A Switch in State Bankruptcy Rules*

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Abstract

U.S. states are sovereign entities and can't declare bankruptcy as cities and municipalities. This paper examines the impact of a switch in sovereign bankruptcy rules that allows declaring bankruptcy from an economics model perspective. Allowing bankruptcy increases ex-ante risks for the government to refuse repayment, but provides ex-post benefits of reducing default costs and saving federal bailouts. This paper provides a simple framework to analyze this trade-off. Whether allowing for bankruptcy increases or decreases borrowing costs depends on the level of income and borrowing for the government.

Keywords: Sovereign bankruptcy, bankruptcy rules, bailouts, state government

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1 Introduction

The COVID-19 pandemic and the economic policies taken in response have caused large fiscal pressure on the states. Many states have been seeking help from the federal government. Instead of providing more federal aid, U.S. Senator Mitch McConnell suggested letting states file for bankruptcy. “I would certainly be in favor of allowing states to use the bankruptcy route,” said McConnell. “There’s not going to be any desire on the Republican side to bail out state pensions by borrowing money from future generations.” The comment by Mitch McConnell has rekindled the debate on whether states should be allowed to file for bankruptcy. This paper develops a simple model framework to analyze the potential economic consequences of allowing states to declare bankruptcy.

Under current rules, cities and municipalities have the legal authority to file for bankruptcy under Chapter 9 of the bankruptcy code, which allows them to seek protection from their creditors and develop plans to reorganize their debts. This option is not available to states. Several cities and municipalities in the United States have filed for bankruptcy in recent years. For example, Jefferson County in Alabama, filed for its bankruptcy in November 2011; Stockton and San Bernardino in California filed for bankruptcy of $1 billion and $492 million debt, respectively. The city of Detroit in Michigan, filed for bankruptcy in 2013. It is by far the largest municipal bankruptcy filing in U.S. history by debt, estimated at $18 billion.

States, on the other hand, are not allowed to declare bankruptcy. It is because they are considered sovereign entities under the U.S. Constitution and have quasi-sovereign immunity, which protects them from being sued without their consent. This immunity extends to bankruptcy proceedings, which are a form of legal action in which creditors can seek to recover debts from a debtor. Because states are immune from such legal action, they are not able to file for bankruptcy.

While states are not able to file for bankruptcy, they are still able to default on their debts, which has occurred in the past. In 1933, the state of Arkansas experienced a default on its bonds, totaling approximately $146 million, due to the economic challenges posed by the Great Depression. This default had significant consequences for Arkansas and its ability to borrow in the future. After the 1933 Arkansas default, Arkansas experienced severe austerity measures and was unable to invest in the desired infrastructure. Arkansas default also triggers financial exclusions: financial centers remained closed to Arkansas for many years.[1]

Default and bankruptcy are different concepts. Default occurs when a debtor fails to make timely payments on debts, while bankruptcy is a legal process in which creditors work with legal authorities to manage the finances of an insolvent entity and collect the debts owed to them. Default can have negative consequences for the borrower, such as damaging their credit rating and making it more expensive for them to borrow in the future. Bankruptcy can also have negative consequences, such as the sale of the entity's assets to pay off its debts and the development of a plan to restructure its debts. However, bankruptcy can also provide a way for an entity to address financial challenges and improve its fiscal stability.

Despite states are not allowed to file for bankruptcy, discussions about the potential benefits and drawbacks of allowing states to file for bankruptcy have emerged, primarily from legal perspectives (Skeel Jr (2012), Conti-Brown and Skeel (2012)). However, these discussions have not been grounded in a formal economics framework. In this

[1] In New York and Pennsylvania, the banks and trusts did not invest in Arkansas bonds until 1944 and not until 1954 for investors in Massachusetts and Connecticut.

paper, we seek to address this gap by examining the potential impacts of allowing states to file for bankruptcy through the use of a formal economics model that enables quantitative analysis. Our goal is to examine the economic benefits and costs of allowing state bankruptcy and to contribute to the ongoing debate surrounding state bankruptcy.

To this end, we develop a simple model that aims to clearly illustrate the benefits and costs of allowing state bankruptcy. In the model, we compare the current case where bankruptcy is not allowed to a scenario where bankruptcy is permitted. Before allowing bankruptcy, states must choose between repaying their debt or defaulting on it. If a state government defaults on its debt, the federal government has the authority to decide whether to provide a bailout. After state bankruptcy is permitted, states have the option of declaring bankruptcy, so they choose between repayment and declaring bankruptcy.

Whether to allow state government bankruptcy is to trade-off between ex-ante incentives for repayment and ex-post costs of default. Permitting states to declare bankruptcy offers them a less severe alternative to outright default, which may decrease their incentives to repay their debt and raise the cost of future borrowing. Conversely, the denial of bankruptcy may enhance incentives for states to repay their debt ex-ante, but may also result in significant default costs in the event of default.

To demonstrate this trade-off, we first present a simplified two-period model with closed-form solutions that allow us to illustrate the trade-off analytically. We then assign parameter values to an infinite-horizon model to further explore the trade-off and to examine the impact of allowing state bankruptcy on government borrowing cost. We find that whether allowing bankruptcy increases or decreases government borrowing cost depends on the income and borrowing level of the government.

Specifically, we find that an unexpected switch in bankruptcy rules that allows for bankruptcy can reduce government bond spreads if the government has a high level of debt-to-income ratio.

Our research is closely related to prior proposals and studies on sovereign bankruptcy rules at the country level. In the aftermath of the 1994-95 Mexican crisis, several proposals were made to create a bankruptcy procedure at the country level (Sachs (1995); Eichengreen et al. (1995); Chun (1995)).[2] In 2001, the IMF First Deputy Managing Director Anne Krueger proposed a formal sovereign debt restructuring mechanism (SDRM) which was modeled on the segment of U.S. Bankruptcy Code Chapter 11. The SDRM was intensely debated but ultimately unsuccessful. One main objection during the debates is about sovereign's incentives ex ante: SDRM could make lenders reluctant to give loans for fear that the sovereign would abuse the mechanism. Also, collective settlement process for bondholders, a feature of sovereign bankruptcy, may increase free riding on negotiation costs in high-cost complicated restructurings and so lead to increase in delay (Pitchford and Wright (2012)). However, Chatterjee (2016) mentions that SDRM could facilitate timely restructurings when foreign obligations become excessive, reduce the likelihood of excessive borrowing, and eliminate bailouts. Bolton and Jeanne (2007) points out that a bankruptcy regime for sovereigns could mitigate inefficiency by facilitating debt restructuring in a sovereign debt crisis. Like previous studies on sovereign bankruptcy, this paper also focuses on the topic of sovereign bankruptcy and aims to contribute to the ongoing debate surrounding the issue. However, our approach differs in that we use a simple model to illustrate the trade-offs involved in the decision to allow state bankruptcy and to examine the potential consequences of such a policy change in a quantitative framework.

[2] Rogoff and Zettelmeyer (2002) summarizes the evolution of ideas to apply bankruptcy procedures for sovereigns from 1976 to 2001.

The remainder of the paper proceeds as follows. Section 2 presents a simple sovereign default model with the possibility of the federal government bailout. Section 3 describes a switch in state bankruptcy rules that allows states to declare bankruptcy. Using a simplified two-period model, Section 4 explains the ex-ante risks and ex-post benefits of a switch in state bankruptcy rules analytically. Section 5 assigns parameters to the model and plots the policy functions to visualize the ex-ante risks and ex-post benefits for a switch in bankruptcy rule. Section 6 analyzes the role of the federal government bailout probability. Section 7 concludes.

2 The Model

In this section, we present a simple sovereign default model with the possibility of the federal government bailout. Consider a state that receives a stochastic income stream y_t every period t. The state government borrows by issuing one-period bonds b_t that are not enforceable, and the government can choose to default on its bonds. Let q_t be the price of a bond that promises to pay one unit of the consumption good next period. Lenders recognize that governments may not repay and set the bond price q_t to break even in expectation. If the government defaults, it is temporarily excluded from the financial market. With probability λ, the government returns to the financial market. Outright defaults also incur direct output costs that reduce income: $y^d = h(y) \leq y$. There is a probability p of receiving bailouts from the federal government, in which case the federal government pays the lenders and the state government does not suffer financial exclusion and output loss.[3]

[3]For example, in 2008, the federal government provided financial assistance to several states, including California and Illinois, to help them address budget shortfalls during the Great Recession. In these cases, the states did not suffer financial exclusion or output loss as a result of the bailouts, as the federal government provided the necessary funding to help them address their financial challenges.

We omit the time subscript t to simplify the notation and use x' to denote variable x in the next period. The timing of the model is as follows. At the beginning of each period, income y is observed. The government decides whether to repay its debt or default. If the government repays its debt, it can issue new bonds b'. If the government defaults, with probability p, the federal government provides bailouts and the debt b is written off; with probability $1 - p$, the federal government does not provide bailouts and the state government enters into financial autarky.[4] With probability λ, the government returns to the financial market.

The state government decides whether to default on its debt or to repay it. If it defaults, it may incur financial exclusion and output costs, but it may also have the possibility of receiving a bailout from the federal government. Formally, a government with access to financial markets chooses whether to default on its debt to maximize consumption:

$$V(y,b) = \max\{V^c(y,b),\ pV^d_{bailout}(y,b) + (1-p)V^d(y)\}, \tag{1}$$

where V^c denotes the repayment value. p is the probability of receiving federal government bailouts after default. $V^d_{bailout}(y,b)$ denotes the default value when the federal government provides bailouts, and $V^d(y)$ denotes the default value without bailouts. Thus, $pV^d_{bailout}(y,b) + (1-p)V^d(y)$ is the expected defaulting value. If $V^c(y,b) < pV^d_{bailout}(y,b) + (1-p)V^d(y)$, the government chooses to default. Let $D(y,b) = 1$ denote default.

[4] We focus on the state government's decisions and treat the federal government decisions as exogenous. For analyses on conditions under which bailouts occur and their welfare implications, see Cooper et al. (2008).

If the government chooses to repay, it can issue new bonds b' to maximize utility:

$$V^c(y, b) = \max_{\{c, b'\}} \quad u(c) + \beta \mathbb{E}\left[V(y', b')\right], \tag{2}$$

subject to the budget constraint:

$$c + b = y + q(y, b')b', \tag{3}$$

where c is consumption, b is debt repayment, $q(y, b')$ is the bond price which depends on income and new bonds issued. $q(y, b')b'$ are thus the proceeds from issuing new bonds.

If the federal government provides bailouts, the default value for the state government is given by:

$$V^d_{bailout}(y, b) = \max_{\{c, b'\}} \quad u(c) + \beta \mathbb{E}\left[V(y', b')\right], \tag{4}$$

subject to the budget constraint:

$$c = y + q(y, b')b'.$$

If the federal government does not provide bailouts, the default value for the state government is given by:

$$V^d(y) = \max_{\{c\}} \quad u(c) + \beta \mathbb{E}\left[\lambda V(y', 0) + (1 - \lambda)V^d(y')\right], \tag{5}$$

subject to the budget constraint $c = y^d$. In this equation, $V^d(y)$ is the default value for the state government, and λ is the probability of returning to the financial market after default. The state government's budget constraint is represented by the equation $c = y^d$, which shows that consumption must equal the output loss resulting from default y^d.

In this model, the lenders are competitive and risk neutral. They face a fixed world interest rate of r and are willing to lend to the government as long as their expected value breaks even. The break-even condition implies that the bond price schedule $q(y, b')$ satisfies:

$$q(y, b') = \frac{1}{1+r} \mathbb{E} \left[1 - D(y', b') + pD(y', b') \right], \tag{6}$$

where p is the probability that the federal government providing a bailout. The bond price compensates the lenders for their losses when the state government defaults (and the federal government does not bailout). The government spread on its bond is defined as $sp(y, b') = 1/q(y, b') - (1 + r)$, where r is the risk-free interest rate.

Recursive equilibrium. The recursive equilibrium consists of policy functions for consumption $c(y, b)$, borrowing $b'(y, b))$, default set $D(y, b)$; the government value functions $V(y, b)$, $V^c(y, b)$, $V^d_{bailout}(y, b)$ and $V^d(y)$; and government bond price $q(y, b')$ such that:

1. 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 $V(y, b)$, $V^c(y, b)$, $V^d_{bailout}(y, b)$ and $V^d(y)$, solve the government's problem (1), where the repayment value $V^c(y, b)$ is given by (2), the default value when the federal government provides bailouts $V^d_{bailout}(y, b)$ is given by (4), and the default value without bailouts $V^d(y)$ is given by (5).

2. The government bond price schedule (6) reflects the government's default probability and federal government bailout probability, and satisfies the lenders' break-even condition.

The probability of the federal government providing bailouts is exogenous to the state governments. Let us consider two extreme cases. The first case is when the federal government always provides bailouts, which means $p = 1$. In this case, the state government has the expectation of receiving a bailout and bears little consequence for defaulting. This leads to a decrease in the incentives for the state government to repay its debt, as defaulting would not result in significant costs.

The second case is when the federal government never provides bailouts, which means $p = 0$. In this case, the state government has no expectation of receiving bailouts and must bear the full consequences of defaulting. This creates a strong incentive for the state government to repay its debt, as defaulting would result in financial exclusion and output loss.

Case I ($p = 1$). In this case, the federal government provides bailouts with certainty. The state government's decision to default or repay its debt depends on whether the default value or the repayment value is greater. Its maximization problem is

$$V(y, b) = \max\{V^c(y, b), V^d_{bailout}(y, b)\},$$

where the repayment value is

$$V^c(y, b) = \max_{\{c, b'\}}\{u(c) + \beta\mathbb{E}\left[V(y', b')\right]\}, \text{subject to } c + b = y + q(y, b')b',$$

and the default value is

$$V^d_{bailout}(y,b) = \max_{\{c,b'\}}\{u(c) + \beta\mathbb{E}\left[V(y',b')\right]\}, \text{subject to } c = y + q(y,b')b'.$$

The state government will default with certainty because $V^d_{bailout}(y,b) \geq V^c(y,b)$. In this case, the bond price is a constant $\frac{1}{1+r}$ and the federal government bears the repayment burden.

Case II ($p = 0$). In this case, the federal government has committed to not providing bailouts in the event of a state government default. Therefore, the state government must consider the consequences of default without the possibility of receiving a bailout. The state government's decision-making process can be represented by a standard quantitative sovereign default model, similar to the one proposed by Arellano (2008). The government aims to maximize its payoff, which is the maximum of either repaying its debt or defaulting on it:

$$V(y,b) = \max\{V^c(y,b), V^d(y)\},$$

where

$$V^c(y,b) = \max_{\{c,b'\}}\{u(c) + \beta\mathbb{E}\left[V(y',b')\right]\}, \text{subject to } c + b = y + q(y,b')b'$$

and

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

The probability that the state government defaults, denoted by $\mathbb{E}(D(y',b'))$, affects the bond price. The bond price is given by:

$$q(y, b') = \frac{1}{1+r}\mathbb{E}\left[1 - D(y', b')\right].$$

In the cases where $0 < p < 1$, the probability that the state government defaults is greater than the expected probability of default in *Case II* ($p = 0$), but less than 1. Overall, the probability of the federal government providing bailouts affects the incentives for the state government to repay its debt. A higher probability of bailouts leads to lower incentives for repayment, while a lower probability leads to higher incentives for repayment.

3 A Switch in State Bankruptcy Rules

Suppose now that the state government is allowed to declare bankruptcy. After declaring bankruptcy, the lenders can get a recovery value $R(y, b) = \alpha y/b$ per dollar of debt, where $0 < \alpha < 1$. Following the declaration of bankruptcy, the state government retains the ability to borrow for future periods. At the beginning of each period, income y is observed. The government decides whether to repay its debt or declare bankruptcy. If the government declares bankruptcy, the debt b is written off and the lenders get the recovery value from the bankruptcy process. The government issues new bonds b' for the next period.

A state government chooses whether to repay or declare bankruptcy on its debt to maximize consumption:

$$\hat{V}(y, b) = \max\{\hat{V}^c(y, b), \hat{V}^b(y, b)\}, \tag{7}$$

where $\hat{V}^c$ denotes the repayment value and $\hat{V}^b$ denotes the bankruptcy value. If $\hat{V}^c(y,b) < \hat{V}^b(y,b)$, the government chooses to declare bankruptcy. Let $B(y,b) = 1$ denote bankruptcy.

If the government chooses to repay, it can issue new bonds b' to maximize utility:

$$\hat{V}^c(y,b) = \max_{\{c,b'\}} \quad u(c) + \beta \mathbb{E}\left[\hat{V}(y',b')\right], \tag{8}$$

subject to the budget constraint:

$$c + b = y + \hat{q}(y,b')b', \tag{9}$$

where c is consumption, b is debt repayment, $\hat{q}(y,b')$ is the bond price under the case where the state government is allowed to declare bankruptcy, and $\hat{q}(y,b')b'$ are thus the proceeds from issuing new bonds. Note that before and after allowing for bankruptcy, the bond price schedules are different: $q(y,b')$ and $\hat{q}(y,b')$. The bond price schedule $\hat{q}(y,b')$ represents the bond price schedule after allowing for bankruptcy, while the bond price schedule $q(y,b')$ represents the bond price schedule before the state's bankruptcy rules were changed. In the quantitative section, we will be comparing these two bond price schedules in order to understand how the change in bankruptcy rules affects the government borrowing cost.

The value of declaring bankruptcy for the state government is represented by the function $\hat{V}^b(y,b)$:

$$\hat{V}^b(y,b) = \max_{\{c,b'\}} \quad u(c) + \beta \mathbb{E}\left[\hat{V}(y',b')\right], \tag{10}$$

subject to the budget constraint:

$$c = (1-\alpha)y + \hat{q}(y,b')b',$$

where α is the parameter in the function of recovery value $R(y,b) = \alpha y/b$, which is the value the lenders will receive per dollar of debt in the event of bankruptcy.

The lenders are aware that the government may declare bankruptcy and they have claims for bond holding. The break-even condition implies that the bond price schedule $\hat{q}(y,b')$ satisfies:

$$\hat{q}(y,b') = \frac{1}{1+r}\mathbb{E}\left[1 - B(y',b') + B(y',b')R(y',b')\right], \tag{11}$$

where r is the risk-free interest rate and $B(y',b')$ is a binary function that is equal to 1 if the government declares bankruptcy and 0 if it does not. $R(y',b') = \alpha y'/b'$ is the recovery value the lenders can claim during the bankruptcy process. The bond prices reflect the likelihood of future bankruptcy events and the recovery value that the lenders can expect to receive in the event of bankruptcy. The government spread on its bond is defined as $\hat{sp}(y,b') = 1/\hat{q}(y,b') - (1+r)$.

Recursive equilibrium. The recursive equilibrium consists of policy functions for consumption $c(y,b)$, borrowing $b'(y,b))$, bankruptcy set $B(y,b)$; the government value functions $\hat{V}(y,b)$, $\hat{V}^c(y,b)$, and $\hat{V}^b(y)$; and government bond price $\hat{q}(y,b')$ such that:

1. Taking the bond price schedule $\hat{q}(y,b')$ as given, the government's choices for borrowing $b'(y,b)$ and its bankruptcy set $B(y,b)$, along with its value functions

$\hat{V}(y,b)$, $\hat{V}^c(y,b)$ and $\hat{V}^b(y,b)$, solve the government's problem (7), where the repayment value $\hat{V}^c(y,b)$ is given by (8) and the bankruptcy value $\hat{V}^b(y,b)$ is given by (10).

2. The government bond price schedule (11) reflects the government's bankruptcy probability and recovery value during the bankruptcy process, and satisfies the lenders' break-even condition.

4 Ex-ante Risks and Ex-post Benefits

In the previous section, we discussed the problems of a state government when it is not allowed to declare bankruptcy and compared them to the situation when bankruptcy is allowed. Allowing for bankruptcy increases ex-ante risks for the government not to repay its debt. Intuitively, with the existence of a bankruptcy rule, a state government obtains a less painful outcome when not repaying, thus increasing its incentives to not repay. However, bankruptcy also brings ex-post benefits to the government. Bankruptcy can prevent the government from facing large costs or austerity measures that may result from an outright default. This can allow the government to avoid financial exclusions and invest in the desired infrastructure in the future. An example of this can be seen in the Arkansas default event, where the state experienced severe austerity measures and financial exclusions for years after defaulting on its debt.

In order to illustrate the trade-off between the risks and benefits of allowing for bankruptcy, we will use a simplified two-period model that includes both analytical and numerical solutions. Assume that the economy receives income y_1 and y_2 in periods 1 and 2, respectively. The government's payoff is represented by the function $u(c_1) + \beta u(c_2)$, where c_1 is the consumption level in period 1, c_2 is the consumption level in period 2, and β is a discount factor. The government has an initial bond holding of b_0, and at the beginning of period 1, it must decide whether to repay this debt or not. Assume that the federal government will not provide a bailout in this simple model.

Repayment value. If repays, the government can choose a non-defaultable bond b_1 with proceeds $\frac{b_1}{1+r}$ in period 1. The period-1 budget constraint is $c_1 + b_0 = y_1 + \frac{b_1}{1+r}$ and the period-2 budget constraint is $c_2 + b_1 = y_2$. Because it is a two-period model, bond holdings must be nil at the end of period 2, that is, $b_2 = 0$. Combining the per-period budget constraint and the transversality condition $b_2 = 0$ yields the intertemporal budget constraint:

$$c_1 + \frac{c_2}{1+r} = y_1 + \frac{y_2}{1+r} - b_0.$$

Formally, the government's problem under repayment is

$$v^c = \max_{\{c_1, c_2\}} u(c_1) + \beta u(c_2),$$

subject to

$$c_1 + \frac{c_2}{1+r} = y_1 + \frac{y_2}{1+r} - b_0.$$

The government takes as given all objects on the right-hand side of the intertemporal budget constraint. Therefore, to save notation, let's call the right-hand side $\bar{Y}$:

$$\bar{Y} = y_1 + \frac{y_2}{1+r} - b_0.$$

Assume that preferences are logarithmic and there is no discounting ($\beta = 1$). Then the lifetime utility is given by $u(c_1) + \beta u(c_2) = \ln c_1 + \ln c_2$. The intertemporal budget constraint is $c_1 + \frac{c_2}{1+r} = \bar{Y}$. Solving the intertemporal budget constraint for c_2 and using the result to eliminate c_2 from the lifetime utility function, the government's optimization problem reduces to choosing c_1 to maximize $\ln(c_1) + \ln((1+r)(\bar{Y} - c_1))$ The first order condition associated with this problem is $\frac{1}{c_1} - \frac{1}{\bar{Y} - c_1} = 0$. Thus we have

$$c_1 = \frac{1}{2}(y_1 + \frac{y_2}{1+r} - b_0), \qquad c_2 = \frac{1}{2}(y_1 + \frac{y_2}{1+r} - b_0)(1+r),$$

and the government payoff under repayment is

$$v^c = 2\ln\left(y_1 + \frac{y_2}{1+r} - b_0\right) + \ln\left(\frac{1+r}{4}\right).$$

It shows that, with more outstanding debt b_0, the government's payoff v^c is lower.

Default value. At the beginning of period 1, if the state government chooses to default on its debt b_0, the state government can't borrow and suffers default cost. The state government period-1 budget constraint is $c_1 = y_1$ and the period-2 budget constraint is $c_2 = y_2^d$, where $y_2^d = y_2 - \Delta$ reflects the default punishment on income when government defaults. Formally, the government's problem is

$$v^d = \max_{\{c_1, c_2\}} u(c_1) + \beta u(c_2),$$

subject to the intertemporal budget constraint:

$$c_1 + c_2 = y_1 + y_2 - \Delta,$$

where $\Delta = y_2 - y_2^d > 0$ indicates default cost. Assume logarithmic preference and

$\beta = 1$, the first order conditions give

$$c_1 = \frac{1}{2}(y_1 + y_2 - \Delta), \qquad c_2 = \frac{1}{2}(y_1 + y_2 - \Delta),$$

and the government payoff under default is

$$v^d = 2\ln(y_1 + y_2 - \Delta) + \ln\left(\frac{1}{4}\right).$$

With higher default punishment, the government payoff under default v^d is lower.

Bankruptcy value. Now, suppose the state government is allowed to go bankrupt. At the beginning of period 1, the state government can also choose to declare bankruptcy on its debt b_0. The lenders get a fraction of state government endowment αy_1 as recovery value. After the bankruptcy process, the state government can still borrow the non-defaultable bond b_1. Thus, the state government period-1 budget constraint is $c_1 = (1-\alpha)y_1 + \frac{b_1}{1+r}$ and the period-2 budget constraint is $c_2 + b_1 = y_2$. Formally, the state government's problem is

$$v^b = \max_{\{c_1, c_2\}} u(c_1) + \beta u(c_2),$$

subject to the intertemporal budget constraint:

$$c_1 + \frac{c_2}{(1+r)} = (1-\alpha)y_1 + \frac{y_2}{(1+r)},$$

Assume logarithmic preference and $\beta = 1$, the first order conditions give

$$c_1 = \frac{1}{2}\left((1-\alpha)y_1 + \frac{y_2}{1+r}\right), \qquad c_2 = \frac{1}{2}\left((1-\alpha)y_1 + \frac{y_2}{1+r}\right)(1+r),$$

and the government payoff is

$$v^b = 2\ln\left((1-\alpha)y_1 + \frac{y_2}{1+r}\right) + \ln\left(\frac{1+r}{4}\right).$$

By comparing the repayment value v^c, the default value v^d, and the bankruptcy value v^b, we can observe how different variables such as the initial bond holding, the cost of default, and the remaining fraction of income after bankruptcy affect the government's decision to repay, default, or declare bankruptcy. If the initial bond holding b_0 is high, the government is less likely to repay its debt because the value of v^c will be low. Similarly, if the cost of default, Δ, is high, the government is less likely to default because the value of v^d will be low. On the other hand, if the remaining fraction of income after the bankruptcy process, $(1-\alpha)$, is low, the government is less likely to choose bankruptcy because the value of v^b will be low.

Before a switch in bankruptcy rules, the government compares the repayment value v^c, and the default value v^d, and will refuse to repay if $v^c < v^d$. However, after allowing for bankruptcy, the government compares v^c and v^b, and will refuse to repay (and declare bankruptcy) if $b_0 > \alpha y_1$. This condition is easier to meet than $v^c < v^d$, meaning that the government has a higher probability of refusing to repay its debt after allowing bankruptcy. Of course, the relative size of this probability change depends on the default punishment as well as the parameter values for bankruptcy. In the next section, we will calibrate the full infinite horizon model to further illustrate this comparison and its dependence on the parameters.

Using this simple two-period model, we can see that a switch in bankruptcy rule features a larger *ex-ante* probability of not repaying debt but a less painful *ex-post* outcome without high default punishment. In the next section, we analyze this trade-off quantitatively and shed light on how a switch in bankruptcy rules affects bond prices. By examining bond prices, we will be able to understand how a switch in bankruptcy rules affects the borrowing cost for the government.

5 Quantitative Analysis

In the infinite-horizon model, we calibrate the model and plot the policy functions to visualize the risks and gains of a switch in bankruptcy rule. We also analyze the impact of a switch in bankruptcy rule on government bond spreads.

The model is at an annual frequency. Income y follows an AR(1) 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: $y^d = h(y) = \min\{y, \gamma \mathbb{E} y\}$, where γ is a parameter. The utility function is $u(c_t) = \frac{c_t^{1-\sigma}}{1-\sigma}$, where σ is the risk aversion parameter.

We parameterize the model to the average of 50 U.S. states. There are two groups of parameters. The first group of parameters is assigned, and those in the second group are jointly chosen to match relevant empirical moments. The first group includes $\{\rho, \sigma_y, r, \sigma, \lambda, p, \alpha\}$. The parameters for the income process $\{\rho, \sigma_y\}$ are estimated using state-level GDP data in 1960-2020, which generates $\rho = 0.98$ and $\sigma_y = 0.04$. The annual risk-free rate r is 2%. The risk aversion parameter σ is set to 2, a commonly used value in literature. The return parameter λ after default is 0.25 following Gelos et al. (2011). This implies that a defaulting government is excluded from financial markets for four years on average. The fraction of income that lenders can recover in bankruptcy α is set at 0.45, in line with data from cases such as the Detroit bankruptcy.[5] The probability of the federal government providing a bailout to the state government in the event of default p is set to be 0.25 for the benchmark case.[6]

The second group of parameters is $\{\beta, \gamma\}$. We choose them to jointly target the average spread (0.86%) and average debt-to-GDP ratio (0.16) from 2000 to 2019 in 50 states. We use the global method to solve the model. Given the model policy functions, we perform simulations to obtain the model-implied moments. We jointly choose $\{\beta, \gamma\}$ to minimize the sum of the distance between the moments in the model and their corresponding counterparts in the data, which generates $\beta = 0.979$ and $\gamma = 0.55$.

In order to demonstrate the ex-ante risks associated with allowing bankruptcy, Figure 1 compares the probability of the government repaying its debt under two different scenarios: with no bankruptcy allowed (blue dashed lines) and after allowing for bankruptcy (solid red lines). This visualization allows us to see how the introduction of a bankruptcy option affects the likelihood of the government repaying its debt.

The left, middle, and right panels of Figure 1 depict the repayment probabilities for the government under different income levels, where $y_1 < y_2 < y_3$. It can be seen that, after allowing for bankruptcy (solid red lines), the probability of the government repaying its debt is lower than in the case of no bankruptcy allowed (blue dashed

[5] In Detroit bankruptcy, creditors received between 14 and 75 cents on the dollar. Sources: `https://slate.com/business/2014/11/detroit-exits-bankruptcy-city-s-pensions-saved-in-part-thanks-to-detroit-institute-of-art.html` and `https://www.wsj.com/articles/judge-approves-detroits-bankruptcy-exit-plan-1415383905`.

[6] While we do not have a specific numerical value for the probability of the federal government bailout based on empirical estimation, we have chosen values within reasonable ranges based on existing documents and reports. To better understand the impact of the federal government bailout on the state government's decisions, we will be conducting comparative analyses using alternative values for p in Section 6.

lines). This demonstrates that the ex-ante risk of the government not repaying its debt is higher after allowing for bankruptcy. This is because allowing for bankruptcy provides the government with a less painful outcome if it decides not to repay its debt, which reduces its incentives to repay.

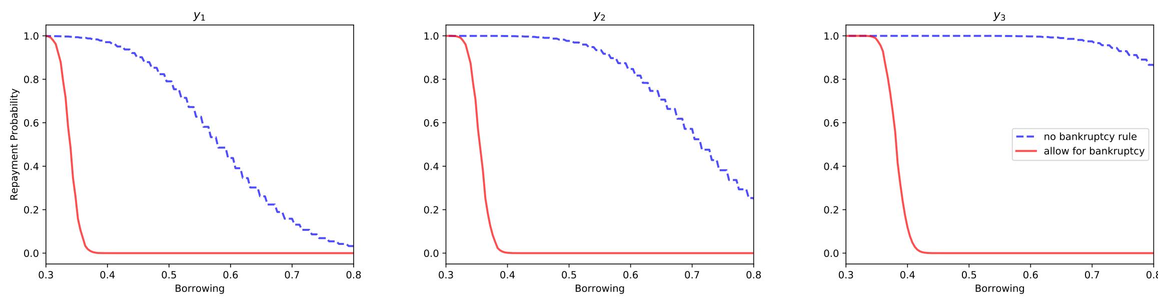

Figure 1: Ex-ante risk of allowing bankruptcy

Notes: Repayment probabilities as a function of borrowing for different income levels, where $y_1 < y_2 < y_3$. The blue dashed lines plot the case when bankruptcy is not allowed. The solid red lines plot the case where bankruptcy is allowed. Lower red lines show the larger ex-ante risk of not repaying debt after allowing bankruptcy.

Allowing bankruptcy provides ex-post benefits because the government suffers less under bankruptcy rules if debts are not repaid. This is illustrated in Figure 2, which shows the payoffs for the government when it chooses not to repay its debt. The left panel of the figure plots the government payoffs as a function of income under two different scenarios: without bankruptcy (dashed blue line) and with bankruptcy allowed (solid red line). The right panel displays the consumption equivalence under these two scenarios. It can be seen that, in almost every income level, the government experiences higher value and consumption equivalence if bankruptcy is allowed, as indicated by the higher red solid lines. This demonstrates the ex-post benefit of allowing bankruptcy for the government.

To analyze the impact of a switch in the state bankruptcy rule on government bond prices, recall that the price of government bonds before the switch to bankruptcy rule

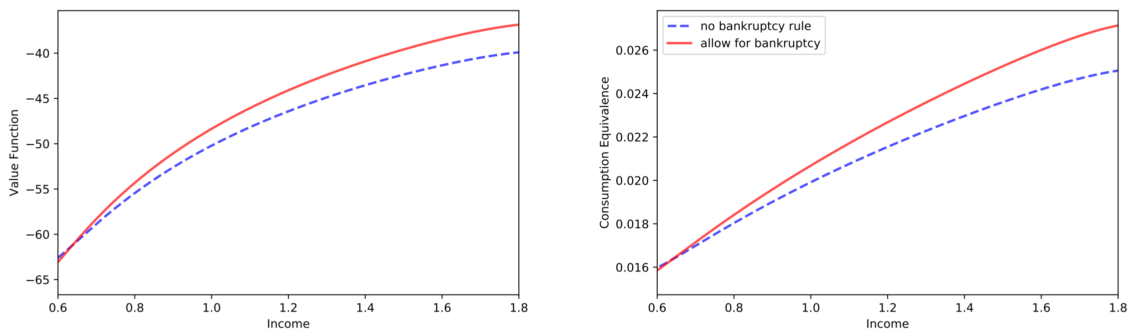

Figure 2: Ex-post benefit of allowing bankruptcy

Notes: Government payoffs and consumption equivalence after not repaying its debt. The dashed blue lines plot the case when bankruptcy is not allowed. The solid red lines plot the case where bankruptcy is allowed. Higher red lines show the ex-post benefit of allowing bankruptcy.

is the following:

$$q(y, b') = \frac{1}{1+r}\mathbb{E}\left[1 - D(y', b') + pD(y', b')\right], \tag{6}$$

and bond price after the switch is given by:

$$\hat{q}(y, b') = \frac{1}{1+r}\mathbb{E}\left[1 - B(y', b') + B(y', b')R(y', b')\right], \text{where } R(y', b') = \alpha y'/b'. \tag{11}$$

Comparing bond prices in two cases, the following elements lead to different bond prices: expected default/bankruptcy probabilities, federal government bailout probability, and bond recovery value. In terms of expected default/bankruptcy probabilities, we had implications from Figure 1 showing that, first, given the same borrowing level (and income level), the bankruptcy probability is higher than the default probability; second, the gap between bankruptcy and default probability is not monotonic with debt—when debt level is not high enough, the gap between bankruptcy and default probability is increasing with debt. When debt is high enough such that the government would surely declare bankruptcy, the gap between bankruptcy and default probability is decreasing with debt. With everything else equal and when the government defaults, a larger bailout probability increases bond price q. With everything else equal and when the government declares bankruptcy, high income or low debt leads to a higher recovery value and therefore a higher price of bonds $\hat{q}$.

To visualize the impact of a switch in the state bankruptcy rule on government bond prices, we plot bond prices q (the case where bankruptcy is not allowed) and $\hat{q}$ (after allowing bankruptcy) in Figure 3, and bond spreads in Figure 4. A higher bond spread indicates a higher borrowing cost for the government. Our main observation is that whether allowing for bankruptcy increases or decreases borrowing costs depends on the level of income and borrowing for the government.

When a government has a high income and relatively low borrowing, allowing for bankruptcy can lead to an increase in the spread of its bonds. This is because allowing bankruptcy increases the likelihood of not repaying debt. On the other hand, if a government has a lower income and a heavy debt burden, allowing for bankruptcy can actually decrease the spread of its bonds. This is because the potential benefits of bankruptcy in terms of reducing the debt burden and relieving financial strain are greater in this scenario. Therefore, an unexpected change in state bankruptcy rule that allows for bankruptcy may result in a decrease in the spread of government bonds if the government has a low income and a large debt burden.

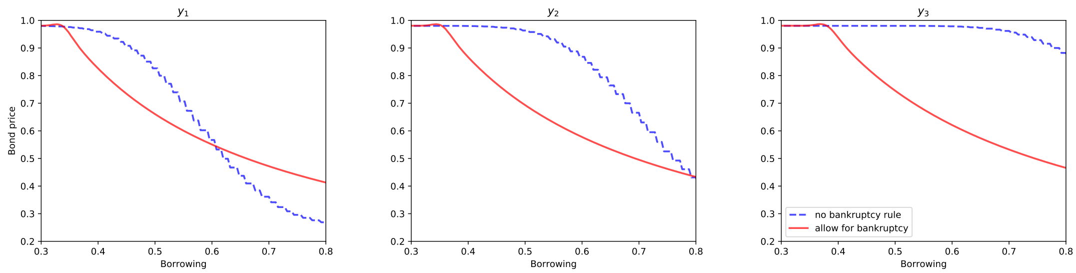

Figure 3: Bond price q and $\hat{q}$

Notes: Bond price as a function of borrowing for different income levels, where $y_1 < y_2 < y_3$. The dashed blue lines plot q (bond price when bankruptcy is not allowed). The solid red lines plot $\hat{q}$ (bond price when bankruptcy is allowed).

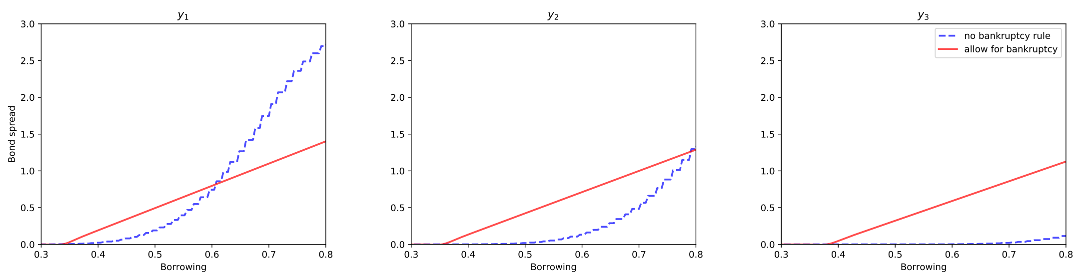

Figure 4: Bond spread sp and $\hat{sp}$

Notes: Bond spread as a function of borrowing for different income levels, where $y_1 < y_2 < y_3$. The dashed blue lines plot sp (bond spread when bankruptcy is not allowed). The solid red lines plot $\hat{sp}$ (bond spread when bankruptcy is allowed).

6 Role of Federal Government Bailouts

The probability of the federal government bailout, represented by p, is an important parameter in the model. A high probability of a bailout may result in deviations from optimal resource allocation and over-borrowing (Crivelli (2011)). This problem became particularly relevant after the Great Recession, as the outbreak of the recession quickly put state governments in deep fiscal distress (Dilger (2014)) and their reliance on the federal fiscal relief program such as the American Recovery and Reinvestment Act (ARRA) raised concerns about agency problems by state governments and re-emphasized the importance of the federal government's commitment to not bail out state governments in order to maintain efficient state government finances (Inman (2010)).

Measuring the probability of federal government bailouts in the literature is often done in an ad-hoc manner in empirical studies. For example, Heppke-Falk and Wolff (2008) uses the "interest payments-to-revenue ratio" as a proxy for the probability of federal government bailouts in the case of Germany, as the Federal Constitutional Court uses that statistic as a reference to decide whether a sub-national government is eligible for federal aid. In contrast, Beck et al. (2017) exploits institutional differences across multiple countries and interacts the level of debt with dummy variables for institutional characteristics to serve as an indirect measure for the probability of federal government bailouts.

With the use of our model, we can conduct a comparative analysis to understand the impact of the possibility of a bailout on state government decisions. A higher value of p means that the government has a higher chance of receiving a bailout in the event of default, which reduces the negative consequences of default and may increase the government's incentives to default. Thus, intuitively, a higher value of p leads to higher government default risk.

The bond price schedule (6) illustrates that the probability of a federal government bailout p influences bond prices q through both direct and indirect channels. The direct effect is that as p increases, the expected payment from the federal government increases, resulting in a corresponding increase in bond prices. The indirect effect is that as p increases, the government default risk $\mathbb{E}[D(y', b')]$ increases, leading to a decrease in bond prices.

To show the role of federal government bailouts, we resolve the model with $p \in [0, 1]$. Table 1 reports the model moments under different values for p, with other parameter values fixed. As the likelihood of a federal government bailout increases, the probability of state governments repaying their debt decreases. Additionally, the debt-to-GDP ratio increases as the likelihood of a bailout increases, with the exception of a slight decrease when the likelihood increases from 0% to 10%. Lastly, the average spread also increases as the likelihood of a bailout increases, except when the likelihood is at 100% where the average spread is 0.

Table 1: Federal Government Bailout Probability and Model Moments

	Prob. of Federal Government Bailout										
	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Prob.of Repayment	0.999	0.996	0.991	0.982	0.962	0.920	0.830	0.643	0.327	0.051	0.003
Debt-to-GDP	0.144	0.141	0.147	0.162	0.185	0.210	0.232	0.267	0.366	0.772	1.019
Avg. Spread (%)	0.021	0.619	0.773	0.930	1.017	1.159	1.359	1.602	2.287	5.730	0.000

Notes: This table reports the generated model moments with different values for p (the probability of the federal government providing bailout to the state government). Other parameter values are fixed.

7 Conclusion

This paper provides a formal economics framework for analyzing the impacts of allowing state government bankruptcy. Allowing for bankruptcy increases ex-ante risks for the state government to refuse repayment, but reduces ex-post cost from outright default. This paper explains this trade-off analytically and quantitatively. In terms of bond prices and borrowing costs, whether allowing bankruptcy increases or decreases government debt spreads depends on the income level and borrowing level. An unexpected switch in bankruptcy rules that allows for bankruptcy can reduce government bond spread if the government has a heavy debt burden relative to their income. Furthermore, a high likelihood of the federal government bailout can result in an increase in debt and an elevated risk of default for state governments.

To highlight the key mechanism, the model is abstract from several features such as interactions between state governments and potential economic spillovers across different states. The design of the optimal bankruptcy rule would be an interesting future research revenue.

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