text{Spread}_{i,s,t}$ cannot eliminate the differences in the coupon and term structure between issues, we control for the specific characteristics of the bonds. In the sovereign default literature, two key variables driving government borrowing costs are its debt level, measured by the debt-to-GDP ratio, and its economic condition, measured by output growth. Intuitively, a sovereign with a larger debt position is more likely to default because the benefit of default is likely to be larger, while one with higher economic growth is less likely to default because the cost of default is greater if default punishments are related to output. Besides these variables, we also control government revenues and expenditures because they could affect state spreads. A government with a strong fiscal position—that generates more fiscal revenue or spends less—may be considered by investors as less likely to default on its debt. With all these potential driving forces of the state government spreads controlled, our key coefficient of interest is β^{BBR}.

Our sample is an unbalanced panel because there are instances of multiple bond issuances for a given state in one year or no bond issued for a state-year pair. Aggregating into a state-year sample would miss information on the variations across each issuance that are useful for identification. We consider state and year fixed effects to capture any unobserved differences across states (such as political institutions, financial market openness, etc.) that might have influenced the cross-sectional variation in bond spreads, and any unobserved time-varying nationwide factors (such as time-varying risk aversion, monetary policy changes, nationwide fiscal policy changes, inflation, inflation expectations, etc.) that might have contributed to the variation in bond spreads over time.

Equation (3.1) can also be seen as a generalized difference-in-difference regression, where β^{BBR} measures the average treatment effect (as in Asatryan et al., 2018). As with any other DID estimation, an important concern that might threaten a correct identification is that policy changes may be endogenous. There are three potential ways to address it. First, one could check the trends in the dependent variable $\text{Spread}_{i,s,t}$ in the years leading to the introduction of BBR to see if past fiscal and economic outcomes affect the probability that a state adopts a BBR. However, this exercise is infeasible in our setting because our sample of BBR is discrete, with data available for only a small number of years. Second, one could add additional controls, including fixed effects and other control variables that may drive the dependent variable, to minimize the bias due to omitted variables. In our robustness tests, we add more control variables (in addition to the fiscal control variables and fixed effects presented in the baseline result). Third, a good IV for BBR would also help address the endogeneity issue. In our baseline exercise, we examine such an approach using lagged state government surplus as the IV, with the identification assumption that changes in BBRs are correlated with past government budgets because the fiscal rule change may be a response to government budget conditions and it takes time for a new policy to be enacted, but past government budget conditions are arguably unrelated to the residual factors that drive today's government bond prices—satisfying both the exogeneity and relevance conditions.

3.2 Results

Table 4 presents our main empirical findings using least squares estimations (Panels A and B) and IV estimations (Panel C). In all of the specifications, we consider debt to GDP ratio, per capita GDP growth and year fixed effects. We add fiscal control variables expenditure-to-GDP ratio and revenue-to-GDP ratio in columns (2) (4) (6) and (8). We add state fixed effects in columns (3) (4) (7) (8) (10) and (12).

Let us first focus on the results for our preferred specifications under a least squares approach, which include all the control variables together with both state and year fixed effects, shown in columns (4) and (8). Estimates for the BBR coefficient are negative and significant at (at least) the 10% level for both specifications. Column (4) shows that imposing a "no deficit carryover" BBR would, on average, lead to a 0.166 percentage point decrease in state bond spreads. The estimate is harder to interpret for the Panel B results, because a one numerical point increase in the ACIR index does not carry a natural interpretation. Nonetheless, it provides additional evidence for the negative relationship between BBR and state government financing costs. The estimates for the coefficients of the main control variables are very similar across the two panels. The debt-to-GDP ratio is significantly positively associated with spreads, consistent with the predictions of standard theories. The coefficients on GDP growth are negative—again consistent with theory—yet not significantly different from 0 in our sample. Coefficients on the bond-level controls, maturity and coupon, are both anticipated to be significantly positive by construction. Adjusted R-squares in both regressions are greater than 0.4, indicating that the right-hand side variables included in our baseline specifications have strong explanatory power.

Our main result is robust to other specifications, as shown in columns (1)-(3) and (5)-(7). For example, taking out the fiscal control variables does not affect the magnitude or significance of our key estimates, as shown in columns (3) and (7). Including only time fixed effects, as shown in columns (2) and (6), does not alter the sign of the BBR coefficients or their magnitudes. The BBR coefficient turns slightly insignificant at the 10% level when the BBR variable takes the ACIR index, but its sign remains negative. Columns (1) and (5), reporting the estimation result when neither the fiscal variables nor the state fixed effects are included, yield a similar conclusion. Across all specifications, the magnitudes and signs of the control variable coefficients are also very similar. Overall, the OLS regressions consistently find a significantly negative relationship between state bond spread and BBR. They also suggest that both time and state fixed effects are important in understanding the variation in state bond spreads across states and over time.

In Panel C, we report the IV estimation result using the two-year lagged government budget surplus as the IV. Past government budget conditions may affect current implementation of a BBR, but may not determine the residuals that drive current government debt spread because debt spread is a forward-looking variable. We exclude the fiscal control variable in this estimation approach to avoid the colinearity problem. We estimate (3.1) using a two-stage-least-squares (2SLS) approach. First-stage results in Table B.1 show that our measures of BBR are indeed likely to be endogenous to past government budget surplus: a higher government surplus is negatively correlated with BBR. Weak IV tests and R^2 of the first stage regressions indicate that our IV is valid. Three observations stand out from this exercise. First, the coefficient on BBR remains significantly negative, no matter which measure we use or whether state fixed effects are included. Second, estimates of the coefficients on control variables are similar to their

OLS counterparts. Third, the BBR coefficient estimates under the IV approach are one magnitude larger than those under OLS. On the one hand, it indicates that the OLS estimates are potentially biased; while on the other hand, the finding in the IV estimation only strengthens our argument for the negative link between BBR and state bond spread.

Taken together, our baseline empirical tests suggest a significantly negative relationship between BBRs and government financing costs measured by bond spreads at the state level.

The impact of BBR on bond spreads with different maturities. Our previous tests do not distinguish the potentially differential impacts of BBRs on bond spreads with different maturities. We now proceed to study whether such a difference exists in our sample. We test this potential heterogeneity in the impact of BBRs by adding an interaction term "BBR $\times$ Short", where "Short" is a dummy variable that denotes short-term bonds with a maturity ≤ 1 year or ≤ 2 years, together with the dummy variable "Short" itself. We consider all the control variables including the debt-to-GDP ratio, GDP growth, bond characteristics, other fiscal controls, and fixed effects. Table 5 reports the result of this exercise across various specifications. The coefficient on BBR remains significantly negative in all of the specifications. The coefficients on the interaction term are all estimated to be positive, with the ones in two-way fixed effects models being significantly positive regardless of which BBR measure we use. This result implies that the spread for short-term bonds react much less aggressively to a change in BBR than that for long-term ones.

Table 4: State Bond Spread and BBR

	Panel A: *OLS, No Deficit Carryover*				**Panel B**: *OLS, ACIR Index*				**Panel C**: *IV Estimation*			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
BBR	-0.102*	-0.123**	-0.174**	-0.166**	-0.012	-0.014	-0.024*	-0.022*	-0.827**	-1.201**	-0.166*	-0.211**
	(0.059)	(0.055)	(0.077)	(0.071)	(0.009)	(0.009)	(0.014)	(0.013)	(0.379)	(0.498)	(0.090)	(0.101)
Debt/GDP	1.642*	1.578*	3.607**	3.261**	1.649*	1.624**	3.582**	3.232**	2.438**	2.806	2.456**	3.301*
	(0.830)	(0.788)	(1.480)	(1.380)	(0.842)	(0.805)	(1.546)	(1.446)	(1.025)	(2.120)	(1.239)	(1.991)
ΔGDP	-1.554	-1.613	0.015	-0.798	-1.505	-1.601	0.021	-0.796	-2.640	-1.745	-3.074	-2.061
	(1.633)	(1.634)	(1.614)	(1.738)	(1.671)	(1.683)	(1.642)	(1.777)	(2.048)	(2.357)	(2.343)	(2.826)
Maturity	0.074***	0.073***	0.067***	0.067***	0.075***	0.074***	0.068***	0.067***	0.057***	0.053***	0.057***	0.054***
	(0.007)	(0.008)	(0.007)	(0.007)	(0.007)	(0.008)	(0.007)	(0.007)	(0.007)	(0.008)	(0.007)	(0.008)
Coupon	0.070**	0.076***	0.089***	0.091***	0.070**	0.075***	0.088***	0.091***	0.101***	0.110***	0.100***	0.105***
	(0.027)	(0.028)	(0.028)	(0.028)	(0.027)	(0.028)	(0.027)	(0.028)	(0.033)	(0.034)	(0.033)	(0.034)
Fiscal Controls	No	Yes	No	Yes	No	Yes	No	Yes	No	No	No	No
State Fixed Effect	No	No	Yes	Yes	No	No	Yes	Yes	No	Yes	No	Yes
Time Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.264*	0.054	0.035	0.146	0.284*	0.099	0.101	0.203	1.440***	1.592***	2.191**	2.376**
	(0.155)	(0.219)	(0.204)	(0.487)	(0.165)	(0.230)	(0.212)	(0.478)	(0.491)	(0.578)	(0.949)	(0.966)
N	978	978	977	977	978	978	977	977	806	806	806	806
adj.R^2	0.385	0.392	0.436	0.438	0.384	0.391	0.434	0.436	0.240	0.171	0.187	0.141

Notes: This table reports the baseline coefficient estimates of (3.1) and their standard errors (all clustered by state). * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Panel A reports OLS estimation results using the deficit carryover definition of BBR. In the OLS estimation results shown in Panel B, BBR tightness is proxied for by the ACIR Index. Panel C shows the result using state government surplus (measured by total revenue less total expenditure, in logs and with a two-year lag) as the instrumental variable. Columns (9) and (10) use the "No Deficit Carryover" measure of BBR; (11) and (12) use the "ACIR Index" measure. The control variables for state economic conditions (Debt/GDP, per-capita GDP growth ΔGDP) and fiscal conditions (ΔGDP, Revenue/GDP, and Expenditure/GDP) all enter the regressions with a one-year lag. We consider two fixed effects—the state fixed effect and the time fixed effect. "Yes" means that the corresponding group of variables and fixed effect are considered in the regression. R^2 are reported as adjusted R^2 for OLS results and overall R^2 for IV results.

Table 5: BBR and State Bond Spread: Long-Term v.s. Short-Term

	Panel A: *OLS, No Deficit Carryover*				**Panel B**: *OLS, ACIR Index*			
	≤ 1		≤ 2		≤ 1		≤ 2	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
BBR	-0.216**	-0.278***	-0.252*	-0.346***	-0.032*	-0.043**	-0.045*	-0.060***
	(0.102)	(0.100)	(0.148)	(0.119)	(0.016)	(0.017)	(0.025)	(0.021)
BBR × Short	0.140	0.202*	0.166	0.254*	0.027	0.037**	0.037	0.051**
	(0.115)	(0.106)	(0.151)	(0.127)	(0.018)	(0.016)	(0.025)	(0.022)
Short	-0.296**	-0.324***	-0.418**	-0.506***	-0.409**	-0.471***	-0.601**	-0.737***
	(0.111)	(0.100)	(0.185)	(0.140)	(0.163)	(0.145)	(0.268)	(0.209)
Debt/GDP	1.266	2.690**	1.198	2.595*	1.290	2.600*	1.203	2.472*
	(0.790)	(1.281)	(0.813)	(1.356)	(0.803)	(1.345)	(0.825)	(1.405)
ΔGDP	-1.286	-0.685	-1.212	-0.792	-1.272	-0.695	-1.131	-0.782
	(1.653)	(1.784)	(1.579)	(1.708)	(1.692)	(1.807)	(1.613)	(1.730)
Bond Features	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fiscal Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State Fixed Effect	No	Yes	No	Yes	No	Yes	No	Yes
Time Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.262	0.335	0.441	0.700	0.379	0.465	0.634*	0.948*
	(0.229)	(0.451)	(0.277)	(0.518)	(0.249)	(0.422)	(0.333)	(0.520)
N	978	977	978	977	978	977	978	977
adj. R^2	0.403	0.448	0.405	0.453	0.402	0.447	0.405	0.453

Notes: This table reports the coefficient estimates and their standard errors (all clustered by state), adding an interaction term "BBR × Short" where "short" is a dummy variable that is 1 if the bond maturity is equal to or less than 1 year or 2 years, and the dummy "Short" itself. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Panel A reports OLS estimation results using the deficit carryover definition of BBR. In the OLS estimation results shown in Panel B, BBR tightness is proxied for by the ACIR Index. As with other regressions, we control for bond characteristics coupon and maturity. The control variables for state economic conditions (Debt/GDP, per-capita GDP growth ΔGDP) and fiscal conditions (ΔGDP, Revenue/GDP, and Expenditure/GDP) all enter the regressions with a one-year lag. We consider two fixed effects—the state fixed effect and the time fixed effect. "Yes" means that the corresponding group of variables and fixed effect are considered in the regression.

3.3 Robustness Tests

While our baseline estimation result provides a consistently negative correlation between BBRs and state bond spreads, there may still be concerns about the validity of this result. First, our newly constructed measures of BBR may not capture all the requirements underlying a BBR, given the complexity of BBR implementation in practice. Second, there may be omitted factors that systematically affect both fiscal rules and state bond spreads, leading to biased estimates. To address these concerns, we conduct the following robustness tests.

An alternative BBR measure. In addition to the two BBR measures described in the main text, we also estimate (3.1) using an alternative BBR measure derived from the Urban Institute's definition[6], who classify BBRs into five categories: "Governor must ultimately sign, no deficit carryover permitted", "Governor must ultimately sign, deficit carryover permitted", "Governor must propose or legislature pass, no deficit carryover permitted", "Governor must propose or legislature pass, deficit carryover permitted" and "none". Although the ranking of BBR tightness is not clear from this definition, we are sure that the first category is the strongest. Therefore, we define a dummy variable that equals 1 if a state lies within the first category, and 0 otherwise. We perform the same exercise as in the baseline and present the result in Table B.2. Across the four different specifications, the coefficients on the BBR are consistently negative, in line with our baseline results. In our most preferred specification with fiscal control variables and two-way fixed effects, this coefficient is significantly different from 0 at the 10% level. In terms of magnitude, the estimated BBR coefficient is similar to that in the baseline regression using the "No Deficit Carryover" dummy variable as the explanatory variable, which lends more support to the robustness of our main conclusion.

Adding state political party information. To address the second concern, we include a possible omitted factor that might simultaneously drive a state government's preference for fiscal rules and financial outcomes. In particular, we include political factors besides the aforementioned baseline explanatory variables. We take our data from the National Conference of State Legislatures. States are classified as "Democratic" if both legislative chambers have Democratic majorities, while "Republican" indicates that both legislative chambers have Republican majorities. A state is "Split" if neither party has majorities in both legislative chambers. Following this classification, we construct two dummy

[6]https://www.urban.org/research/publication/balanced-budget-requirements.

variables, "Democratic" and "Republican", and include them as additional explanatory variables. Table B.3 shows that controlling for these variables has minimal impact on our baseline results. Furthermore, the coefficients of these political party variables are not significantly different from 0, indicating that political party control is not a key factor in explaining the variation in state government financing costs after controlling for BBR.

Adding dependency ratio. The difference in demographic structures across states may also be a confounding factor that biases our baseline result. Butler and Yi (2022) find that an increase in a state's population age leads to a significant increase in municipal bond issue spread via three channels: lower tax revenue, higher unfunded pension obligations, and higher retiree healthcare liabilities. Given that these changes may also facilitate changes in state government fiscal rules, population aging may likely be an omitted variable. Therefore, we add the state dependency ratio, measured by the ratio of the retirement age population (65+) to working age population (18-64), to the baseline regressions using an OLS approach. Table B.4 presents the estimation result. The coefficient of BBR stays unchanged to this additional control variable, and the coefficient on "Dependency Ratio" is not significant.

3.4 Inspecting the Mechanism

Schwert (2017) shows that the tax-adjusted municipal bond yield spread can be decomposed into a default risk component, and an illiquidity compensation component. In this section, we proceed to understand the channels through which a BBR affects government borrowing costs and highlight the role of sovereign default risk. To understand the correlation between BBRs and default risk, we use state government CDS spreads (premia) to measure the default component of state bond spreads. CDS data are readily available from Bloomberg, and they provide a direct measure of state government credit default risk as perceived by investors. They are available for 19 states from 2010 to 2020, and 10 states for 2009. To increase the sample size used in estimation, we impute BBR data for 2009 by assuming that all state BBRs remained unchanged from 2007, the closest year to 2009 with available BBR data. This allows us to run a pooled OLS regression using 48 observations[7].

We find that BBR existence is negatively correlated with CDS premia in all of our specifications: with or without fiscal control variables, using either the dummy or index measure as a proxy for BBR. Columns (2) and (4) of Table 6 present the coefficient estimates controlling for fiscal variables, our preferred specifications. It is evident that coefficients on BBR for both measures are significantly negative at the 10% level. This result implies that other things being equal, imposing a BBR (column (2)) or a tighter BBR (column (4)) would lead to a significantly lower government default risk, and thus lower borrowing costs for state governments. In Appendix B Tables B.5 and B.6, we present more results using different standard errors by assuming homoscedasticity, and by doing a sub-sample analysis.

These results indicate the crucial role played by the default risk channel in explaining the negative correlation between BBR and state government bond spreads. In the next sections, we rely on this finding to quantify the impact of BBRs in a sovereign default model.

[7]Panel regressions controlling for fixed effects are not feasible because of the small sample size.

Table 6: CDS Spreads and BBRs

	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/GDP	-0.920	1.701	-0.923	1.696
	(2.254)	(1.718)	(2.270)	(1.738)
ΔGDP	-10.470***	-4.746	-10.515***	-4.786
	(3.386)	(2.890)	(3.415)	(2.899)
Revenue/GDP		-19.667***		-19.650***
		(6.855)		(6.855)
Expenditure/GDP		10.784		10.834
		(6.999)		(7.029)
Constant	1.355***	2.234***	1.644***	2.510***
	(0.414)	(0.566)	(0.601)	(0.707)
N	48	48	48	48
adj. R^2	0.142	0.344	0.140	0.341

Notes: This table reports the baseline parameter estimates and their robust standard errors (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. The estimations are pooled OLS regressions of all observations. CDS data source: Bloomberg.

4 Model

Our empirical results show that states with tighter BBRs are associated with significantly lower state government spreads, and default risk is a plausible explanation for this main finding. In this section, we use a simple sovereign default model à la Arellano (2008) to illustrate the mechanism. Since transfers from the federal government to the state governments do not fall into the constraint of a BBR, we do not model the federal government. We keep the model as simple as possible and discuss several model extensions in Section 6.

Consider a small open economy that receives a stochastic stream of income y_t. The households have a discount factor β and a constant relative risk aversion utility function over consumption c_t given by:

$$u(c_t) = \frac{c_t^{1-\sigma}}{1-\sigma}, \tag{4.2}$$

where σ is the risk aversion parameter. Households pay taxes τy_t to the state government, where τ is the tax rate ($\tau > 0$), and receive transfers T_t from the government.

The government has access to tax revenue τy_t. It borrows by issuing bonds and returns the proceeds as a transfer to the households. Thus, the government can be viewed as borrowing on behalf of households.

The government borrows by issuing state-uncontingent long-term bonds to the rest of the world's risk-neutral lenders. Let q_t be the price of a bond that promises to pay one unit of the consumption good in the next period. Governments can default on their bonds. Lenders recognize that governments can default and set the price of the bond q_t to break even in expectation. Thus, the price of bonds is determined endogenously and reflects the risk of government default. If a government defaults, it is excluded from the borrowing market for a period of time. The government regains the ability to borrow with probability λ. In the event of default, there is an exogenous cost that reduces income in this economy: $y^d = h(y) \leq y$.

4.1 Recursive Formulation

In this subsection, we describe the government's problem without a BBR and then introduce a BBR in the next subsection. We describe the government using a recursive formulation and then characterize the recursive equilibrium. Each period, the local economy starts with a level of local income y and public debt B. We omit the time subscript t to simplify the notation, and we use x' to denote the variable x in the next period. The timing of the model is as follows. At the beginning of each period, income y is observed. A fraction ϕ of government debt matures, and the remaining 1-ϕ fraction remains outstanding. Given tax revenue, the government decides whether to repay its debt or not. If the government repays its debt, it can choose new borrowing B'. If the government defaults, it enters financial autarky. With probability λ, the government returns to the financial market.

A government with access to financial markets chooses whether to default to maximize household welfare:

$$V(y,B) = \max\{V^c(y,B), V^d(y)\}, \tag{4.3}$$

where V^c denotes the non-defaulting value and V^d the defaulting value. When the defaulting value is larger, the government chooses to default on its debt. Let $D(y,B) = 1$ denote default. If the government does not default, it can choose a new debt level, B', by solving the following dynamic programming problem:

$$V^c(y,B) = \max_{\{c,B'\}} \quad u(c) + \beta \mathbb{E}\left[V(y',B')\right], \tag{4.4}$$

subject to the household and government budget constraints:

$$c = (1-\tau)y + T, \tag{4.5}$$

$$c \geq 0, \tag{4.6}$$

$$T + \phi B = \tau y + Q(y,B')\big(B' - (1-\phi)B\big), \tag{4.7}$$

where T is government transfers to households, B is the stock of debt (bonds), ϕB is debt repayment, τy is government tax revenue, $Q(y,B')$ is the bond price, and $\big(B' - (1-\phi)B\big)$ is the new debt issuance. Combining (4.5) and (4.7), we get the resource constraint: $c + \phi B = y + Q(y,B')\big(B' - (1-\phi)B\big)$. Here the tax τ does not show up in the economy-wide resource constraint because the government transfers to the households in a lump-sum fashion and there is no distortion associated with tax.

If the government defaults, the local economy suffers a loss of income from y to y^d and enters financial autarky. During financial autarky, the government cannot issue bonds. With probability λ, the government returns to the financial market. The default value is then given by:

$$V^d(y) = \max_{\{c\}} \quad u(c) + \beta \mathbb{E}\left[\lambda V(y',0) + (1-\lambda)V^d(y')\right], \tag{4.8}$$

subject to the resource constraint:

$$c = y^d. \tag{4.9}$$

The lenders are competitive and risk neutral. They face a constant world interest rate r and are willing to lend to the government as long as they break even in expected value. Moreover, lenders are aware of the government's incentives to default on its bonds. Thus, in equilibrium, the break-even condition implies that the bond price schedule $Q(y, B')$ satisfies:

$$Q(y, B') = \frac{1}{1+r}\mathbb{E}\left[(1 - D(y', B'))(\phi + (1-\phi)Q(y', B''))\right], \tag{4.10}$$

where $D(y', B') = 1$ denotes default. The bond price compensates the lenders for their losses during sovereign defaults. The bond price captures the entire future path of probability of default through its dependence on $Q(y', B'')$. The government spread on its bond is defined as $spread(y, B') = \phi/Q(y, B') - (\phi + r)$, where r is the risk-free interest rate.

4.2 Government Financing with a BBR

We are ready to analyze government financing with a balanced budget rule (BBR). As illustrated in the empirical section, BBRs vary in stringency and forms across governments. We model a BBR as a requirement that when the government makes a borrowing decision B', it must consider the expected interest payment on its borrowing: the expected interest payment and government spending must be sufficiently covered by government tax revenues. Formally, given the aggregate state variables $S = (y, B)$, a BBR requires that:

$$\tau y \geq T + \phi B' - Q\left(y, B'\right)\left(B' - (1-\phi)B\right), \tag{4.11}$$

where $\phi B'$ is what the government is expected to repay and $Q(y, B')\big(B' - (1-\phi)B\big)$ are the proceeds from borrowing. Repayment in excess of borrowing (the gap between the two terms) is the interest payment. A BBR imposes an additional constraint on government borrowing, as (4.11) is equivalent to:

$$B' \leq \frac{1}{\phi}\left[\tau y - T + Q(y,B')\big(B' - (1-\phi)B\big)\right]. \tag{4.12}$$

Under a BBR, the government still maximizes household welfare by choosing whether to default or not. If the government does not default, it can choose a new level of debt, B', by solving a similar dynamic programming problem but with the BBR as another constraint. Here, unlike (4.4), we combine the household budget constraint and the government constraint into a unified resource constraint. The repayment value for the government is given by:

$$V^c(y,B) = \max_{\{c,B'\}} \quad u(c) + \beta\mathbb{E}\left[V(y',B')\right], \tag{4.13}$$

subject to the resource constraint and the BBR:

$$c + \phi B = y + Q(y,B')\big(B' - (1-\phi)B\big) \tag{4.14}$$

$$c \geq 0 \tag{4.15}$$

$$\tau y \geq T + \phi B' - Q\left(y,B'\right)\left(B' - (1-\phi)B\right) \tag{4.16}$$

If the government defaults, the maximization problem is the same as before because the budget constraint under default already trivially satisfies the BBR.

Recursive equilibrium. The recursive equilibrium under a BBR consists of policy functions for consumption $c(y,B)$, transfers $T(y,B)$, borrowing $B'(y,B))$, default set $D(y,B)$; the government value functions $V(y,B)$, $V^c(y,B)$, and $V^d(y)$; and government bond price $Q(y,B')$ such that:

1. Taking the government policies as given, household consumption $c(y,B)$ satisfies the household budget constraints (4.5) and (4.6).

2. Taking the bond price schedule $Q(y,B')$ as given, the government's choices for borrowing $B'(y,B)$ and its default set $D(y,B)$, along with its value functions $V(y,B)$,

$V^c(y, B)$, and $V^d(y)$, solve the government problem (4.3), where the repayment value $V^c(y, B)$ is given by (4.13) and the default value $V^d(y)$ is given by (4.8).

3. The government bond price schedule (4.10) reflects the probability of government default and satisfies the lenders' break-even condition.

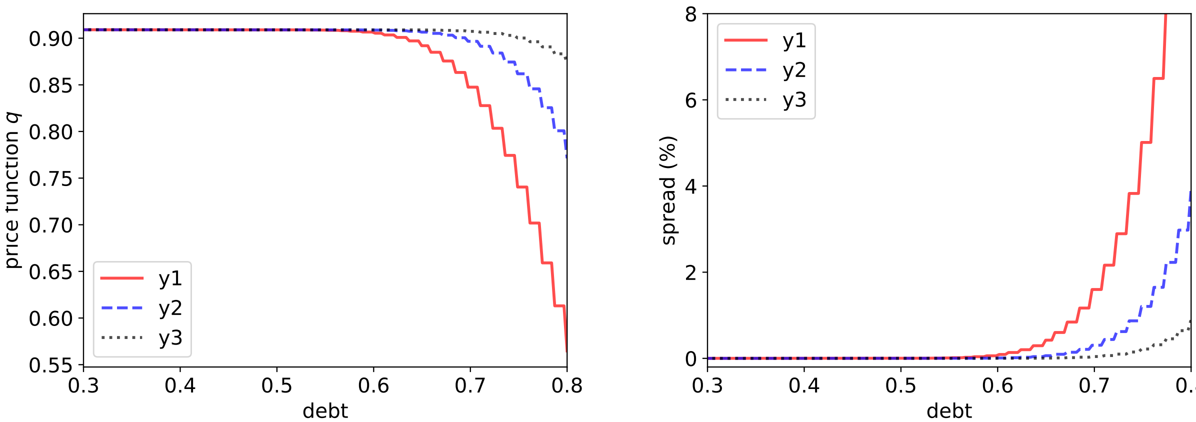
4.3 Bond Price and Impact of a Balanced Budget Rule

In this section, we show the bond price schedules and the impact of a BBR on government borrowing and spreads. We first show the bond price schedules without a BBR and then compare them with the case with a BBR. The figures are plotted with the parameters listed in Section 5.

Figure 2 plots the the government bond price functions and the corresponding bond spreads as a function of debt, at different levels of income. A lower bond price q indicates that the government obtains less funding for the same repayment, thus a more expensive financing and higher bond spread. With more debt, bond prices decrease, and spreads increase because of higher default risk. With lower income (y1<y2<y3 in the figure), the bond price is lower and spread is higher. Those observations are standard predictions in sovereign default models. This is also the theoretical background for including debt and GDP as key control variables in the empirical regression.

To show the impact of a BBR, we compare the government policy function for the next period debt and the bond spreads with and without a BBR in Figure 3. In panels (a), (b), and (c), the solid blue lines plot the case without a BBR and the dashed black lines plot the case with a BBR. Panel (a) plots the government policy function for next period's debt. With a BBR, the next period debt is lower than in the case without a BBR, a result substantiated by many empirical studies. Panel (b) plots the price function and panel (c) plots the bond spreads as a function of the current debt level. With more debt, bond price decreases and spread increases. With a BBR, the bond price is higher, and the bond spread is lower. This is because when the government has a BBR, the new debt it can issue for the next period is constrained by BBR, thus reducing future default risk.

Panel (d) plots the gap between the spread without a BBR and the spread with a



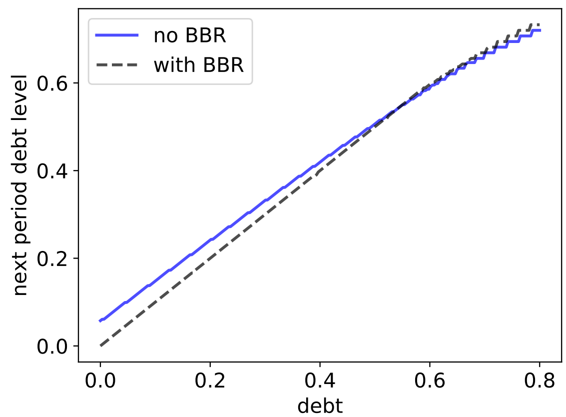
(a) Price function

(b) Spreads

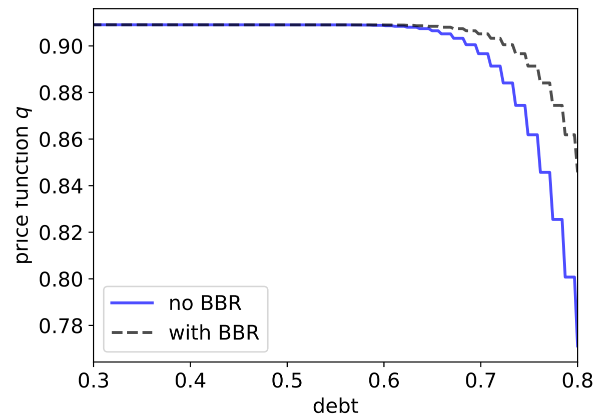
Figure 2: Bond Prices and Spreads

Notes: This figure plots bond prices and spreads as functions of total debt under different income levels y1<y2<y3. The x-axis is the debt level. The y-axis is bond price in Panel (a) and bond spread (%) in Panel (b). The figures are plotted using the parameters listed in Section 5.

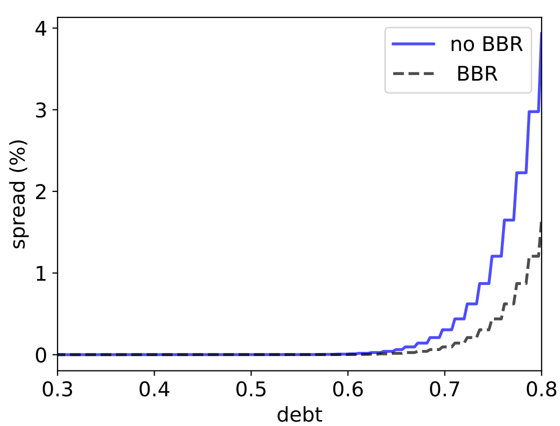
BBR, reflecting the reduction of spread that a BBR brings. The horizontal axis is the debt level. Given the income level, with a greater amount of debt, the spread gap is larger, indicating that implementing BBR has a greater impact on reducing debt spreads when the government is more indebted. The red line and the black line plot the spread gap at a lower income level and a higher income level, respectively. Given the level of debt, the impact of a BBR is greater for a lower level of income. Combining these two observations, our model suggests that a BBR is more effective in reducing spreads when the economy has a higher debt-to-GDP ratio.



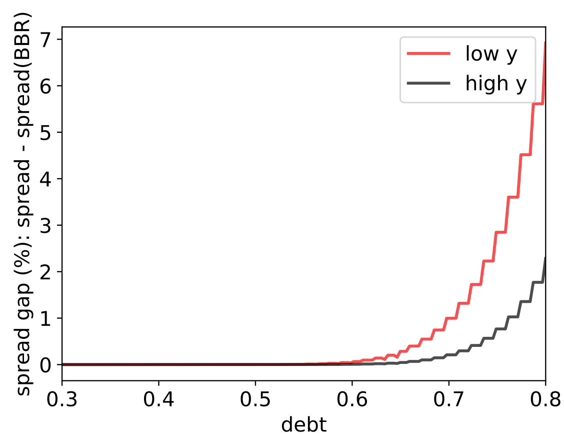
(a) Next period debt



(b) Price function



(c) Spreads



(d) Impact of a BBR

Figure 3: Bond Spreads and Policy Function: Impact of a BBR

Notes: This figure plots the impact of a BBR. Panel (a) plots the next period debt a function of debt for the case without a BBR and the case with a BBR. Panel (b) and (c) plot bond prices and bond spreads as a function of debt without and with a BBR. The solid blue lines plot the case without a BBR and the dashed black lines plot the case with a BBR. Panel (d) plots the gap between the spread without a BBR and the spread with a BBR as a function of debt at different income levels. The red line plots the spread gap at a low income level and the black line plots the spread gap at a high income level. The figures are plotted using the parameters listed in Section 5.

5 A Case Study

We parameterize the model without a BBR using data from the state of Illinois. We chose Illinois as a state that consistently experiences financial difficulties that have only worsened following the pandemic. Based on the state's 2020 audited financial reports, Illinois had a "taxpayer burden" of $57,000, earning it an "F" grade from Truth in Accounting.[8] The CDS spread for Illinois is also higher than for other states. Between 2009 and 2020, Illinois had an average CDS spread of 237 bps, while the average for all other states was 67 bps. In 2020, Illinois averaged 327 bps, much higher than many other states. A high spread means that when issuing bonds the government needs to offer a higher interest rate, increasing debt service costs, and making it harder for the government to roll over debt. If imposing a BBR can lower bond spreads for newly issued bonds, it could help Illinois' finances and ultimately its taxpayers.

The model is calibrated at an annual frequency. Income y follows a stochastic first-order autoregressive process: $\log(y_t) = \rho \log(y_{t-1}) + \varepsilon_t$, where ε_t follows a normal distribution with mean zero and a standard deviation of σ_y. If the government defaults, the economy suffers an income loss. Following Arellano (2008), we specify income in default is $y_d = h(y) = \min\{y, \gamma \mathbb{E} y\}$, where γ is a parameter.

We parameterize the model to match key properties of the Illinois data from 2009 to 2020. There are two groups of parameters. The first group of parameters is assigned following the standard literature or estimated outside the model, and those in the second group are jointly chosen to match relevant empirical moments. The first group includes $\{r, \sigma, \phi, \lambda, \tau, \rho, \sigma_y\}$. The annual risk-free rate r is 2%. The risk aversion parameter σ is set to 2, a commonly used value in the literature. The fraction of long-term debt that needs to be repaid each period ϕ is set to 0.2. Following Gelos et al. (2011), the return parameter λ is 0.25, so that a defaulting government is excluded from financial markets for four years on average.[9] Tax revenue is about 5.2% of total state GDP for Illinois in the data, which gives τ. The parameters for the income process $\{\rho, \sigma_y\}$ are estimated using output data for Illinois.

The second group is $\{\beta, \gamma\}$. We choose these parameters to jointly target Illinois' average spread (2.37%) and its average debt-to-GDP ratio (0.084). We solve the model

[8] https://www.data-z.org/state_data_and_comparisons/detail/illinois

[9] State government default triggers financial exclusions. For example, after Arkansas defaulted in 1933, large financial centers remained closed to Arkansas for some time. In New York and Pennsylvania, the banks and trusts could not invest in Arkansas bonds until 1944 and not until 1954 for investors in Massachusetts and Connecticut. However, because there is not enough data on the length of exclusion, we adopt a standard value in the literature.

using global methods. Given the model policy functions, we perform simulations to obtain the model-implied counterparts of our targets. We jointly choose the parameters to match the sample moments by minimizing the sum of the distance between the moments in the model and their corresponding counterparts in the data. Table 7 reports all parameter values.

To explore the quantitative role of imposing a BBR on government spreads and debt, we simulate the model without a BBR over a long period, then suddenly we introduce a BBR for the government, which we refer to as period 0. For simulations, we simulate 30,000 paths for 500 periods, then drop the first 100 periods to eliminate the influence of the arbitrary (but reasonable) choice of initial guesses. Next, we average all relevant variables across the paths.

Table 8 lists the predicted government spreads, debt, and interest burden after imposing a BBR in year 0. After 10 years, the government spread drops from roughly 2.4% to 1.2%. After imposing a BBR, government debt falls, and the debt-to-GDP ratio drops from about 9.1% to 6.1%. Debt as a fraction of tax revenue declines from 175% to 117%, and interest costs decline from 6.96% of tax revenue to 4.23% of tax revenue. Imposing a balanced budget rule that tax revenues must be sufficient to cover spending and expected interest payments for the government of Illinois could reduce its bond spread by 50% and reduce its indebtedness by 33% in ten years.

Table 7: Parameters

Parameter	Description	Value	Target/Source
r	Risk-free rate	2%	Conventional value
σ	Risk aversion	2	Conventional value
ϕ	Fraction of bonds maturing	0.2	Average bond maturity
λ	Return parameter	0.25	Conventional value
τ	Tax rate	5.2%	Illinois data
ρ	Persistence of income process	0.98	Illinois data
σ_y	Volatility of income process	0.02	Illinois data
β	Discount factor	0.964	Debt-to-GDP ratio
γ	Loss function parameter	0.98	Mean of spread

Table 8: Predicted Government Spreads and Indebtedness After Imposing a BBR

Year	Government Spread(%)	Debt/GDP(%)	Debt/Tax revenue(%)	Interest payment/GDP (%)	Interest payment/Tax revenue (%)
0	2.389	9.09	174.808	0.362	6.962
1	2.247	8.74	168.077	0.356	6.846
2	2.064	8.368	160.923	0.341	6.558
3	1.915	8.02	154.231	0.319	6.135
4	1.807	7.684	147.769	0.301	5.788
5	1.67	7.362	141.577	0.282	5.423
6	1.494	7.059	135.750	0.264	5.077
7	1.449	6.791	130.596	0.254	4.885
8	1.347	6.538	125.731	0.241	4.635
9	1.286	6.303	121.212	0.227	4.365
10	1.205	6.075	116.827	0.220	4.231

Notes: This table reports predicted government spreads and variables related to indebtedness after imposing a BBR in year 0.

6 Concluding Remarks

In this paper, we study how public financing costs are affected by BBRs, an often neglected factor in understanding the variation in government bond spreads across governments and over time. Using data on US state government bond spreads and a new dataset on state government BBRs, we document that government spreads are negatively associated with the presence of and the tightness of BBRs. We apply a canonical sovereign default model with a BBR and qualitatively replicate these results, adding theoretical support to our empirical finding. Intuitively, governments tend to reduce debt under a BBR, a result corroborated by previous empirical studies, making newly-issued debt less risky for the investors. We also find that the difference between government spreads with and without a BBR is larger with more debt, implying that heavily-indebted issuers tend to benefit more from the lower financing costs following the introduction of a BBR. Calibrated to Illinois, our model shows that imposing a BBR for would reduce Illinois' borrowing costs by as much as 50% and its indebtedness by 33% in ten years.

Although we focus on US states in our analysis, our result applies to BBRs in national governments. In light of the heavy debt burdens facing many sovereigns in the past decade, a natural policy implication of our result is that imposing a BBR might be attractive to the extent that it can not only directly alleviate a government's fiscal burdens, but also can indirectly improve it's fiscal conditions via its impact on the cost of accessing the government bond market. In fact, cheaper government borrowing may have more implications than is discussed above.

First, lower government spreads might be associated with a stronger local labor market by reducing labor outflows. Alessandria et al. (2020) show that high sovereign spreads are associated with labor outflows using cross-country data. Deng (2019) finds a similar pattern using US state-level data. The net migration rate for the state of Illinois, a state with no BBR and high government spreads, has been negative and in the bottom quintile across US states for years (-1.23% in 2017, according to IRS migration dataset). Lower government spreads and better fiscal conditions could attract more workers and firms to Illinois and increase economic activity.

Second, cheaper debt financing would strengthen the government's ability to borrow in the government debt market, which has implications for public goods provision and migration. Yi (2021) shows that following a shock to credit access, municipalities tend to cut infrastructure investment and public service quality deteriorates, manifesting in increased water contamination and prolonged power outages. As a result, high-income residents leave while low-income households with limited mobility suffer from the long-term consequences of public spending shocks.

Third, having access to cheaper debt may help stabilize local economic fluctuations. The low interest rates associated with a BBR are especially valuable for a government during economic downturns, when it most needs to borrow in order to stimulate the local economy. Therefore, our study provides a new perspective on understanding the links between fiscal rules and local business cycles, a classical yet unsettled issue (Alesina and Bayoumi, 1996; Krol and Svorny, 2007; Levinson, 1998).

In this paper, we focus on the impact of BBR on the government bond price, which was often taken as exogenous in previous literature. We propose that BBR can reduce the cost of government financing by reducing the risk of government default, which is a new angle on how BBR can benefit the economy. There could be other benefits and costs to imposing a BBR. For example, Azzimonti et al. (2016) finds that although a BBR reduces debt, it could also lead to a less responsive public good provision and greater volatility in tax rates in the short run. Relatedly, Carlino and Inman (2013) suggests that states can increase their own state employment by increasing their deficits. Therefore, although imposing a BBR reduces bond spreads, it may not be a good idea to impose it during economic downturns, as it could destabilize the economy. However, in the long run, as shown by Azzimonti et al. (2016), a BBR benefits the economy because a lower debt burden permits higher average levels of public goods and lower taxes.

To spotlight our main mechanism, we have deliberately abstracted from some assumptions that could potentially lead to a different quantitative result, such as an endogenous change in BBR, lack of commitment on the existing fiscal rule, economic spillovers across different states, etc. We leave those extensions for future research.

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Online Appendix

A Data Details

Data Cleaning. We start data cleaning by omitting observations with any missing values for either 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 $\tau_{s,t}$ as defined in the main text.

B More Empirical Results

Table B.1 reports the first-stage estimation results of the IV regressions reported in Table 4. Table B.2 provides the first robustness check for our baseline regression results using Urban Institute's definition[10] of the highest level of stringency of state-level BBRs: the governor must ultimately sign a balanced budget, and no deficit carryover is permitted. Table B.3 presents the second robustness test by controlling for state-level political party control. Table B.4 presents the third robustness test by controlling for the aged dependency ratio.

Table B.1: 2SLS First-Stage Results

	Panel A: *No Deficit Carryover*		**Panel B**: *ACIR Index*	
	(1)	(2)	(3)	(4)
State Budget Surplus	-0.113*	-0.117*	-0.561	-0.664
	(0.060)	(0.064)	(0.460)	(0.420)
Weak IV Test F-Stat	69.4 [0.00]	21.3 [0.00]	36.9 [0.00]	17.3 [0.00]
Endogeneity Test F-Stat	6.10 [0.01]	5.67 [0.02]	6.72 [0.01]	6.19 [0.01]
Weak IV Test Cluster Robust F-Stat	3.60 [0.06]	3.13 [0.08]	1.49 [0.23]	2.35 [0.13]
Endogeneity Test Cluster Robust F-Stat	3.69 [0.06]	3.53 [0.07]	4.05 [0.05]	3.69 [0.06]
Fiscal Controls	No	No	No	No
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

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

[10]https://www.urban.org/research/publication/balanced-budget-requirements

Table B.2: State Bond Spread and BBR (alternative measure by the Urban Institute)

	(1)	(2)	(3)	(4)
BBR	-0.045	-0.056	-0.135	-0.148*
	(0.061)	(0.060)	(0.088)	(0.083)
Debt/GDP	1.774**	1.802**	3.862**	3.505**
	(0.836)	(0.796)	(1.609)	(1.444)
ΔGDP	-1.472	-1.619	-0.176	-1.150
	(1.712)	(1.744)	(1.641)	(1.757)
Maturity	0.075***	0.074***	0.068***	0.067***
	(0.008)	(0.008)	(0.007)	(0.007)
Coupon	0.074***	0.079***	0.092***	0.095***
	(0.027)	(0.028)	(0.027)	(0.028)
Fiscal Controls	No	Yes	No	Yes
State Fixed Effect	No	No	Yes	Yes
Time Fixed Effect	Yes	Yes	Yes	Yes
Constant	0.188	0.012	-0.036	0.132
	(0.160)	(0.220)	(0.213)	(0.494)
N	969	969	969	969
adj. R^2	0.385	0.391	0.434	0.437

Notes: This table reports the baseline parameter estimates and their standard errors clustered by state, shown in the parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. BBR tightness is defined based on the five categories used by the Urban Institute, and is equal to 1 if in a given state, "the governor must ultimately sign, and no deficit carryover permitted". Other variables are defined the same as those in the baseline regression.

Table B.3: Controlling for State Political Factors

	Panel A: *No Deficit Carryover*		**Panel B**: *ACIR Index*	
	(1)	(2)	(3)	(4)
BBR	-0.174**	-0.167**	-0.024	-0.022*
	(0.079)	(0.072)	(0.014)	(0.013)
Debt/GDP	3.700**	3.357**	3.678**	3.331**
	(1.512)	(1.415)	(1.569)	(1.470)
ΔGDP	-0.071	-0.925	-0.067	-0.926
	(1.567)	(1.726)	(1.595)	(1.763)
Maturity	0.067***	0.067***	0.068***	0.067***
	(0.007)	(0.007)	(0.007)	(0.007)
Coupon	0.089***	0.091***	0.088***	0.090***
	(0.028)	(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)
Fiscal Controls	No	Yes	No	Yes
State Fixed Effect	Yes	Yes	Yes	Yes
Time Fixed Effect	Yes	Yes	Yes	Yes
Constant	0.025	0.145	0.093	0.205
	(0.214)	(0.496)	(0.210)	(0.483)
N	977	977	977	977
adj. R^2	0.436	0.438	0.434	0.436

Notes: This table reports the OLS regression results with the political party control in the state legislative chambers as an additional set of control variables. Both fixed effects are considered. Clustered-by-state standard errors are in parentheses: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. In particular, political party control is a set of indicator variables {Democratic, Split, Republican} and refers to which political party holds the majority of seats in the state Senate and the state House. "Democratic" indicates that both legislative chambers have Democratic majorities, "Split" indicates that neither party has majorities in both legislative chambers, and "Republican" indicates both legislative chambers have Republican majorities. Data source: National Conference of State Legislatures.

Table B.4: Controlling for the Dependency Ratio

	Panel A: *No Deficit Carryover*		**Panel B**: *ACIR Index*	
	(1)	(2)	(3)	(4)
BBR	-0.175**	-0.167**	-0.024*	-0.022*
	(0.076)	(0.071)	(0.014)	(0.013)
Debt/GDP	3.190**	2.889**	3.170**	2.864*
	(1.505)	(1.382)	(1.568)	(1.446)
ΔGDP	-0.082	-0.809	-0.075	-0.807
	(1.623)	(1.753)	(1.652)	(1.791)
Maturity	0.067***	0.067***	0.067***	0.067***
	(0.007)	(0.007)	(0.007)	(0.007)
Coupon	0.089***	0.091***	0.088***	0.091***
	(0.028)	(0.028)	(0.027)	(0.028)
Dependency Ratio	-2.389	-2.149	-2.361	-2.123
	(2.195)	(2.059)	(2.222)	(2.083)
Fiscal Controls	No	Yes	No	Yes
State Fixed Effect	Yes	Yes	Yes	Yes
Time Fixed Effect	Yes	Yes	Yes	Yes
Constant	0.595	0.591	0.655	0.644
	(0.521)	(0.622)	(0.509)	(0.608)
N	977	977	977	977
adj. R^2	0.436	0.438	0.435	0.436

Notes: This table reports the OLS regression results with the aged dependency ratio, measured as the ratio of retirement age population (65+) to working age population (18-64), as an additional control variable. Both fixed effects are considered. Clustered-by-state standard errors are in parentheses: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table B.5 repeats the exercise of Table 6 but without implementing robust standard errors. Table B.6 presents a sub-sample analysis of Table 6 to address two concerns: (1) our imputation for 2009, and (2) the possibility of 2020 as a special year (because of COVID-19). However, it is worth noting that the sample sizes in these regressions are very small, which may lead to a small-sample bias.

Table B.5: CDS and BBRs (non-robust standard error)

	Panel A: *No Deficit Carryover*		**Panel B**: *ACIR Index*	
	(1)	(2)	(3)	(4)
BBR	-0.435**	-0.434**	-0.072**	-0.072**
	(0.193)	(0.170)	(0.032)	(0.029)
Debt/GDP	-0.920	1.701	-0.923	1.696
	(2.410)	(2.369)	(2.417)	(2.382)
ΔGDP	-10.470***	-4.746	-10.515***	-4.786
	(3.826)	(3.653)	(3.839)	(3.671)
Revenue/GDP		-19.667***		-19.650***
		(5.954)		(5.969)
Expenditure/GDP		10.784		10.834
		(6.969)		(6.989)
Constant	1.355***	2.234***	1.644***	2.510***
	(0.310)	(0.454)	(0.419)	(0.509)
N	48	48	48	48
adj. R^2	0.142	0.344	0.140	0.341

Notes: This table reports the baseline parameter estimates and their (non-robust) standard errors shown in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Effective sample period: 2009, 2014 and 2020.

Table B.6: CDS and BBRs: Sub-Samples

	2014				2014 & 2020			
BBR	-0.315*	-0.400**	-0.053*	-0.066**	-0.398*	-0.344*	-0.066*	-0.056*
	(0.166)	(0.170)	(0.028)	(0.029)	(0.199)	(0.195)	(0.034)	(0.033)
Debt/GDP	0.218	0.468	0.201	0.447	-0.286	2.548	-0.293	2.560
	(2.187)	(2.618)	(2.203)	(2.680)	(2.620)	(2.884)	(2.632)	(2.911)
ΔGDP	-1.535	-1.923	-1.680	-2.081	-1.445	-1.428	-1.519	-1.449
	(4.482)	(4.249)	(4.507)	(4.321)	(6.312)	(6.054)	(6.333)	(6.084)
Revenue/GDP		-12.043		-11.732		-11.040		-10.983
		(8.246)		(8.334)		(7.749)		(7.768)
Expenditure/GDP		6.449		6.380		1.263		1.269
		(9.334)		(9.483)		(8.251)		(8.280)
Constant	0.727**	1.638***	0.941**	1.863***	0.926**	2.004***	1.192**	2.216***
	(0.305)	(0.544)	(0.396)	(0.608)	(0.389)	(0.613)	(0.495)	(0.663)
N	19	19	19	19	38	38	38	38
adj. R^2	0.112	0.223	0.107	0.204	0.055	0.137	0.053	0.132

Notes: This table reports the baseline parameter estimates and their standard errors shown in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Effective sample period: 2014 only for the first panel; 2014 and 2020 for the second panel.