Legal Uncertainty and Municipal Bond Yields: Market Spillovers from Puerto Rico

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ABSTRACT

I explore the effects of legal uncertainty on U.S. municipal bond yields. The legal framework for state government default in the United States is very uncertain, and has very little precedent (no state has defaulted on its debt since the 1930s). I argue that recent events in the Puerto Rican debt crisis may provide information to investors about the potential legal structure for future state government default events. I test whether U.S. state government bond yields react to legal news and decisions relating to the Puerto Rican default crisis. Additionally, I explore cross-sectional differences in these spillover effects. I find that state bond yields do react to events in Puerto Rico. However, I do not find evidence that effects are stronger in states with lower credit quality. This suggests that markets may perceive these events as setting precedent for potential future state default events. Overall my results imply that creating a default framework for U.S. state governments could reduce market uncertainty, and therefore state borrowing costs.

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I. Introduction

> Some of the legal precedents potentially being set, whether or not technically binding outside Puerto Rico or the 1st Circuit, erode the expectations and good order of the municipal bond marketplace that finances the activities of states and municipal instrumentalities nationwide.
>
> Len Weiser-Varon and William Kannel, *Bond Buyer*, March 21, 2018

The municipal bond market is a $3.8 billion capital market which finances 2/3 of infrastructure projects in the U.S. along with other activities for more than 50,000 state and local governments. [1]. Therefore, borrowing costs are of critical concern to municipal policymakers. When determining prices (and consequently borrowing costs), investors in these markets need to make assumptions regarding both default probabilities and recovery rates in default when determining prices. Currently, there is no legal structure for how a U.S. state government might restructure its debt obligations in a default event. This lack of framework implies a great deal of uncertainty with regards to what recovery rates bond investors might expect given an inability to meet obligations. This uncertainty is more pronounced than in other (local) municipal debt markets which have Chapter 9 bankruptcy laws which contain a framework for recovery in default. Despite this fact, the municipal bond literature has not yet studied how this legal uncertainty may affect government bond prices.

Recent legal decisions and legislation surrounding the Puerto Rican debt crisis are a fruitful laboratory in which to study the relationship between legal uncertainty and municipal bond prices. Chari, Leary, and Phan (2017) show that various legal events (e.g.the passing of PROMESA, the Debt Enforcement and Recovery Act, and the Debt Moratorium and Financial Recovery Act) do have a material effect on Puerto Rican bond yields. As the quote above subjects, some market participants have seen these events as precedent setting and implied that they may have spillovers in other municipal markets. Building on this intuition, I posit that these decisions (and others) may provide signals to other markets regarding the potential framework for future state government default. If this is the case, one might expect to price changes in other municipal bond markets around these decisions even if the events themselves are not legally binding for these other municipalities. I perform various event study analyses around these decisions to test this hypothesis. I also explore

[1] "Muni Facts," MSRB 2019.

whether or not there are cross-sectional differences in reactions to these events.

My empirical results show that legal events in Puerto Rico do have effects on state debt markets, which suggests markets do indeed see these decisions as setting precedent for other markets. Using an event study methodology I show that state bond prices have statistically significant reactions to legal uncertainty shocks related to legislation and legal decisions regarding Puerto Rico. I do not find convincing evidence that states that are closer to default are more sensitive to these legal uncertainty shocks. This may be in part due to the large degree of noise in my estimates. However, my results are an important first step in understanding how legal uncertainty may affect municipal market prices.

My results suggest that markets see these legal decisions as potentially setting precedent for state government default. Policy makers may want to consider these potential effects when thinking about creating bankruptcy structures for state government. Ultimately the legal uncertainty channel in municipal bond yields required more research. However, if that channel is real it suggests that creating a legal framework for state government default (argued for by scholars such as Skeel (2013)), and therefore decreasing uncertainty, could lead to lower borrowing costs today for municipal governments.

A. Background

Sub-state municipal governments have access to Chapter 9 of the U.S. Bankruptcy Code. This is a defined legal framework for default, similar in spirit to Chapter 11 bankruptcy for corporations. Detroit filed for Chapter 9 bankruptcy in 2013 and ultimately restructured its debt in part under this framework[2]. However, U.S states as sovereigns under the Constitution **do not** have access to Chapter 9. Moreover, no U.S. state has defaulted on its debt since Arkansas in 1933. Thus, in addition to no legal framework, there is no modern practical precedent for how lenders' claims might be settled in a state default. This likely creates a great deal of uncertainty among investors with regards to how a state government default would play out.

Recent events in Puerto Rico, which is legally similar U.S. states, have led to a number of novel pieces of legislation and court rulings regarding bankruptcy and default. Many politicians

[2]This was the largest and most known Chapter 9 bankruptcy filing in U.S. history, but is certainly not the only one. Other notable large Chapter 9 filings include San Bernadino, CA (2012), Stockton, CA (2012), Jefferson County, AL(2011), Orange County, CA (1994).

and market participants have suggested that these legal decisions may be setting a precedent for how a state in fiscal crisis may handle a default event. Senator Bernie Sanders upon passage of PROMESA argued strongly that, "I rise in very strong opposition to the Puerto Rico Oversight, Management, and Economic Stability Act, the so-called PROMESA Act. This is a terrible piece of legislation, setting horrific precedent, and it must not be passed..." If this is true, investors in government bond markets may be learning about potential legal frameworks for future defaults through these events. Thus, one would expect to see existing state bond markets react to these changes in expectations.

For context, I briefly describe the history of the Puerto Rican debt crisis. Any events I study explicitly will be discussed in more detail in section III. For a more detailed description of the Puerto Rican debt crisis, see Chari et al. (2017). Prior to 1996 Puerto Rico benefited from favorable tax laws as part of the Jones Act of 1920. These benefits were generally phased out from 1996 to 2006. This, along with the financial crisis, led to poor results for the Puerto Rican economy which was exacerbated by attempts to shore up tax shortfalls with increases in debt. In 2014 Puerto Rican bonds were downgraded to "junk" status, which led to concerns about default. Puerto Rico was explicitly barred from Chapter 9 bankruptcy and therefore looked towards other means of restructuring. This included multiple laws passed by the Puerto Rican government to create Chapter 9 like frameworks for restructuring. Finally in June 2016 the U.S. Congress passed the Puerto Rico Oversight, Management, and Economic Stability Act (PROMESA) which created a federal framework for the restructuring of Puerto Rico's debt. This event in particular drew a lot of ire for potentially creating a legal precedent for state default given that states also do not have access to Chapter 9. A number of legal decisions have also taken place since PROMESA giving a more concrete framework to Puerto Rican restructuring, including the January 2018 decision by Judge Swain that allowed Puerto Rico to not make payments on special revenue bonds while in bankruptcy. In this paper I study the spillovers of this and various other legal events in Puerto Rico on state municipal bond markets.

The rest of the paper is laid out as follows: In Section II I explain my empirical methodology and describe the data I use in my analyses. Next, in Section III I display and discuss the results from my event study exercises. Finally, Section IV concludes.

II. Data and Methodology

In this section I describe the empirical methodology of my paper. First I present a framework for thinking about how these events may effect spreads. Following this, I present the event study regressions I use to quantify the effects of legal decisions surrounding Puerto Rico on state municipal markets. Next, I briefly describe the data I use in the paper. Finally, I discuss the specific events around which I perform event studies.

A. Framework

A credit spread (or difference between the yield on a bond and a risk-free rate)can be approximated by the following formula:

$$s \approx E\left[P(Default)\right] \times E\left[(1-R)\right] \tag{1}$$

That is, the spread is roughly the expected probability of default times one minus the recovery rate in default. Therefore, if an event leads to an increase in the expected likelihood of default it results in a higher credit spread, and vice versa. Similarly, if an event leads to an increase in the expected recovery rate, one would expect to see a decrease in spread as the expected payout to debtholders is now higher. The legal events in Puerto Rico are most likely to effect expectations about recovery rates, as opposed to default. The ability of a U.S. state to make payments is based on the fiscal health of a state which can generally be seen as independent of the legal framework for default. These events are more likely to affect the amount debtholders would recover in an actual default. Therefore, a legal precedent that raises the expected recovery rates for state default may lead to a decrease in spreads. The direction of the coefficients in my event study may help discern patterns in changes in expected recovery rates.

However, the level expectation is not the only thing that may affect this equation. Implicit in this approximation are assumptions about the uncertainty of expectations. Risk averse investors dislike uncertainty. Therefore greater uncertainty about recovery rates would lead to a higher credit spread and vice versa. So a legal precedent that reduces the uncertainty around state default frameworks may lead to a decrease in spreads. As you can see, this channel could be at odds with

the level expectations channel discussed above. For example, a legal precedent which reduces the uncertainty around recovery rates and also decreases the likely recovery rate will have conflicting effects. My event studies as of yet cannot totally separate these two facts. However, by looking at multiple events which a priori we may expect to have certain effects on expectations and uncertainty, I may be able to discern some patterns which can help discern which channel is driving the reactions.

B. Event Study Methodology

Event studies are designed to measure the reaction of a given security to a certain event. They are most commonly used with equities to explore stock price reactions to events such as merger announcements, earnings releases, etc. Given the high liquidity of equities, event studies for stocks are fairly straightforward. However, for less liquid fixed-income securities there are fewer well defined methods. I use an event study methodology similar to that of Chari et al. (2017) and Gao, Lee, and Murphy (2018). I regress daily bond spreads on an indicator variable for whether or not the date t is after the event in question. Thus the estimated coefficient is meant to pick-up a change in the average bond spread following an event. My main specification is as follows:

$$s_{i,t} = \alpha + \beta I_t + \gamma^{'} X_{i,t} + \epsilon_{i,t} \tag{2}$$

$s_{i,t}$ is the spread of bond i at date t. I_t is an indicator for whether or not date t is after the event in question. Therefore the main coefficient of interest is β which represents the average increase/decrease in bond spreads after the event. Finally $X_{i,t}$ represents a set of bond-level controls which I briefly describe below. I perform this regression separately for each event and test the significance of β to explore whether or not the given legal event in Puerto Rico has a material effects on state spreads.

Ideally one would want to measure the instantaneous (e.g. within a day or hour) impact of a given event. This is crucial to discerning the causal effect of a given piece of news by ensuring you are not measuring the effects of a confounding event. With equities this is more feasible given the presence of high-frequency trading data. However, this is much trickier with fixed-income data. In this paper I use various window sizes around a given event, and measure the change in average spread within that window of the event. That is, for an event on day t a window of x days indicates

that the regression only uses data in the $[t-x, t+x]$ window. I use window sizes varying from 30 to 10 days for robustness. Even the 10 day window is quite large as numerous other things could cause a change in the average spread within the window. However, due to the lack of liquidity (and trades) of municipal bonds, this is about as small a window as I can use while still maintaining statistical power.

This small window has two potential issues. First, it could include other events which bias my findings. For example, if a given event of interest actually has zero impact on spreads, but another event within that window has a positive impact I may incorrectly attribute a positive reaction to the event of interest (or vice versa). Second, this could simply introduce noise in my estimates which will bias them towards zero. In these cases, I may measure no effect (or a lesser effect) of a given event, even if there is in fact a positive/negative spillover. This is necessarily a limitation of the data, and makes true causal inference difficult. However, I hope that the number of events I study can help show the general presence of these market spillovers.

Another concern with these specifications is the correlation of errors across both CUSIPs but even more so days. Both issues could contaminate my statistical tests. If I am not capturing all the relevant bond features in my controls I may have errors correlated within CUSIPs. More concerning changes in the overall municipal markets could lead to correlation within days. Thus, I perform specifications that cluster standard errors at both the CUSIP and day level to help alleviate these concerns.

Next, I explore whether or not there are cross-sectional differences in the "spillovers" from Puerto Rican events. To do this I add an interaction term to capture the credit quality/fiscal health of a state. My hypothesis is that these legal events may be more relevant for states that are closer to default. If they are setting a precedent for what may happen in a state default, that will be more germane to states where that is a possibility in the near future. To proxy for credit health I use the credit rating of a state. In particular I proxy for states that are relatively closer to default by using an indicator for "low" rating states (see below for more detail). The specification is as follows:

$$s_{i,t} = \alpha + \beta I_t + \nu \left(LOWRAT\right)_{i,t} + \phi I_t \times \left(LOWRAT\right)_{i,t} + \gamma^{'} X_{i,t} + \epsilon_{i,t} \tag{3}$$

Here, the second coefficient of interest is ϕ which measures whether the average spread after an event is different for states with low ratings, as opposed to those with higher ratings. Most likely I would expect to see a magnification of effects for the states with lower credit ratings as any precedents said are more salient for areas closer to default. Once again, my concerns about potential noise arising from the large window size may obfuscate my findings.

C. Data

For bond spread data, I rely on two databases: the Mergent Municipal Bond Securities Database(MSRB) and the Municipal Securities Rulemaking Board's (MSRB) Electronic Municipal Market Access Database (EMMA). Mergent provides issue level information such as CUSIP, offering date, maturity date, offering amount, bond type and other characteristics such as option flags. EMMA is a transaction database, which tracks trades of municipal bonds and contains information on trade date, traded yield, and amount. I link the two datasets by CUSIP to obtain both original issue characteristics and updated pricing (yield) information. This provides me updated pricing information along with original bond characteristics which I can control for in my regression analyses.

I filter these for only bonds issued by the state government itself (i.e. I exclude lower municipalities). For each bond I also calculate the difference between the traded yield and a maturity matched treasury to obtain the bond spread. To obtain the maturity matched treasury I interpolate between points on the treasury yield curve to correspond to the current time-to-maturity (TTM) of an issue[3]. I focus on tax-exempt general obligation bonds with fixed-coupons as these most accurately measure the overall credit risk of a state. In my regressions I control for issue size, trade size,time to maturity and indicator variables for bond insurance and various optionality features.

For my cross-sectional analysis I use credit ratings data from Moody's which I obtain from Bloomberg. I use the long-term rating for each state. A state is classified as "low rating" if it has a rating below Aa, which is about 25% of the sample. I have also performed the analysis using public pension funding ratios as a proxy for the fiscal health of a state. Results are similar using this data.

[3]Results are insensitive to the use of a linear interpolation or a cubic spline. Reported results use the linear interpolation.

D. Events

Below I list each of the events I include in my event study analysis. I very briefly describe the event and why it might set a precedent for other municipal markets.

- Puerto Rico Public Corporation Debt Enforcement and Recovery Act (Recovery Act - June 30, 2014): PR courts create legal structure for agencies (state owned corporations) of PR to restructure debt. Creates precedent through which states could enact laws allowing themselves to restructure debts. This act was eventually found to be unconstitutional. To the extent that markets realized it would not hold up legally, there may not be a reaction to the passage. Additionally, the Act applies to sub-sovereign corporations, and thus would not apply to state GO bonds directly. Again, this factor might dampen any spillover effects.
- Debt Moratorium and Financial Recovery Act (Debt Act - April 6, 2016): Law attempted to allow PR to stop making debt payments. Creates legal framework by which states could halt debt payments. Unlike the Recovery Act, applies to government debt itself, and therefore may be more of a "precedent" for states.
- PR Oversight, Management, and Economic Stability Act (PROMESA - June 30, 2016): Enacted by US Congress, creates bankruptcy framework under which PR could restructure debts (Passed by House June 9, 2016). As part of the law, an oversight board was created to guide the restructuring of Puerto Rico's debt. Debt payments were halted the day after passage It was generally seen as more favorable than Chapter 9 toward creditors. Creates precedent for federal laws which would allow states to default on debt and go through bankruptcy. Given that it is an act of the federal government it is more likely that this event (as opposed to the two previous) may be seen as precedent setting for future state default events.
- Judge Swain Revenue Bond Decision (Swan - January 30, 2018): Judge Swain rules that special revenue bond payments are "optional" by Puerto Rico during bankruptcy proceedings. This event was/is seen by many as at odds with the language in the Chapter 9 bankruptcy code. Therefore, this event is likely the largest "surprise" of the events I have measured. It sets precedent for U.S. states that they can halt special revenue payments during general default. This is the event that will likely have the largest spillovers as it sets **actual** precedent for all municipal markets. Given that it applies specifically to revenue bonds, for this event

study I look at revenue as opposed to GO bonds as they are more likely to be affected.

For the majority of these events it is not clear a priori what directional effect they should have on other markets. In general, I believe they appear to decrease market uncertainty as they have begun to create some precedent for a framework for state government default. However, one could also argue they increase uncertainty if they had previously thought there would be no framework for state default. The effects on expectations of recover rates are less clear from event to event. Part of my event study exercise is to help uncover what the market believes is the prevailing effect.

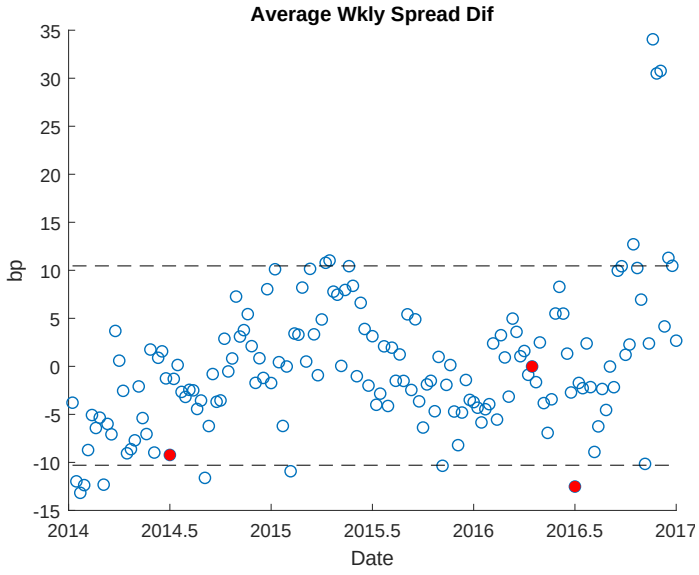
Another issue that adds noise to my estimates is the degree to which any of these events are "surprises". In an efficient market, any reactions should only arise due to unexpected news. If a piece of legislation was already anticipated, its final passage should not constitute news and therefore I should not expect to see a reaction. This will bias my estimates towards zero (i.e. no effect). My larger windows, along with the fast moving pace of much of this legislation helps mitigate this concern a bit.

The Swain decision likely has the clearest expected effect on spreads. First, this event was seen by many as a surprise and therefore constitutes "news" after which one see a change in expectations. Revenue bonds (which I use as the dependent variable in this event study) have now become relatively less secure as governments are no longer required to make payments on them in bankruptcy. Also if anything, this likely increases uncertainty as to recovery rates as the decision was unexpected and seemed to run contrary to the general understanding prior to the decision. Together, these two effects should unambiguously lead to an increase in spreads as discussed above.

Below in Figure 1 I present average weekly bond spread changes over the sample. The red dots indicate the three main events in my analysis while the dotted lines represent the 5th and 95th percentiles of the average changes. The average change in the PROMESA week lies outside the bounds while the Recovery Act is very close indicating that these were both abnormal changes. The Debt Act on the other hand appears to coincide with a more average weekly change. This figure is meant for illustration as I test the statistical significance of these events in the next section.

Figure 1: Weekly Average Bond Spread Changes

Figure 1 presents average weekly bond spread changes over my sample. The red dots indicate the three main events in my analysis while the dotted lines represent the 5th and 95th percentiles of changes.



III. Results

In this section I present the results from my event study analyses. I first present my main tests exploring whether there were any "spillovers" in municipal markets from legal events in Puerto Rico. Next I present results exploring the cross-sectional differences in those tests. Then for robustness I perform my pooled event study analysis. Finally I briefly discuss implications and interpretations of my results. All coefficients are presented in basis points.

A. Main Results

In Tables I, II, III, and IV I present the results from my main event studies. "Post-Ruling" represents the β coefficient representing the average increase/decrease in spreads after the given event. From left to right, the window for the event study decreases from 30 to 10 days. All specifications include the control variables discussed above. Specifications 2, 4, and 5 cluster standard errors at the CUSIP level while specifications 3 and 6 specification at the date level.

Table I: Recovery Act Event Study Results

Table I presents results from an event study around passage of the 6/30/14 Puerto Rico Public Corporation Debt Enforcement and Recovery Act in Puerto Rico. The event study is performed by regressing fixed-coupon general obligation U.S. state bond spreads on an indicator variable for whether or not the day is after the ruling. Controls include issue size, trade size, time to maturity and indicators for bond insurance, and optionality. Window describes the number of days before and after the event day that are included in the regression. R^2 is adjusted R^2. Estimated coefficients are presented in basis points.

	(1)	(2)	(3)	(4)	(5)	(6)
Post-Ruling	-3.328	-3.328	-3.328	-6.378**	-8.301**	-8.301
	(-1.93)	(-1.64)	(-1.45)	(-2.66)	(-2.95)	(-2.11)
N	37295	37295	37295	18629	12374	12374
R^2	0.267	0.267	0.267	0.309	0.302	0.302
Cluster	-	CUSIP	Date	CUSIP	CUSIP	Date
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Window	30 days	30 days	30 days	15 days	10 days	10 days

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

All specifications for the Recovery Act in Table I show a decrease in spreads following the passage of the law. For specifications 4 and 5 the negative coefficient is statistically significant at 6 and 8 basis points respectively. Moreover, specification 1 and 6 are statistically significant at the

10% level. Thus, this table provides some evidence of spillovers from the Recovery Act to other municipal markets. The negative coefficient suggests that this could be resulting from an increase in expected recovery rates or a decrease in uncertainty about that expectation. As discussed above, the dubious legality of this decision may lead to a dampened reaction as markets perceived the legislation as unlikely to be upheld.

Table II: Debt Act Event Study Results

Table II presents results from an event study around passage of the 4/6/2016 Debt Moratorium and Financial Recovery Act in Puerto Rico. The event study is performed by regressing fixed-coupon general obligation U.S. state bond spreads on an indicator variable for whether or not the day is after the ruling. Controls include issue size, trade size, time to maturity and indicators for bond insurance, and optionality. Window describes the number of days before and after the event day that are included in the regression. R^2 is adjusted R^2. Estimated coefficients are presented in basis points.

	(1)	(2)	(3)	(4)	(5)	(6)
Post-Ruling	-7.954***	-7.954***	-7.954**	-7.396**	-4.728	-4.728
	(-5.11)	(-4.33)	(-3.04)	(-3.04)	(-1.80)	(-1.63)
N	41482	41482	41482	21251	14491	14491
R^2	0.168	0.168	0.168	0.142	0.154	0.154
Cluster	-	CUSIP	Date	CUSIP	CUSIP	Date
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Window	30 days	30 days	30 days	15 days	10 days	10 days

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Similarly, specifications for the Debt Act in Table II show a decrease in spreads following the passage of the law. For specifications 1-4 the negative coefficient is statistically significant at approximately 8 basis points respectively. This is similar in magnitude to the effect for the Recovery Act. Again, this table provides some evidence of spillovers from the Debt Act to other municipal markets. And, as with the Recovery Act, the negative coefficient suggests that this could be resulting from an increase in expected recovery rates or a decrease in uncertainty about that expectation.

For PROMESA specifications 1-3 are statistically significant and show a decrease in spreads following the passage of the law. At 7.7 basis points, this is similar in magnitude to the effect for both events above. However, the coefficient becomes positive at the 15 and 10 day windows. Therefore the evidence here is a bit more mixed than the previous two events. This could be for a number of reasons. While PROMESA is the landmark legislation in the Puerto Rican debt crisis,

Table III: PROMESA Event Study Results

Table III presents results from an event study around finall senate passage of the 6/30/16 PROMESA. The event study is performed by regressing fixed-coupon general obligation U.S. state bond spreads on an indicator variable for whether or not the day is after the ruling. Controls include issue size, trade size, time to maturity and indicators for bond insurance, and optionality. Window describes the number of days before and after the event day that are included in the regression. R^2 is adjusted R^2. Estimated coefficients are presented in basis points.

	(1)	(2)	(3)	(4)	(5)	(6)
Post-Ruling	-7.691***	-7.691***	-7.691*	-4.213	4.353	4.353
	(-4.15)	(-3.92)	(-2.56)	(-1.62)	(1.41)	(1.30)
N	37137	37137	37137	18895	12058	12058
R^2	0.115	0.115	0.115	0.106	0.111	0.111
Cluster	-	CUSIP	Date	CUSIP	CUSIP	Date
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Window	30 days	30 days	30 days	15 days	10 days	10 days

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

its effects may not be so clear. As I discussed above, their may be conflicting channels whereby the legislation reduces legal uncertainty but decreases expected recovery rates, thus having an ambiguous net effect. And with all events, confounding events within the short window could taint the effects.

Finally, results from the Swain decision event study are in IV. Note that for this event study only I use revenue bonds as opposed to general obligation. This is because the decision pertains particularly to revenue bonds, and it is more likely that spillovers will be seen on those instruments. Here we see a consistent statistically significant increase in spreads after the decision. Again, the effect is similar to the previous event studies in magnitude with about 7.8 basis points. The decision that revenue bonds need not be paid in bankruptcy certainly seems to decrease the recovery rate of the bonds which would have a positive effect on spreads. This is what I find consistently in this table.

Taken together there is evidence that U.S. state bond prices reacted to legal events in Puerto Rico. While not a complete shut case, each of the four event studies has some specifications with statistically significant reactions. All but the Swain decision have negative coefficients. This consistency suggests that the decrease in uncertainty channel is may be at play. The Swain decision has a more clear cut likely effect on recovery rates which is consistent with the bond reactions. In

Table IV: Swain Decision Event Study Results

Table IV presents results from an event study around the decision of Judge Swain regarding special revenue bonds on 1/30/2018. The event study is performed by regressing fixed-coupon special revenue U.S. state bond spreads on an indicator variable for whether or not the day is after the ruling. Controls include issue size, trade size, time to maturity and indicators for bond insurance, and optionality. Window describes the number of days before and after the event day that are included in the regression. R^2 is adjusted R^2. Estimated coefficients are presented in basis points.

	(1)	(2)	(3)	(4)	(5)	(6)
Post-Ruling	7.837***	7.837***	7.837***	8.080***	6.738***	6.738
	(7.45)	(6.77)	(4.82)	(5.84)	(3.93)	(2.13)
N	50770	50770	50770	27506	18521	18521
R^2	0.221	0.221	0.221	0.222	0.220	0.220
Within R^2						
CUSIP FE	No	No	No	No	No	No
Cluster	-	CUSIP	Date	CUSIP	CUSIP	Date
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Window	30 days	30 days	30 days	15 days	10 days	10 days

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

the next subsection I explore whether or not these spillovers vary from state to state. While the channels are not perfectly clear, I see these results as in important piece of evidence that markets are learning about potential legal frameworks for state default and are incorporating that information into municipal prices.

B. Interaction Results

In Tables V, VI, and VII, I present the results from my cross-sectional event studies. "Post-Ruling" represents the β coefficient representing the average increase/decrease in spreads after the given event. "Post x Low Rat" represents the interaction coefficient (ϕ) between the post-ruling indicator and an indicator for a state with a low credit rating.

Table V: Recovery Act Event Study Results: Cross-Sectional

Table V presents results from an event study around passage of the 6/30/14 Puerto Rico Public Corporation Debt Enforcement and Recovery Act in Puerto Rico. The event study is performed by regressing fixed-coupon general obligation U.S. state bond spreads on an indicator variable for whether or not the day is after the ruling. Low Rating is and indicator for whether or not the state has a below Aa credit rating from Moody's. Controls include issue size, trade size, time to maturity and indicators for bond insurance, and optionality. Window describes the number of days before and after the event day that are included in the regression. R^2 is adjusted R^2. Estimated coefficients are presented in basis points.

	(1)	(2)	(3)	(4)	(5)	(6)
Post-Ruling	0.139	0.139	0.139	-2.822	-4.030	-4.030
	(0.07)	(0.06)	(0.06)	(-1.20)	(-1.50)	(-1.17)
Low Rating	82.43***	82.43***	82.43***	85.80***	106.9***	106.9***
	(30.15)	(13.97)	(15.43)	(12.87)	(12.89)	(5.20)
Post x Low. Rat.	124.4***	124.4***	124.4***	116.0***	95.22***	95.22***
	(27.04)	(14.67)	(17.49)	(10.92)	(8.26)	(4.39)
N	37295	37295	37295	18629	12374	12374
R^2	0.330	0.330	0.330	0.375	0.377	0.377
Cluster	-	CUSIP	Date	CUSIP	CUSIP	Date
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Window	30 days	30 days	30 days	15 days	10 days	10 days

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The Recovery Act shows cross-sectional differences in spillovers. States with lower credit ratings have much larger positive reactions to the legislation. These large coefficients, over 100bp, are statistically significant across all specifications. If the act is decreasing recovery rates, or increasing uncertainty, we would expect these coefficients. Also of note is that including the low-rating variables leaves the post-ruling coefficient insignificant across specifications. The low rating indicator itself is unsurprisingly statistically significant across specifications. This table is an outlier given the subsequent results. It seems likely that the high correlation between low rating and the inter-

action term is driving this result (the sum of the coefficients is similar to the low rating coefficients in subsequent regressions), and therefore the large interaction coefficients perhaps should not be taken at face value.

Table VI: Debt Act Event Study Results: Cross-Sectional

Table VI presents results from an event study around passage of the 4/6/2016 Debt Moratorium and Financial Recovery Act in Puerto Rico. The event study is performed by regressing fixed-coupon general obligation U.S. state bond spreads on an indicator variable for whether or not the day is after the ruling. Low Rating is and indicator for whether or not the state has a below Aa credit rating from Moody's. Controls include issue size, trade size, time to maturity and indicators for bond insurance, and optionality. Window describes the number of days before and after the event day that are included in the regression. R^2 is adjusted R^2. Estimated coefficients are presented in basis points.

	(1)	(2)	(3)	(4)	(5)	(6)
Post-Ruling	-8.497***	-8.497***	-8.497**	-8.269***	-6.432**	-6.432*
	(-5.83)	(-5.08)	(-3.36)	(-3.75)	(-2.81)	(-2.27)
Low Rating	265.0***	265.0***	265.0***	241.7***	241.4***	241.4***
	(71.71)	(20.82)	(39.40)	(17.46)	(16.96)	(32.44)
Post x Low. Rat.	-5.404	-5.404	-5.404	11.08	16.61	16.61
	(-1.09)	(-0.71)	(-0.65)	(1.08)	(1.40)	(1.33)
N	41480	41480	41480	21251	14491	14491
R^2	0.334	0.334	0.334	0.282	0.312	0.312
Cluster	-	CUSIP	Date	CUSIP	CUSIP	Date
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Window	30 days	30 days	30 days	15 days	10 days	10 days

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Both the Debt Act and PROMESA show no evidence of cross-sectional effects as the interaction term is not statistically significant. The coefficients on the post-ruling variable are consistent with the results in the previous section. This suggests those results are not being driven by low rating states. Moreover, after controlling for credit quality, the PROMESA results are even stronger here than in the previous section. As with the previous section this lack of effect could also arise from the different channels working at the same time. Additionally, it may be that the high degree of noise in the estimation windows makes it difficult to tease out any cross-sectional effects.

Thus, there is no broad evidence of cross-sectional differences in spillovers due to credit quality. Although for the Recovery Act I find stronger positive reactions for states with low credit ratings. I also performed these regressions using pension funding ratios, as opposed to credit ratings, as

Table VII: PROMESA Event Study Results: Cross-Sectional

Table VII presents results from an event study around final senate passage of the 6/30/16 PROMESA in Puerto Rico. The event study is performed by regressing fixed-coupon general obligation U.S. state bond spreads on an indicator variable for whether or not the day is after the ruling. Low Rating is and indicator for whether or not the state has a below Aa credit rating from Moody's. Controls include issue size, trade size, time to maturity and indicators for bond insurance, and optionality. Window describes the number of days before and after the event day that are included in the regression. R^2 is adjusted R^2. Estimated coefficients are presented in basis points.

	(1)	(2)	(3)	(4)	(5)	(6)
Post-Ruling	-1.104	-1.104	-1.104	4.515*	7.002**	7.002
	(-0.65)	(-0.73)	(-0.54)	(2.16)	(2.91)	(2.12)
Low Rating	304.3***	304.3***	304.3***	308.4***	298.5***	298.5***
	(88.45)	(23.60)	(46.15)	(19.65)	(17.82)	(35.63)
Post x Low. Rat.	0.180	0.180	0.180	-11.76	17.10	17.10
	(0.03)	(0.02)	(0.02)	(-1.05)	(1.11)	(0.90)
N	37118	37118	37118	18885	12056	12056
R^2	0.342	0.342	0.342	0.327	0.330	0.330
Cluster	-	CUSIP	Date	CUSIP	CUSIP	Date
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Window	30 days	30 days	30 days	15 days	10 days	10 days

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

a proxy for fiscal health. Results were very similar. This result is a bit surprising given that one would expect these legal events to be more relevant for states that are closer to default. In future work I hope to develop a model of legal uncertainty and municipal bond prices which would hopefully illuminate how one might expect reactions to vary in the cross-section.

IV. Conclusion

In this paper I study the spillovers of legal decisions regarding the Puerto Rican debt crisis on municipal debt markets. I find that U.S. state bond prices do have statistically significant reactions to events in Puerto Rico. Although these reactions differ in size, direction (and significance) across events. However, I do not find evidence of strong cross-sectional differences in these reactions based on credit strength. The reactions are generally decreases in spreads (and therefore borrowing costs) which suggests these events may be reducing legal uncertainty around state government default.

Overall, I see my work as an important first step in understanding the role of legal uncertainty and expectations in municipal bond prices. My results suggest that markets see these legal decisions as potentially setting precedent for state government default. Ultimately the legal uncertainty channel in municipal bond yields required more research. However, if that channel is real it suggests that creating a legal framework for state government default, and therefore decreasing uncertainty, could lead to lower borrowing costs today for municipal governments.

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