TWO PAPERS ON PUERTO RICO'S DEBT CRISIS

Ryan Michael Leary

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Approved by:

Anusha Chari

Peter Hansen

Neville Francis

Toan Phan

Simon Alder

ABSTRACT

Ryan Michael Leary: Two Papers on Puerto Rico's Debt Crisis
(Under the direction of Anusha Chari)

My dissertation utilizes the natural experiment of Puerto Rico's debt crisis in order to investigate the economic effects of (sub)sovereign default risk and the pricing of security contract provisions.

The first chapter uses the interesting case of Puerto Rico to address the questions: do investors price contract provisions and the related law? Does the pricing of contract provisions vary with credit risk? Puerto Rico provides an interesting case allowing the study of three different types of contract provisions in the presence of high and increasing credit risk; a strong legal system; and rich data to select well matched control groups. I find that investors indeed price contract provisions specifying governing law, securing debt with specific revenues, and including collective action clauses. I also find that investors especially price these contract provisions when credit risk is highest.

The second chapter uses Puerto Rico's unique characteristics as a U.S. territory to examine the real effects of (sub) sovereign default risk. In the post-2012 period of increased default probabilities, Puerto Rico spirals into a significant decline and the co-integrating relationship with real activity on the US mainland breaks down. Cross-industry variation in default risk exposure identifies significantly higher employment growth declines in external finance and government demand dependent industries. Using government bond yields and stock returns we confirm that news of increased default risk raises the cost of capital for the Puerto Rican government and for publicly traded Puerto Rican firms.

To my loving wife, Jing Zhou, without whose patient and unwavering support I would not have succeeded.

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CHAPTER 1

INTRODUCTION

The global financial crisis and the subsequent debt crises highlight the heightened levels of sovereign default risk across the developed world. A large literature in international economics investigates the costs of sovereign default and default risk.[1] Puerto Rico's financial crisis, involving a debt burden of about $72 billion, marks the largest municipal restructuring in U.S. history, far surpassing Detroit's $18 billion bankruptcy.[2] The study of Puerto Rico's interesting crisis allows contributions to two key questions in the sovereign debt literature. First, do investors price contract provisions and the related law? Second, does sovereign default risk have real effects on the economy?

My dissertation uses Puerto Rico's crisis as a case study to add evidence to the debate surrounding both of these questions with two papers. By focusing exclusively on Puerto Rico's crisis, the two chapters in my dissertation provide an in depth understanding of the nuances of Puerto Rico's crisis and in so doing, help address wider questions about sovereign debt crises using Puerto Rico's unique attributes. My first paper (Chapter 2) investigates the pricing of key contract provisions for Puerto Rican debt. In doing so, the paper contributes to wide ranging research that asks the questions: do investors price contract provisions and the related law? Does the pricing of contract provisions vary with credit or default risk? To my knowledge, this is the first paper to address these questions for the case of Puerto Rico or any municipal issuer.

Puerto Rico's unique status as a U.S. territory implies that its subsidiaries, such as municipalities, cannot file for bankruptcy under Chapter 9 of the U.S. Bankruptcy Code. Further, while local Puerto Rican laws govern Puerto Rico's bonds, U.S. courts ultimately determined that Puerto Rico cannot change its laws to reduce its debt as the Contracts Clause provides U.S. constitutional protection on government interference with private contracts (Commonwealth of Puerto Rico v. Franklin California Tax-Free Trust et al., October 2015). Puerto Rico is also an interesting case study because it offers multiple sources of variation in the inclusion of contract provisions across different types of debt.

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[1] For example, Borensztein and Panizza (2009), Yeyati and Panizza (2011), Cruces and Trebesch (2013), Hébert and Schreger (2016). The related literature provides a more comprehensive list.

[2] See Park and Samples (2017) for a detailed accounting of Puerto Rico's debt burden.

First, Puerto Rico issued debt under New York law in 2014, with the typical and express aim of assuaging investor concerns about the bias of domestic courts.[3,4] Second, Puerto Rico issued debt under a related entity, the Puerto Rico Sales Tax Financing Corporation which promises no recourse to the full faith and credit of Puerto Rico, but rather promises by law a first lien on a sales and use tax to secure the debt. Finally, the U.S. federal government passed the Puerto Rico Oversight, Management, and Economic Stability Act (referred to as "PROMESA" hereafter) which retroactively enacted collective action clauses (referred to as "CACs" hereafter) for Puerto Rican debt.

To conduct my investigation, I use a dataset retrieved from Bloomberg containing daily bond yields and characteristics for over 4,000 Puerto Rican bonds spanning a decade. The results suggest that investors indeed price contract provisions and law, especially when credit risk is highest. The findings are consistent with the hypothesis that investors price contract provisions and that investors value them more when a restructuring becomes more likely.

First, I find that New York law debt trades at higher yields than Puerto Rican law debt. This result differs from the findings in the existing literature that shows a foreign-law premium (Chamon et al. (2015); Clare and Schmidlin (2014)). I also find that the differential in the pricing of New York law and Puerto Rican law debt increases as Puerto Rico's credit risk increases. Second, I find that general obligation debt (referred to as "GO" hereafter) trades at higher yields than COFINA debt. This result is consistent with the finding in the existing literature that secured debt trades at lower yields across corporate issuers (Bradley and Roberts (2015)). I also find that investors pricing differential for the alternative legal protections of each type of debt increases when credit risk is at its highest. Finally, I find that news of PROMESA significantly affects GO bond yields. Specifically, the passage of PROMESA by the U.S. Senate and the signing of PROMESA by President Obama were associated with an increase in bond yields. This result differs from the finding in the existing literature that CACs reduce yields across securities (e.g. Carletti et al. (2017); Bardozzetti and Dottori (2014)). The finding that investors priced news of PROMESA when Puerto Rico was closest to default again supports the hypothesis that legal protections are most valued when credit risk is highest.

In joint work with Anusha Chari and Toan Phan, my second paper (Chapter 3) examines the real effects of anticipation of Puerto Rico's default. First, using activity for the mainland U.S. as a control, we investigate whether the deterioration in Puerto Rico's credit rating and credit spreads that occurred after 2012 led to a

[3] https://www.publicfinancematters.com/2014/02/could-bondholders-bring-claims-against-puerto-rico-bond-issuers-in-courts-outside-puerto-rico/#more-989

[4] Indeed, New York courts are also known to be among the most protective of creditor rights. I thank Mitu Gulati for his expertise on this topic

significant divergence in Puerto Rico's real economic activity from the rest of the U.S.. Second, we use an approach similar to Rajan and Zingales (1998) to establish that increased default risk reduces employment in industries that are ex ante more exposed or sensitive to a default event due to greater dependence on external finance. We use this methodology to address the concern that declines in economic activity may drive increased default probability and thus confound identification of the effect of default probability on employment. Similarly, we investigate whether increased default risk reduces employment in industries more exposed to government demand. Third, we use an event study framework to investigate whether changes in Puerto Rico's credit risk affected yields on government debt or the stock returns of public Puerto Rican firms. We identify changes in Puerto Rico's credit risk using ratings actions on Puerto Rican debt and legal events related to the legal rights of Puerto Rican government entities to restructure their debt. Standard event-study assumptions allow us to causally identify the effect of changes in sovereign risk on the cost of capital.

The main findings are as follows. First, while the U.S. private employment, economic activity, and investment spending improved significantly post-2012, Puerto Rico's did not. Specifically, difference-in-difference estimates suggest that average quarterly private employment growth, economic activity growth, and investment spending growth were significantly lower for Puerto Rico compared to the U.S. mainland post-2012 relative to the pre-2012 period. This divergence coincides with the increased credit spreads on Puerto Rican debt and the declining credit ratings that preceded Puerto Rico's default. These results establish that increased (sub)sovereign risk coincided with a negative and significant aggregate divergence of Puerto Rico's economy from the rest of the U.S. mainland.

Second, increased default probabilities are associated with lower employment growth in industries that are relatively more exposed to Puerto Rican government demand and more dependent on external finance. These findings are both statistically and economically significant. Further, the magnitude of the negative effect of default risk on employment growth in government-demand-dependent industries increases when the government undertakes austerity measures. One potential rationale for these results is that agents learn about future government policy when they observe how austerity measures respond to increased default risk. We also find that increased default risk Granger causes austerity, indicating the government may undertake austerity in response to borrowing constraints or to reassure investors.

Last, we find that negative credit events are associated with significant increases in credit spreads on Puerto Rican debt and significant decreases in stock returns for Puerto Rican firms. These findings show that increased credit risk significantly increased the cost of capital for the Puerto Rican government and Puerto Rican firms.

CHAPTER 2

THE PRICING OF CONTRACT PROVISIONS AND LAW: THE CASE OF PUERTO RICO

2.1 Introduction

Puerto Rico's financial crisis, involving a debt burden of about $72 billion, marks the largest municipal restructuring in U.S. history, far surpassing Detroit's $18 billion bankruptcy.[1] This research joins a growing body of literature studying Puerto Rico's crisis.[2] Specifically, this paper conducts a case study investigating the pricing of key contract provisions of Puerto Rican debt. In doing so, this paper contributes to wide ranging research which asks the questions: do investors price contract provisions and the related law? Does the pricing of contract provisions vary with credit risk? To my knowledge, this paper is the first to address these questions for the case of Puerto Rico or any municipal issuer. Puerto Rico is an interesting case study to contribute to this literature because it offers multiple sources of variation in the inclusion of contract provisions.

The case of Puerto Rico's debt crisis and default in 2016 is the latest in a long line of sovereign default crises which have raised questions about the pricing of contract provisions and their potential modification by sovereigns after issuance (known as legal risk).[3] Indeed, sovereign debt is unique in that the issuer's legislature and court system has the authority to impose restructuring terms on holders of domestic law debt (Zettlemeyer et al. (2013); Chamon et al. (2015)).

To address legal risk with the aim of reducing borrowing costs, sovereigns have turned to issuing debt under foreign legal systems, typically in New York or London, where domestic legislative fiat and domestic courts can not affect contract provisions (Carletti et al. (2017)). Sovereigns have also sought to include contract provisions aimed at streamlining the restructuring process. In particular, collective action clauses (referred to as "CACs" throughout), which allow a majority of creditors to impose restructuring terms on holdout creditors, have been commonly included in sovereign debt since the mid 1990s (Panizza et al. (2009); Aguiar and Amador (2014)). U.S. municipal and corporate issuers have also sought to secure debt by including provisions pledging specific

[1] See Park and Samples (2017) for a detailed accounting of Puerto Rico's debt burden.

[2] See Feliciano and Green (2017); Chari et al. (2017); Gulati and Rasmussen (2017); Park and Samples (2017).

[3] For example, consider the case of Greece's restructuring in 2012 where Greece imposed retroactive modification of contract terms (Zettlemeyer et al. (2013)).

assets or revenue streams.

Puerto Rico's interesting status as a sub-sovereign of the United States created an environment where investor concern about legal risk resulted in some of the same contract provisions seen in the sovereign and municipal debt markets. First, Puerto Rico issued debt under New York law in 2014, with the typical and express aim of assuaging investor concerns about the bias of domestic courts.[4,5] However, Puerto Rico's New York law debt is interesting in that it may violate the law by exceeding Puerto Rico's legally mandated debt service limits, potentially rendering the debt unenforceable and void (Showalter (2017)). I ask the question, how did investors price the Puerto Rican debt issued under New York law versus Puerto Rican law? To answer this question, I match Puerto Rican law debt to New York law debt along observable security issue characteristics and estimate the average yield differential in the otherwise equivalent debt using a panel regression. I also investigate whether this differential varied with Puerto Rico's credit risk.

Second, Puerto Rico attempted to provide two types of legal protections that to my knowledge, are unique among sovereign issuers and offer protection from the legal risk inherent in domestic law debt. First, Puerto Rico issued general obligation debt (referred to as "GO" hereafter) which is backed by the full faith and credit of Puerto Rico and was further guaranteed to be paid before any other obligation under Puerto Rico's Constitution. Second, Puerto Rico issued debt under a related entity, the Puerto Rico Sales Tax Financing Corporation (referred to as "COFINA" hereafter) which promises no recourse to the full faith and credit of Puerto Rico, but rather promises by law a first lien on a sales and use tax. The pledged revenues were unavailable for the payment of any other obligation, including GO debt. I ask the question, did investors value the Constitutional protections of GO debt and the securing revenues offered by COFINA debt differently? To answer this question, I match Puerto Rican law GO debt to Puerto Rican law COFINA debt along observable security issue characteristics and estimate the average yield differential in the otherwise equivalent debt using a panel regression. I also investigate whether this differential varied with Puerto Rico's credit risk.

Finally, the U.S. federal government passed the Puerto Rico Oversight, Management, and Economic Stability Act (referred to as "PROMESA" hereafter) which retroactively imposed CACs on Puerto Rican debt. However, PROMESA differs from other cases of CACs because the decision was imposed by an outside government after issuance and also included an option for a court supervised restructuring process which like CACs, also allows the binding of holdout creditors (Gulati and Rasmussen (2017)). Much like CACs, PROMESA may create an

[4]https://www.publicfinancematters.com/2014/02/could-bondholders-bring-claims-against-puerto-rico-bond-issuers-in-courts-outside-puerto-rico/#more-989

[5]Indeed, New York courts are also known to be among the most protective of creditor rights. I thank Mitu Gulati for his expertise on this topic

incentive for Puerto Rico to default by making default easier, reducing individual bondholder rights versus the prior unanimous consent clauses. On the other hand, PROMESA reduces negotiation inefficiencies given default and improves the prospects for an orderly recovery by bondholders.[6] I ask the question, how did investors price the change in the restructuring process created by PROMESA? I answer this question by using an event study to measure the effect of news events indicating the law was moving closer to being enacted. I also assess whether the pricing of PROMESA varied with Puerto Rico's credit risk.

Main Findings: In all three cases, I find that investors indeed price contract provisions and law, especially when credit risk is highest. The results are consistent with the hypothesis that investors price contract provisions and that investors value them more when a restructuring becomes more likely. First, I find that New York law debt trades at higher yields than Puerto Rican law debt. These findings are both statistically and economically significant. This result differs from the findings in existing literature which show a foreign law premium (Chamon et al. (2015); Clare and Schmidlin (2014)). One possible explanation is that investors priced the risk that they would not be entitled to recovery in the case of Puerto Rico's New York law debt due to its potential violation of Puerto Rico's legal debt limits. I also find that the differential in the pricing of New York law and Puerto Rican law debt increases as Puerto Rico's credit risk increases.

Second, I find that GO debt trades at higher yields than COFINA debt. These findings are both statistically and economically significant. This result is consistent with the finding in the existing literature that secured debt trades at lower yields across corporate issuers (Bradley and Roberts (2015)). I also find that investors price the different legal protections of each type of debt most when credit risk is highest.

Finally, I find that news of PROMESA did significantly affect GO bond yields. Specifically, the passage of PROMESA by the Senate and the signing of PROMESA by the President were associated with an economically and statistically significant increase in bond yields. This result differs from the finding in the most recent literature that CACs reduce yields across securities (e.g. Carletti et al. (2017); Bardozzetti and Dottori (2014)). It is possible that in the case of Puerto Rican debt, individual creditors valued the right to holdout more than the streamlining of the recovery process affected by the introduction of CACs. This may result from the strength of the U.S. legal system and protections of creditor rights.[7] The finding that investors only priced news of PROMESA when Puerto Rico was closest to default again supports the theory that legal protections are most valued when credit risk is highest.

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[6] See Ghosal and Thampanishvong (2013) for a discussion of this trade-off for CACs.

[7] It is also possible that investors saw the court supervised bankruptcy process as more favorable to the issuer than the traditional standalone CACs observed in sovereign debt.

Related Literature: This paper joins a growing number of recent papers studying Puerto Rico's debt and economic crisis. To the best of my knowledge, this paper is the first to estimate the pricing of contract provisions in the case of Puerto Rico or any other municipal issuer. Feliciano and Green (2017) show the significant negative effect that the repeal of Section 936 tax exemptions had on Puerto Rican manufacturing wages and the number of manufacturing establishments. Chari et al. (2017) find that increased default risk is associated with reduced economic activity in the aggregate and especially in sensitive industries. Gulati and Rasmussen (2017) discuss the legal debate about Puerto Rico's rights to restructure and Park and Samples (2017) discuss the types of Puerto Rican debt and the related legal issues.

This paper contributes to a broad debate about whether contract provisions matter. Bolton and Jeanne (2009) argue that debt that is harder to restructure is effectively senior and should trade at lower yields. On the other hand, Roubini (2000) and Weinschelbaum and Wynne (2005) argue that protections like CACs and governing law likely don't matter because investors think they have implicit guarantees of bailouts and because sovereigns can render contract protections null ex-post. This paper's investigation of the value of governing law, securing revenues, and CACs all add evidence to the debate in this literature.

More narrowly, this paper adds to the literature studying the borrowing costs of domestic law versus foreign law sovereign debt. Studying Eurozone debt, existing work finds that foreign law debt trades at significantly lower yields than domestic law debt, especially when default risk is elevated (Chamon et al. (2015); Clare and Schmidlin (2014); Choi et al. (2011)). Existing work uses Eurozone debt to address the confounding factor of a currency risk premium. The case of Puerto Rico's issuance of New York law debt provides another case of comparable domestic and foreign law debt issued under the same currency as well as the interesting possibility that the debt will be found to be illegal. In addition, Puerto Rico's crisis allows me to investigate the effect of governing law in a high credit risk environment when legal protections should matter most.

This paper also contributes to the literature studying the price impact of securing debt. Smith and Warner (1979) argue that secured debt may, in theory, optimally comprise any portion of total debt, depending on the relative costs of the lien imposed on the borrower versus the benefits of improved enforcement and preventing subordination. Bradley and Roberts (2015) find that including debt covenants, including securing debt, reduces yields across borrowers and is especially issued by smaller, high risk borrowers. The investigation of COFINA versus GO debt in this paper exploits the debt of the same issuer facing the same economic risks where prior studies of secured debt focus primarily on cross-issuer variation.

This paper further adds to the literature studying the price impact of CACs. Ghosal and Thampanishvong (2013) formalize the theoretical trade-off inherent in CACs and their effect on borrowing costs. Specifically,

CACs may increase the incentive to default while also increasing recovery rates. Earlier empirical findings about the effect of CACs on prices is mixed and the existing research has vigorously debated the appropriate sampling and methodology (Tsatsaronis (1999); Eichengreen and Mody (2000); Eichengreen and Mody (2004); Becker et al. (2003); Gugiatti and Richards (2003)). These results were subjected to criticisms in later work. Specifically, proxies for the presence of CACs and selection of governing law for a security raised endogeneity concerns (Gugiatti and Richards (2004)). More recently, panel data models identify CACs directly and find that CACs reduce yields and that the effect varies with credit risk, though the results on how credit risk matters differ across studies (Bardozzetti and Dottori (2014); Carletti et al. (2017)). As with the most recent work on foreign law, the data on domestic law bonds with CACs issued in the Eurozone allows the comparison of debt that is issued under the same domestic law and in the same currency. In addition, the issuance of debt with CACs was imposed on the whole Eurozone and is thus exogenous to the issuers (Carletti et al. (2017)).

Puerto Rico provides an additional natural experiment to assess the effect of CACs on borrowing costs. As with the latest existing work on CACs, Puerto Rico allows an investigation of the effect of CACs on debt issued under the same legal system and in the same currency. In contrast to the Eurozone experiment, PROMESA provides exogenous and discrete variation in the presence of CACs within-security, rather than across securities. PROMESA is exogenous because it was imposed by the U.S. federal government, rather than the local government.

Robustness checks and plan of the paper: I conduct several robustness checks to confirm my benchmark results. I find that my results are robust to alternative definitions of which securities price frequently enough to be included in the selected samples. I restrict the benchmark samples to exclude the period following the issuance of the selected securities and preceding Puerto Rico's default and find my results are robust. I control for outliers in observed yields by using the log of the mid yield rather than the raw mid yield and find the results remain robust. I also confirm my results are robust to an alternative measure of credit risk. To ensure my results are not dependent on the size of the event window in the event study, I expand the benchmark event window and find that the benchmark results remain robust. I also find that my event study results are robust to controlling for time trends and event window overlap.

The paper proceeds as follows. Section 3.2 provides a brief historical summary of the debt contracts studied here. Section 2.3 establishes the pricing of New York law versus Puerto Rican law debt. Section 2.4 documents the pricing differential between GO and COFINA debt. Section 2.5 shows the effect of PROMESA on bond yields. Section 2.6 presents robustness checks. Section 2.7 concludes.

2.2 Background on Puerto Rican Debt

GO Debt and New York Law: On March 11, 2014 Puerto Rico adopted a bond resolution authorizing the issuance of $3.5 billion in additional GO bonds, maturing on July 1, 2035. This was Puerto Rico's final issuance of GO debt and amounted to 22% of total GO debt and less than 5% of Puerto Rico's total public debt. These bonds carried the same legal guarantee as the outstanding GO debt of the Commonwealth. This guarantee is made in Puerto Rico's constitution and stipulates that GO bonds are backed by Puerto Rico's full faith, credit and taxing power and, importantly, that GO debt has the first claim on revenues over all of Puerto Rico's obligations, including operating expenses like public services and the pensions of public employees (Park and Samples (2017)). Of course, much like domestic law CACs (Carletti et al. (2017)), Puerto Rico could overturn existing Puerto Rican law protecting any of its debt with new legislation, but the imposition of this hurdle may nevertheless provide value to investors, depending on the degree of "partial commitment" investors perceive in each type of debt (Aguiar and Amador (2014)).

The major difference between this GO debt issue and the GO debt issued prior to 2014 was the agreement that the laws of the State of New York apply to any case related to these bonds. The lawsuits may be brought in New York state courts, Puerto Rican courts, or U.S. federal courts in New York or Puerto Rico.[8] The issuance of this debt occurred in an environment where Puerto Rico had recently been downgraded to a credit rating of BB+ by Standard & Poors, just one notch above junk status. The decision was made to issue the debt with New York governing law in order to provide investors with a forum for resolving disputes which was seen as less partial to Puerto Rican issuers than Puerto Rican courts.[9]

COFINA Debt: In 2007, Puerto Rico established COFINA in order to finance Puerto Rico's debt payable to the Puerto Rican Government Development Bank. COFINA debt is secured by the first lien on half of a 5.5% sales and use tax to be deposited in a fund solely for the payment of COFINA debt. This guarantee is made in Puerto Rican law but not in Puerto Rico's constitution as with GO debt. There is no recourse to the Commonwealth of Puerto Rico beyond the dedicated sales tax. From July 2007 to December 2011 COFINA issued about $38 billion in debt. However, only $16 billion is senior COFINA debt. This amounts to about the same total value as Puerto Rico's total GO debt issues (Park and Samples (2017)).

PROMESA: On June 30, 2016, President Obama signed PROMESA. The law's first version had passed the U.S. senate on November 19, 2015 and established a framework for the restructuring of the debt of Puerto

[8] http://www.gdbpr.com/investors_resources/documents/CommonwealthPRGO2014SeriesA-FinalOS.PDF

[9] https://www.publicfinancematters.com/2014/02/could-bondholders-bring-claims-against-puerto-rico-bond-issuers-in-courts-outside-puerto-rico/#more-989

Rico and its instrumentalities which had not existed previously. The Supreme Court had ultimately affirmed on June 13, 2016 that Puerto Rico could not pass local laws allowing restructuring and that Puerto Rico did not have access to Chapter 9 of the U.S. bankruptcy code, reserved for the municipalities of states. Given this determination, a framework for Puerto Rican restructuring required Congressional action.

PROMESA temporarily halted creditor actions against Puerto Rico until February 15, 2017 and established a seven person oversight board with the aim of eliminating deficits and authority to approve Puerto Rico's fiscal plans. PROMESA also retroactively inserted standard CACs into Puerto Rico's debt which allowed a super-majority of creditors to bind holdout creditors to restructuring deals. The CACs replaced the unanimous consent clauses present in Puerto Rican debt prior to PROMESA. PROMESA also allowed Puerto Rico and its instrumentalities to declare a form of bankruptcy in federal court much like Chapter 9 of the U.S. bankruptcy code. Like CACs, the bankruptcy process allows a super-majority of creditors to bind holdout creditors (Gulati and Rasmussen (2017)).

2.3 The Pricing of New York Law Debt

To identify the pricing of Puerto Rican debt issued under New York law versus Puerto Rican law, I adopt a panel data model estimated with pooled ordinary least squares. This approach is based in the foreign law and collective action clause literature, both of which similarly attempt to identify the effect of a time-invariant security characteristic on yields (e.g. Becker et al. (2003); Eichengreen and Mody (2004); Clare and Schmidlin (2014)). Given the interesting case of Puerto Rico, it is theoretically unclear whether Puerto Rico's New York Law debt should trade at a higher or lower yield than equivalent debt issued under Puerto Rican law.

In the case of typical foreign law sovereign debt, the existing literature is unambiguous that foreign law debt should trade at a premium to otherwise equivalent domestic law debt. This follows from the fact that domestic law debt is subject to the risk that the domestic government will alter contract terms after issuance. In addition, creditor rights for foreign law debt can be litigated in a relatively unsympathetic foreign court and may result in attachment to the sovereign's assets held overseas (Chamon et al. (2015)). In this sense, Puerto Rico's New York law debt is similar to other foreign law sovereign debt, in that New York courts are known to be particularly protective of creditor rights.[10] Also note that investor concern about the bias of Puerto Rican courts was the express purpose of issuing debt under New York law.[11]

Showalter (2017) conducts an extensive discussion of the legal issues surrounding Puerto Rico's New York

[10] I thank Mitu Gulati for his expertise on this topic.

[11] https://www.publicfinancematters.com/2014/02/could-bondholders-bring-claims-against-puerto-rico-bond-issuers-in-courts-outside-puerto-rico/#more-989

law debt, which I summarize here. Puerto Rico's New York law debt is in somewhat uncharted territory because it is not certain that the courts will enforce a clause making the debt subject to New York law. In addition, Puerto Rico's issuance of New York law debt entailed a consequence that was not foreseen by the creditors' legal counsel when the debt was issued - namely, that the New York law debt may be a violation of the balanced budgets clause of Puerto Rico's Constitution. The balanced budgets clause requires that debt may not be issued that would result in Puerto Rico spending more than 15% of its internal revenues on GO debt service. This was found to apply particularly to Puerto Rico's New York law debt, potentially making this debt illegal and thus unenforceable and void. Importantly, debt issues found to be illegal have been found to be unenforceable in both New York and Puerto Rican case law. However, bondholders may have a chance at getting some recovery as New York courts may only consider the contract illegal if it violates New York law, rather than Puerto Rican law. Bondholder can also try and argue for quasi-contractual protection.

In summary, lawsuits pertaining to New York law debt may be heard in a venue known to be among the most protective of creditor rights, but the debt may also be in danger of being deemed void. Therefore, I leave the sign of investor beliefs about the likely legal outcomes to my empirical investigation. The question of the effect of credit risk on the pricing of New York law debt is more straightforward. If the New York debt issue is associated with different beliefs about recovery rates, then a more likely default should widen this differential.[12]

2.3.1 Data and Summary Statistics

The analysis of the pricing of Puerto Rican debt issued under New York law versus Puerto Rican law uses two groups of bonds: GO debt issued by Puerto Rico under Puerto Rican law before the issuance of New York law debt on March 11, 2014, and GO debt issued by Puerto Rico under New York law on March 11, 2014 (Puerto Rico's final GO issuance). The data used in the analysis comes from Bloomberg. The sample of daily mid-yields I use runs from after Puerto Rico's final issuance of GO debt on March 11, 2014 to before the signing of PROMESA on June 30, 2016.

I filter the sample of Puerto Rican law GO bonds that match the characteristics of New York law GO bonds. I further require that the selected bonds do not mature during the sample period, have between 1 and 30 years until maturity, and have non-stale yield observations in at least 300 of the 598 trading days in the sample period.[13] Section A.3 describes the filtering process in more detail.

Table A.1 reports the summary statistics of the New York law GO sample and the Puerto Rican law GO

[12]This follows from the fact that Puerto Rico would likely seek to avoid the potential reputation cost of default unless it decided to substantially restructure its debt. This is especially plausible given that New York law debts is a small share of total Puerto Rican debt.

[13]I add the latter restriction to exclude securities which do not have updated pricing information throughout the sample. As 300 trading days is an arbitrary requirement, I relax this assumption for robustness.

sample. On average, New York law bonds have been outstanding for 6.3 fewer years and have a $3.3 billion higher face value; both differences are significant at the 99% level. However, the average time to maturity of New York law and Puerto Rican law GO debt are not statistically different, averaging about 20 years. The average yield to maturity on New York law bonds is 10.33% and is 1.62% higher than Puerto Rican law bonds, a difference significant at the 99% level. Figure A.1 shows the average yields for the selected sample of New York law and Puerto Rican law bonds. The plot shows that the yields on both types securities increase over the sample period as Puerto Rico approaches default. New York law debt appears to trade at higher yields for the entire period, and the differential between the two sets of securities appears to widen over the sample period as Puerto Rico's credit risk increases.

2.3.2 Methodology and Results

With the New York law GO sample and the Puerto Rican law GO sample in hand, I ask the following questions: first, do investors price New York law GO debt differently than Puerto Rican law GO debt? Second, does the yield differential vary with Puerto Rico's credit risk? To answer the former question, I regress the daily mid yield to maturity for security issue i on day t on a dummy indicating if New York law pertains to a security issue while controlling for variables capturing the credit rating of Puerto Rico, the term structure of yields, and variables controlling for issue liquidity. The specification also includes time (day) fixed effects to capture security invariant time effects. The standard errors are clustered by security issue. I estimate the following benchmark model:

$$YTM_{it} = \alpha + \mu_t + \beta_1 NY_i + \beta_2 RISK_t + \beta_3 YM_{it} + \beta_4 YM_{it}^2 + \beta_5 AGE_{it} + \beta_6 FV_i + \epsilon_{it} \tag{2.1}$$

where YTM_{it} is the mid yield to maturity on security issue i on day t, μ_t is a time (day) fixed effect, NY is a dummy indicating if a security is issued under New York law, $RISK$ is the S & P Long Term issuer rating measured as a categorical variable ranging from 1 (AAA) to 22 (D), YM is the number of years remaining to maturity, AGE is the number of years since issue, and FV is the face value in millions (definitions of the independent variables are included in Table A.9).

The coefficient on NY is the primary variable of interest, capturing whether or not Puerto Rican debt issued under New York law is priced differently than Puerto Rican debt issued under Puerto Rican law. $RISK$ captures the effect of credit ratings on yields and thus the coefficient is expected to be positive, indicating that increased risk is associated with higher yields. $RISK$ runs from 11 (BB+) to 20 (CC) over the sample period. AGE and FV are typical controls included to account for liquidity. This is a concern especially because New York law

debt is on the run during the entire sample period.

The results are in Table A.2. In column 1, I regress yield on a constant and NY, excluding fixed effects. The constant term indicates that the average yield for Puerto Rican law GO debt is 8.7%. The coefficient on NY indicates that New York law GO debt has an average yield 1.6 percentage points higher than Puerto Rican law GO debt, an 18% increase significant at the 99% level. The results are consistent with the hypothesis that from the perspective of investors, New York law debt provided less protection than Puerto Rican law debt, perhaps given the possibility that New York law debt would be deemed void and unenforceable. The results indicate that investors do price contract provisions and the related legal environment. However, specification 1 has a low R squared of .058 and omits several key bond characteristics.

In column 2, I introduce time (day) fixed effects to control for security-invariant time effects, controlling for many plausible types of omitted variable bias. I find an increased R squared of .285 and find no significant change in the results of specification 1. In column 3, I include controls for risk and the term structure of yields to account for bond characteristics and improve model fit. With an R squared of .315, specification 3 further improves explanatory power. The positive coefficient on NY indicates that New York law debt remains associated with higher yields than debt issued under Puerto Rican law, significant at the 99% level. Turning to additional controls, the positive and significant coefficient on $RISK$ indicates that a one unit increase in $RISK$ (a one notch downgrade) is associated with a .09% increase in yields. This is the expected result and indicates that increased credit risk is associated with higher yields. The coefficients on YM and YM^2 are not significant.

To determine the economic importance of NY in specification 3, I use the estimated coefficients of specification 3 and the average values of the independent variables for Puerto Rican law debt. I find the predicted average yield of Puerto Rican law debt is 8.48%, while the predicted average yield of New York law debt that is otherwise the same as Puerto Rican law debt is 10.34% or 22% higher than Puerto Rican law debt.[14] Therefore, the controls added in specification 3 improve sample fit and show that New York governing law is associated with a larger increase in borrowing costs once key security characteristics are controlled for.

In column 4, I add controls for liquidity to the model in specification 3. Column 4 continues to show that New York governing law is associated with a significantly higher yield than Puerto Rican law debt. Specifically, New York governing law is associated with yields 17.4% higher than equivalent Puerto Rican law debt, significant at the 95% level. When compared to the predicted average yield of Puerto Rican law debt from specification 4 of 8.3%, New York law debt trades at yields 210% higher than Puerto Rican law debt on average. However, these

[14]The predicted yields reported here pertain to the reference time period. The choice of time period has no effect on the percent difference in yields.

estimates are based on the assumption that the included liquidity controls do an adequate job of capturing the liquidity premium on both types of debt.

Importantly, there are significant differences in the range of the liquidity controls across samples seen in Table A.1. Specifically, the range of the face value of Puerto Rican law debt is far from the face value of New York law debt. In addition, the fact that New York law debt is on the run also raises the concern that the included liquidity controls may not adequately control for the liquidity premium which may be present in New York law debt. However, note from specifications 1 through 3 that New York law debt trades at significantly higher yields than Puerto Rican law debt in the absence of liquidity controls. If New York law debt carries a significant liquidity premium, the estimates in specifications 1 through 3 would underestimate the positive effect New York governing law has on yields. For this reason, specifications without liquidity controls provide the most conservative estimate of the effect of governing law. I discuss this issue in further detail in Section A.6.

I turn to my next question; does the yield differential between New York law and Puerto Rican law debt vary with credit risk? Figure A.1 offers suggestive evidence that the yield differential between New York law and Puerto Rican law debt widened as Puerto's credit risk increased. To address this question analytically, I add an interaction term between $RISK$ and NY to specification 3 of Table A.2. I use this specification because it provides the best fit among models that make the more conservative estimate of the effect of governing law. That is, I estimate the model:

$$YTM_{it} = \alpha + \mu_t + \beta_1 NY_i + \beta_2 RISK_t + \beta_3 NY_i \times RISK_t + \gamma X_{it} + \epsilon_{it} \tag{2.2}$$

where $\gamma X_{it} = \beta_4 YM_{it} + \beta_5 YM_{it}^2$.

The results are in Table A.3. Specification 1 repeats specification 3 of Table A.2, the benchmark. Specification 2 shows a positive coefficient on the interaction $NY \times RISK$, significant at the 99% level. The coefficient indicates that an increase in credit risk is associated with a larger yield differential between New York law and Puerto Rican law debt. I use specification 2 in order to determine the economic impact of $RISK$ on the marginal effect of NY. This uses the following expression for the marginal effect of NY: $\beta_1 NY_i + \beta_3 NY_i \times RISK_t$. I find that the marginal effect of NY is a 1.1% increase in yield when $RISK$ is at its lowest observed level during the sample period (BB+ or 11). When $RISK$ is at its highest observed level during the sample period (CC or 20), the marginal effect of NY is a 2.5% increase in yield, or an approximate doubling of the effect. Therefore, although NY is associated with significantly higher yields throughout the sample period, the increase in credit risk observed over the sample period is associated with a significant increase in the positive yield differential for

New York law over Puerto Rican law debt. This is consistent with the hypothesis that the more likely default is, the more investors price the different legal environments due to their effect on the recovery process. Taken together, the results indicate that investors price the different legal protections of New York law debt and that the superior legal protection of other GO debt was valued even more as default became more likely.

I also adopt a more granular approach to measuring the effect of credit risk on the marginal effect of NY. This allows me to investigate the presence of any non-linearities in the effect of credit risk on the marginal effect of NY. I do so by estimating the model in equation (2.2) and including indicator variables for each value of $RISK$ and interacting each of these with NY. I omit the equation and the results from the main text for brevity. The full results are available in specification 2 of Table A.13. Figure A.3 summarizes these results in graphic form with 90% confidence intervals.[15] Figure A.3 shows similar results to those obtained in Table A.3. Specifically, the marginal effect of NY is a 1% increase in yield when $RISK$ is at its lowest observed level during the sample period (BB+ or 11). When $RISK$ is at its highest observed level during the sample period (CC or 20), the marginal effect of NY is a 2.55% increase in yield, or an approximate doubling of the effect. The observed effect is fairly linear, with a notable spike as Puerto Rico is closest to default.

While the benchmark results establish the pricing of New York law debt by controlling for security characteristics, I also seek additional confirmation of these results. To do so, I search for the Puerto Rican law security issue from the benchmark sample with the same maturity date as the New York law issue of July 1, 2035. The maturity matched Puerto Rican law security was issued 2 years before the New York law issue. Figure A.2 plots the yields of the New York law issue and the maturity matched Puerto Rican law issue. Like Figure A.1 and the benchmark regression results, Figure A.2 shows that New York law debt trades at significantly higher yields than Puerto Rican law debt and that this differential appears to widen with increased credit risk.

2.4 The Pricing of GO and COFINA Debt

To identify the pricing of GO and COFINA protections in bond yields, I again adopt a panel data model estimated with pooled ordinary least squares based in the foreign law and collective action clause literature (e.g. Becker et al. (2003); Eichengreen and Mody (2004); Clare and Schmidlin (2014)). This approach is natural because similar to my above investigation of governing law, GO and COFINA legal protections are time-invariant security characteristics. The characteristics of GO and COFINA debt make it theoretically unclear which type of guarantee would be more valuable to investors.

On the one hand, investors in COFINA debt have seemingly clear attachment to a specific revenue stream which are legally required to be sequestered in a fund. These funds can not be used for any other purpose until

[15] Standard errors are calculated using the Delta-method.

COFINA debt is paid, whereas investors in GO debt do not have attachment to specific revenues. For this reason, investors in COFINA debt may be less concerned about difficulties in attaching to revenues. On the other hand, COFINA investors are entirely dependent on a single revenue stream, whereas investors in GO debt have broad priority over all other expenses of Puerto Rico. For this reason, investors in GO debt may feel more secure. It is also important to note there is a potential legal argument that COFINA debt was a violation of Puerto Rico's constitutional debt limit imposed for GO debt, an argument made by unsecured creditors in recent litigation.[16] This leaves seniority between these two types of debt uncertain. Finally, as GO debt is protected by Puerto Rico's constitution while COFINA is only protected under Puerto Rican law, investors may believe GO debt poses a lesser legal risk. Given these competing influences, either GO or COFINA debt may theoretically be priced higher. This makes the question of whether GO or COFINA protections are more highly valued an empirical one. The question of the effect of credit risk on the pricing of these protections is more straightforward. If GO or COFINA protections are associated with different beliefs about recovery rates, then a more likely default should widen this differential. I also test this hypothesis.

2.4.1 Data and Summary Statistics

The analysis of the pricing of the legal protections of GO and COFINA debt uses two groups of bonds: GO debt issued by Puerto Rico under Puerto Rican law and senior COFINA debt; all of which is issued under Puerto Rican law.[17] As in the governing law investigation, I restrict my sample period to before the passage of PROMESA on June 30, 2016. As the final COFINA issuance occurred on December 13, 2011 and the final GO issuance occurred on April 3, 2012, I further restrict the sample to the period beginning after the final issuance of GO and COFINA debt on April 3, 2012. The data used in the analysis comes from Bloomberg.

I select a sample of GO debt issued by Puerto Rico under Puerto Rican law and senior COFINA debt by filtering each baseline sample of bonds to include only bonds which are triple tax exempt, not pre-refunded, uninsured, non-sinkable, non-callable, non-puttable, and fixed rate. As before, I also restrict the matched sample to securities with between 1 and 30 years to maturity and that trade in at least half of the sample trading days, in this case in at least 525 of the 1,052 trading days.[18] Section A.4 describes the filtering process in more detail.

Table A.4 reports the summary statistics of the Puerto Rican law GO sample and the senior COFINA sample. On average, GO bonds have maturities of about 15 fewer years, have been outstanding for 8 more years and have

[16] https://www.debtwire.com/info/legal-analysis-judge-swain%E2%80%99s-prhta-statutory-lien-decision-instructive-other-puerto-rico-bondholders

[17] I restrict attention to GO debt issued under Puerto Rican law because COFINA debt is also issued under Puerto Rican law.

[18] Again, I include this restriction to exclude securities which do not have updated pricing information throughout the sample. As 525 trading days is an arbitrary requirement, I relax this assumption for robustness.

a $18 million higher face value than senior COFINA debt; all differences are significant at the 99% level. The average yield to maturity on GO bonds is 8.46% and is 1.11% higher than for COFINA bonds, a difference significant at the 99% level. Figure A.4 shows the average yields for the selected sample of GO and COFINA bonds. The plot shows that the yields on both types securities increase over the sample period as Puerto Rico's credit risk increased. GO and COFINA yields are relatively close for much of the sample, separating sharply as Puerto Rico approaches default and GO yields spike substantially more than COFINA yields.

2.4.2 Methodology and Results

With the Puerto Rican law GO and the senior COFINA sample in hand, I ask the following questions: first, do investors price the different legal protections and security offered by GO and COFINA debt? Second, does the yield differential vary with credit risk? To answer the former question, I proceed in a similar manner as in the governing law investigation by regressing the daily mid yield to maturity for security issue i on day t on a dummy indicating if a security issue is COFINA versus GO while controlling for variables capturing risk, the term structure of yields, and variables controlling for issue liquidity. Note that the differentials in the range of the control variables seen in Table A.4 do not include any extreme differences as seen in the governing law investigation, making their inclusion sensible. The specification also includes time (day) fixed effects to capture security invariant time effects. The standard errors are clustered by security issue. I estimate the following benchmark model:

$$YTM_{it} = \alpha + \mu_t + \beta_1 COFINA_i + \beta_2 RISK_t + \beta_3 YM_{it} + \beta_4 YM_{it}^2 + \beta_5 AGE_{it} + \beta_6 FV_i + \epsilon_{it} \quad (2.3)$$

where YTM_{it} is the mid yield to maturity on security issue i on day t, μ_t is a time (day) fixed effect, $COFINA$ is a dummy indicating if a security issue is COFINA versus GO, $RISK$ is the S & P Long Term issuer rating measured as a categorical variable ranging from 1 (AAA) to 22 (D), YM is the number of years remaining to maturity, AGE is the number of years since issue, and FV is the face value in millions (definitions of the independent variables are included in Table A.9). The coefficient on $COFINA$ is the primary variable of interest, capturing whether or not the differing legal protections and security of COFINA and GO debt are associated with a yield differential. AGE and FV are typical controls included to account for liquidity.

The results are in Table A.5. In column 1, I regress yield on a constant and $COFINA$, excluding fixed effects. The constant term indicates that the average yield for Puerto Rican law GO debt is 8.5%. The coefficient on $COFINA$ indicates that COFINA debt has an average yield 1.1 percentage points lower than Puerto Rican law GO debt, significant at the 85% level. These results tend to indicate that investors did differentiate between

the legal protections and security in GO and COFINA debt. However, these initial results have an extremely low R squared of .004 and do not control for other key bond characteristics. This is key because Table A.4 shows COFINA debt has a significantly different characteristics from GO debt.

In column 2, I include time (day) fixed effects to control for security-invariant time effects, controlling for many plausible types of omitted variable bias. The results show a significant increase in R squared to .373 and no qualitative change in the result that COFINA debt trades at significantly lower yields.

In column 3, I include additional variables to control for key bond characteristics and improve model fit. With an R squared of .450, specification 3 has substantially improved explanatory power over specifications 1 and 2. The negative coefficient on $COFINA$ indicates that COFINA debt is associated with a 3.1% lower yield than otherwise equivalent Puerto Rican law GO debt, significant at the 95% level. Turning to additional controls, the positive and significant coefficient on $RISK$ indicates that a one unit increase in $RISK$ (a one notch downgrade) is associated with a .78% increase in yields. This is the expected result and indicates that increased credit risk is associated with higher yields. The coefficients on YM and YM^2 are each significant at the 99% level. The coefficient on FV is significant at the 95% level and indicates that issues with higher face values tend to have lower yields. As higher face values are associated with increased liquidity, the results indicate that more liquid debt trades at a liquidity premium.

To determine the economic importance of $COFINA$ in specification 3, I use the estimated coefficients of specification 3, and the average values of the independent variables for Puerto Rican law GO debt. I find the predicted average yield of Puerto Rican law GO debt is 7.23%, while the predicted average yield of COFINA debt with the same characteristics of GO debt is 4.16% or 42% lower than equivalent Puerto Rican law GO debt.[19] Therefore, the controls added in specification 3 improve sample fit and show that when critical bond characteristics are controlled for, COFINA debt trades at economically and statistically lower yields than GO debt. This supports the hypothesis that investors value the legal protections and security of COFINA debt more than that of GO debt.

I turn to my next question; does the yield differential between COFINA and GO debt vary with credit risk? Figure A.4 offers suggestive evidence that the yield differential between COFINA and GO debt widened as Puerto approached default. To answer this question analytically, I add an interaction term between $RISK$ and $COFINA$ to specification 3 of Table A.5. I use this specification because it provides the best fit. That is, I

[19]The predicted yields reported here pertain to the reference time period. The choice of time period has no effect on the percent difference in yields.

estimate the model:

$$YTM_{it} = \alpha + \mu_t + \beta_1 COFINA_i + \beta_2 RISK_t + \beta_3 COFINA_i \times RISK_t + \gamma X_{it} + \epsilon_{it} \qquad (2.4)$$

where $\gamma X_{it} = \beta_4 YM_{it} + \beta_5 YM_{it}^2 + \beta_6 AGE_{it} + \beta_7 FV_i$.

The results are in Table A.6. Specification 1 repeats specification 3 of Table A.5, the benchmark. Specification 2 shows a negative coefficient on the interaction $COFINA \times RISK$. Although the coefficient is not individually significant, an F-test of the null hypothesis that $COFINA$ and $COFINA \times RISK$ are jointly zero rejects the null at the 90% level. Similarly, an F-test of the null hypothesis that $RISK$ and $COFINA \times RISK$ are jointly zero rejects the null at the 99% level. The negative coefficient on the interaction indicates that an increase in credit risk is associated with a larger yield differential between GO and COFINA debt.

I use specification 2 in order to determine the economic impact of $RISK$ on the marginal effect of $COFINA$. This uses the following expression for the marginal effect of $COFINA$: $\beta_1 COFINA_i + \beta_3 COFINA_i \times RISK_t$. I find that the marginal effect of $COFINA$ is a 2.3% decrease in yield when $RISK$ is at its lowest observed level during the sample period (BBB or 9). When $RISK$ is at its highest observed level during the sample period (CC or 20), the marginal effect of $COFINA$ is a 4.1% decrease in yield, or about 1.78 times the effect at the lowest rating level in the sample. Therefore, although the marginal effect of COFINA is a significantly lower yield than GO debt throughout the sample period, the increase in credit risk observed over the sample period is associated with a significant increase in the yield differential for COFINA versus GO debt. This is consistent with the hypothesis that the more likely a default is, the more investors price the differing protections offered by COFINA and GO debt due to their effect on the recovery process. Taken together, the results indicate that investors price the differing protections of COFINA and GO debt and that this difference was valued even more as default became more likely.

As with governing law, I also adopt a more granular approach to measuring the effect of credit risk on the marginal effect of $COFINA$. This allows me to investigate the presence of any non-linearities in the effect of credit risk on the marginal effect of $COFINA$. I do so by estimating the model in equation (2.4) and including indicator variables for each value of $RISK$ and interacting each of these with $COFINA$. I omit the equation and the results from the main text for brevity. The full results are available in specification 2 of Table A.14. Figure A.5 summarizes these results in graphic form with 90% confidence intervals.[20] Figure A.5 shows some differences from the results obtained in Table A.6. The marginal effect of $COFINA$ remains negative on

[20] Standard errors are calculated using the Delta-method.

average and increases with risk but it is not a linear relationship. The marginal effect of COFINA is relatively low at about -2.5% when risk is at its lowest and nearly zero when risk is towards the middle of the observed range. However, when credit risk is at its highest (CCC- and CC) the marginal effect of COFINA increases to about -4% and -5% respectively, a significant impact on yields. As with governing law, there is a notable spike in the pricing of the differential as Puerto Rico is closest to default.

2.5 The Pricing of PROMESA

To identify the pricing of PROMESA, I use news events related to PROMESA's passage and an event study approach. Event studies are the standard way to identify the effect of news events on bond yields (e.g. Krishnamurthy and Vissing-Jorgensen (2011), Gürkaynak et al. (2004) and Wright (2012)). PROMESA provides an interesting experiment where the exogenous decisions of the U.S. federal government produce within security variation in the presence of CACs.

PROMESA imposes CACs much like those seen in sovereign debt. However, PROMESA differs in that it also temporarily halted creditor actions, introduced an oversight board for Puerto Rico's finances, and created a bankruptcy process similar to Chapter 9 to provide an alternative restructuring framework to CACs.[21] This framework was aimed at providing an orderly restructuring process in contrast to the existing unanimous consent clauses in Puerto Rican debt. Like the CACs seen in sovereign debt, PROMESA may also incentivize default by making restructuring more orderly. Thus, like the CACs present in sovereign debt, the effect of PROMESA on yields is theoretically ambiguous. However, note that PROMESA may produce different expectations about recovery prospects than the standalone CACs observed in sovereign debt. For example, investors may value the right to hold out that existed before PROMESA more in the U.S. given the strong legal system in place to protect that right. Investors may also believe that the backstop of a court-supervised bankruptcy process improves or reduces their recovery prospects versus CACs alone. The environment makes the question of the effect of PROMESA an empirical one.

2.5.1 Data and Summary Statistics

I identify news events capturing changes in investor beliefs that PROMESA will become law. Specifically, the release of the bill's text, the reference of the bill to committee, the passage of the bill by committee, the passage of the bill by a chamber, and the signing of the bill by the President are all key steps in the legislative process which reveal that PROMESA is closer to becoming law.

This process entailed 7 events which all indicate a greater likelihood that Puerto Rican debt will have CACs retroactively imposed by the U.S. federal government. On November 11, 2015 the first version of PROMESA

[21] Like CACs, the court-supervised process allows a majority of creditors to bind minority holdouts.

(S. 2328) was introduced in the Senate and passed. On April 12, 2016 the first House version of the bill was introduced (H.R. 4900). On May 18, 2016 PROMESA was introduced to the House Natural Resources Committee (H.R. 5278). On May 25, 2016 PROMESA cleared the committee with strong bipartisan support. On June 9, 2016 the House passed PROMESA. On June 29, 2016 the Senate passed PROMESA. President OBAMA signed PROMESA on June 30, 2016. Note that although there are differences in the three versions of the bill, they all include CACs for Puerto Rican debt.[22]

The analysis of the effect of PROMESA on Puerto Rican bond yields uses Puerto Rican GO debt. I use a time series beginning 30 days before the first event and ending 30 days after the last event. The data used in the analysis comes from Bloomberg. I restrict attention to bond issues with the following characteristics: bonds that are not pre-refunded, bonds that are triple tax exempt, bonds that are uninsured, bonds that are not callable or sinkable, bonds that are not puttable, bonds with maturities between 1 and 30 years, and bonds with fixed rate coupons. I further require that the included bonds trade during at least 100 of the 192 trading days in the sample period.[23] I construct the daily change in yields in basis points, censoring the variable at the 1st and 99th percentiles to prevent outliers from skewing the results. Table A.7 shows the summary statistics for the selected sample. The sample includes 21 security issues with a total of 4,263 observations. The results show an average increase in yields of 3.41 basis points over the sample period.[24]

2.5.2 Methodology and Results

I investigate the market's reaction to news about PROMESA using an event-study.[25] Event studies are widely used to examine the reaction of asset prices to public news events. Recently, event studies have been used to investigate the effect of announcements on bond yields.[26] Assuming markets are semi-strong form efficient regarding public information, asset prices will adjust quickly to announcements about PROMESA.[27] Further, assuming that such news is the dominant news during the event window, that investors' risk aversion is unchanged, and that PROMESA announcements are not reversed caused by yields at the daily frequency, changes in Puerto Rican yields during the event window will reflect the effect of the events on the expected cash

[22] https://www.govtrack.us/congress/bills/114/s2328/summary#libraryofcongress

[23] Again, I include this restriction to exclude securities which do not have updated pricing information throughout the sample. As 100 trading days is an arbitrary requirement, I relax this assumption for robustness.

[24] Note that Puerto Rico missed its first GO payment on July 1, 2016, immediately following passage of PROMESA. These securities were not included in the sample as they were near maturity.

[25] See Mackinlay (1997).

[26] See Krishnamurthy and Vissing-Jorgensen (2011), Gürkaynak et al. (2004) and Wright (2012).

[27] Andrade et al. (2001).

flows of each bond.[28] Note that with the assumption that rating actions are the dominant news during the event window, the heteroskedasticity-based identification strategy of Rigobon and Sack (2004) simplifies to a standard event study.

Event windows should be small to avoid contamination of the results by news events other than the news of interest and small enough to claim that investor risk aversion is constant. The market for Puerto Rican municipal debt is surely less efficient than the markets for the broad stock indexes and U.S. Treasuries investigated in event studies with relatively narrow event windows of one day or less.[29] Therefore, in my benchmark results, I use a two-day window following Krishnamurthy and Vissing-Jorgensen (2011) who study agency and corporate yields.

The event study seeks to investigate how yield changes differ during PROMESA announcements from non-announcement days. To do so, I regress the daily change in yields in basis points on a constant and two dummies; one indicating an announcement on this day and another indicating an announcement the previous day. The model is estimated using OLS with standard errors clustered by security. Statistical significance is assessed using an F-test of the null hypothesis that the sum of the dummies is zero.

The results are reported in Table A.8. For the tests reported for individual events, only event window days for the event under investigation and non-event days are included.[30] The results show that only the final passage of PROMESA in the Senate and the signing of the bill by the President are associated with significant changes in yields. Specifically, the passage of PROMESA in the Senate on June 29, 2016 was associated with a two-day increase in yields of 15.1 basis points, significant at the 90% level. The signing of PROMESA by the President on June 30, 2016 is associated with a two-day increase in yields of 23.2 basis points, significant at the 99% level.

The results indicate that only the final stages of PROMESA's passage had a significant effect on yields and that these changes were positive. Although PROMESA made it possible for Puerto Rico to restructure legally and thus would theoretically increase investor expectations of a possible default, Puerto Rico was widely expected to default and indeed missed a payment on GO debt for the first time July 1, 2016 as expected. In fact, this due date prompted passage of the bill on June 30.[31] Therefore, the most plausible explanation for the effect of PROMESA on yields is that investors believed PROMESA harmed their recovery prospects relative to their

[28] Expected cash-flow is in turn affected by default probability, expected recovery rates, and the value of attached options. Note that the benchmark expected change in yields is zero for days where no news arrives.

[29] See, for example, Bernanke and Kuttner (2005), Gürkaynak et al. (2004), and Wright (2012).

[30] Non-event days are days during the benchmark time series which do not fall in the event window of any event.

[31] http://money.cnn.com/2016/06/29/investing/puerto-rico-debt-promesa/index.html

earlier expectations.[32] This may be because given the strength of the U.S. legal system, investors valued their prior holdout rights more than a relatively orderly restructuring. It is also possible that investors saw the court supervised bankruptcy process as more favorable to the issuer than the traditional standalone CACs observed in sovereign debt. The finding that investors only priced PROMESA when Puerto Rico was closest to default again supports the theory that legal protections are most valued when credit risk is highest.

2.6 Robustness Checks

I conduct several checks to confirm the robustness of my results. The results are omitted for brevity and are available upon request.

Including less liquid control securities: To ensure my results in Sections 2.3 and 2.4 are not sensitive to the samples selected, I do not restrict attention to securities that trade in at least half of the trading days in the sample period. Rather, I allow the samples to include securities that price in at least a quarter of the trading days in the sample period. The results remain robust.

Restricted time series: To ensure my results in Sections 2.3 and 2.4 are not affected by the passage of PROMESA just after the end of the benchmark samples or the issuance of the GO debt immediately preceding the benchmark samples, I restrict the samples to begin 30 days after issuance and end 30 days before PROMESA was passed. The results remain robust.

One particular concern about the benchmark results in Sections 2.3 and 2.4 is that PROMESA had a differential effect on the beliefs of investors about the recovery rates of New York law and Puerto Rican law debt in Section 2.3 or for GO versus COFINA debt in Section 2.4. For example, investors may believe that the CACs in PROMESA would fail to produce a restructuring plan, moving the restructuring to a bankruptcy proceeding which may or may not make any distinction between Puerto Rican and New York law debt or GO and COFINA debt. In this case, news of PROMESA may bias my benchmark results. However, my findings in Section 2.5 shows the only statistically important events immediately precede PROMESA's passage, so the robustness check ending the sample 30 days before the passage of PROMESA addresses this concern.

Controlling for outliers: One possible concern about the benchmark analyses in Sections 2.3 and 2.4 is that daily yield data can be volatile and contain outliers, skewing the results. To address this concern, I repeat the benchmark analyses using the log of the daily mid yield rather than the raw mid yield. The results remain robust.

An alternative measure of credit risk: One possible concern about the benchmark results in Sections 2.3 and 2.4 is that credit ratings may be an inadequate proxy for credit risk. To address this concern, I repeat the benchmark analyses using cds spreads and recovery rates from Markit to calculate the 5 year implied default

[32] Again, note that the securities for which a payment was missed are not included in the sample.

probability on Puerto Rican GO debt at the daily frequency and substitute this for the categorical variable capturing Puerto Rico's credit rating. Although this reduces sample size, the results remain robust.

PROMESA sample selection: To ensure my results in Section 2.5 are not sensitive to the sample selected, I do not restrict attention to securities that trade in at least half of the trading days in the sample period. Rather, I allow the sample to include securities that price in at least a quarter of the trading days in the sample period. Given that I am studying changes in yields, I also more greatly restrict the sample to only those securities which price every day in the sample. Finally, I also exclude New York law GO debt to ensure the benchmark results are not driven by that issue which as noted above, is an outlier in many respects. The results remain robust to all of these checks.

PROMESA methodology: To ensure my results are not dependent on the size of the event window, I expand the benchmark event window to 11 days from 2 days and find that the benchmark results remain robust. I also control for overlapping events by using a single dummy for any event day and find the results are robust. Finally, I control for a time trend and find the results are robust.

2.7 Conclusion

This paper conducts a case study investigating the pricing of three key legal provisions of Puerto Rican debt and how these valuations vary with credit risk. In doing so, this paper contributes to wide ranging research which debates the questions: do investors price contract provisions and law? Does the pricing of contract provisions vary with credit risk? To my knowledge, this paper is the first to address these questions for the case of Puerto Rico or any municipal issuer. In all three cases, I find that investors do price contract provisions and the related law, especially when credit risk is elevated.

In each instance, Puerto Rico offers a interesting case to study the pricing of contract provisions and law. First, I use a panel regression to investigate whether investors price the differing legal environments offered by Puerto Rican GO debt issued under New York law and Puerto Rican law GO debt. I find that New York law debt trades at higher yields than otherwise equivalent Puerto Rican law debt. These findings are both statistically and economically significant. This result differs from the findings in existing literature which show a foreign law premium (Chamon et al. (2015); Clare and Schmidlin (2014)). However, Puerto Rico's New York law debt is unique in that it was later found to be potentially illegal by exceeding the debt service limits set forth in Puerto Rican law (Showalter (2017)). It is possible that investors priced the risk that they would not be entitled to recovery in the case of New York law debt. The differential in the pricing of New York law and Puerto Rican law debt increases as Puerto Rico's credit risk and hence the importance of legal protections increases.

Second, I use a panel regression to investigate whether investors price the differing legal protections offered

by Puerto Rican law GO debt and Puerto Rican law debt issued by COFINA - namely, GO debt is guaranteed to be paid before any other obligation under Puerto Rico's Constitution while COFINA debt is secured by a sales tax under Puerto Rican law. I find that GO debt trades at higher yields than otherwise equivalent COFINA debt. These findings are both statistically and economically significant. This result is consistent with the finding in existing literature that secured debt trades at lower yields across corporate issuers (Bradley and Roberts (2015)). The investigation in this paper is also unique because it compares the secured and unsecured debt of the same issuer and thus studies debt facing the same economic risks where prior studies of secured debt focus primarily on cross-issuer variation. I again find that investors price the different legal protections of each type of debt most when credit risk is highest.

Finally, I investigate whether investors priced the legal provisions included in the law PROMESA by using an event study to measure the effect of news events indicating the law was moving closer to being enacted. I find that news of PROMESA did significantly affect GO bond yields but only during the final two news events. This result differs from the finding in the most recent literature that CACs reduce yields across securities (e.g. Carletti et al. (2017); Bardozzetti and Dottori (2014)). However, the investigation in this paper is unique because it measures the effect of the exogenous introduction of CACs on the same security over time rather than cross-sectionally across securities. In addition, PROMESA is unique in that it also creates a bankruptcy like process which like CACs, allows a majority of creditors to bind holdouts. It is possible that in the case of Puerto Rican debt, individual creditors valued the right to holdout more than the streamlining of the recovery process generated by the introduction of CACs. This may result from the strength of the U.S. legal system and protections of creditor rights. It is also possible that investors believed the court supervised restructuring process impaired their rights relative to standalone CACs. The finding that investors only priced PROMESA when Puerto Rico was closest to default again supports the theory that legal protections are most valued when credit risk is highest.

CHAPTER 3

THE COSTS OF (SUB)SOVEREIGN DEFAULT RISK: EVIDENCE FROM PUERTO RICO

3.1 Introduction

The global financial crisis and the subsequent debt crises highlight the heightened levels of sovereign default risk across the developed world. A large literature in international economics investigates the costs of sovereign default and default risk.[1] This paper uses Puerto Rico's debt crisis to develop a novel identification strategy to extract the real costs of (sub)sovereign default risk.

For most countries, it is difficult to isolate changes in sovereign default risk from changes in banking and/or currency crises risk or from the impact of government interventions involving private debt contracts. For example, in the most widely studied case of default of Argentina in 2001, the sovereign default crisis was inextricably linked to a concurrent banking and currency crisis (Perez et al. (2015); Hébert and Schreger (2016)). In the case of Greece, the government intervened in the financial system, declaring a bank holiday, limiting deposit withdrawals, and imposing controls on capital outflows (Arellano et al. (2015)). Although Greece remained on the euro, the possibility of exit constituted ex-ante currency crisis risk.

Several factors make the case of Puerto Rico unique. First, as a U.S. territory, Puerto Rico cannot by law abandon the U.S. dollar, effectively eliminating currency crisis risk (U.S. Constitution, Article I, Sections 8 and 10). Second, Puerto Rico's banks are protected by the Federal Deposit Insurance Corporation and comprise a small share of the U.S. banking sector, thereby preventing bank runs and systemic financial risk. Further, according to the Puerto Rico Federal Relations Act of 1950 and the Contracts Clause of the U.S. Constitution, the Puerto Rican government does not have the legal authority to intervene in the banking system to limit deposit withdrawals or impose capital controls. The risk of a banking crisis is therefore de minimis. Third, Puerto Rican data standards conform to the U.S. mainland. An important advantage is that Puerto Rican data on macro-indicators such as employment are available at higher frequencies and disaggregated at the industry level. Puerto Rico's unique characteristics allow us to examine the channels through which (sub)sovereign default can have real effects on the macroeconomy.

[1] For example, Borensztein and Panizza (2009), Yeyati and Panizza (2011), Cruces and Trebesch (2013), Hébert and Schreger (2016). The related literature provides a more comprehensive list.

We argue that Puerto Rico embodies a set of attributes that make it possible to treat it as an interesting (sub)sovereign. First, it has a constitution, and the ability to tax and create laws on local matters. In almost all of these aspects, Puerto Rico is very much a sovereign akin to U.S. states. However, in some respects it is more sovereign than U.S. states. For example, its subsidiaries, such as municipalities, cannot file for bankruptcy under Chapter 9 of the U.S. Bankruptcy Code. Legally, while it is less clear what kind of sovereign immunity Puerto Rico has, it likely has some (Gulati and Weidemaier (2016)). Given its unique status as a U.S. territory, and similar to sovereign nations, the path to restructuring Puerto Rico's debt is therefore particularly unclear.

There are of course some ways in which Puerto Rico is not quite as sovereign as, for example, Greece. While local Puerto Rican laws govern Puerto Rico's bonds, Puerto Rico cannot-in contrast to Greece-quite so easily change its laws to reduce its debt. While it may have some latitude, the Contracts Clause provides U.S. constitutional protection on government interference with private contracts that constrain it more than the European laws perhaps constrained Greece (Commonwealth of Puerto Rico v. Franklin California Tax-Free Trust et al., October 2015). In addition, enforcement is a real possibility in the case of Puerto Rico, where unpaid creditors can go to court with a real possibility of obtaining recovery, assuming there are some assets. Finally, while there is no possibility of an IMF bailout, there is always the possibility of a federal bailout, which could perhaps be much more significant.[2]

Specifically, this paper examines the real effects of anticipation of Puerto Rico's default. First, using activity for the mainland U.S. as a control, we investigate whether the deterioration in Puerto Rico's credit rating and credit spreads that occurred after 2012 led to a significant divergence in Puerto Rico's real economic activity from the rest of the U.S.. Second, we use an approach similar to Rajan and Zingales (1998) to establish that increased default risk reduces employment in industries that are ex ante more exposed or sensitive to a default event due to greater dependence on external finance. We use this methodology to address the concern that declines in economic activity may drive increased default probability and thus confound identification of the effect of default probability on employment. Similarly, we investigate whether increased default risk reduces employment in industries more exposed to government demand.

Third, we use an event study framework to investigate whether changes in Puerto Rico's credit risk affected yields on government debt or the stock returns of public Puerto Rican firms. We identify changes in Puerto Rico's credit risk using ratings actions on Puerto Rican debt and legal events related to the legal rights of Puerto Rican government entities to restructure their debt. Standard event-study assumptions allow us to causally identify the effect of changes in sovereign risk on the cost of capital.

[2]We are grateful to Mitu Gulati for clarifying many of these details about Puerto Rico's sovereign status.

The main findings are as follows. First, while the U.S. private employment, economic activity, and investment spending improved significantly post-2012, Puerto Rico's did not. Specifically, difference-in-difference estimates suggest that average quarterly private employment growth, economic activity growth, and investment spending growth were significantly lower for Puerto Rico compared to the U.S. mainland post-2012 relative to the pre-2012 period. This divergence coincides with the increased credit spreads on Puerto Rican debt and the declining credit ratings that preceded Puerto Rico's default. These results establish that increased (sub)sovereign risk coincided with a negative and significant aggregate divergence of Puerto Rico's economy from the rest of the U.S. mainland.

Second, increased default probabilities are associated with lower employment growth in industries that are relatively more exposed to Puerto Rican government demand and more dependent on external finance. These findings are both statistically and economically significant. Further, the magnitude of the negative effect of default risk on employment growth in government-demand-dependent industries increases when the government undertakes austerity measures. One potential rationale for these results is that agents learn about future government policy when they observe how austerity measures respond to increased default risk. We also find that increased default risk Granger causes austerity, indicating the government may undertake austerity in response to borrowing constraints or to reassure investors.

Last, we find that negative credit events are associated with significant increases in credit spreads on Puerto Rican debt and significant decreases in stock returns for Puerto Rican firms. These findings show that increased credit risk significantly increased the cost of capital for the Puerto Rican government and Puerto Rican firms.

Related literature: Our paper is closely related to the empirical literature on the costs of sovereign default. To the best of our knowledge, our paper is the first to estimate the economic costs of the risk of default in the case of Puerto Rico. By using high-frequency data, our analysis complements Hébert and Schreger (2016), who exploit a legal ruling to estimate the cost of the risk of default in the case of Argentina. Our case study of Puerto Rico also complements Zettelmeyer et al.'s (2013) case study of the recent Greek default episode.

Our paper adds to the earlier literature that uses data at lower frequencies. For surveys of this literature, see Borensztein and Panizza (2009), Tomz and Wright (2013), and Reinhart and Trebesch (2016). For instance, Yeyati and Panizza (2011) suggest that output contractions tend to precede defaults and that output starts growing after the quarter in which the default took place, indicating that the costs of default are likely to be driven by anticipation. Arteta and Hale (2008) and Fuentes and Saravia (2011) document that default episodes are associated with declines in foreign credit to the defaulting countries' private sector and declines in foreign direct investment. In contrast, using longer historical data, Tomz and Wright (2010) find that sovereigns rarely

defaulted and expropriated foreign investment at the same time. Cruces and Trebesch (2013) document that defaults with larger haircuts are associated with longer periods of exclusion from international financial markets. On the political side, Borensztein and Panizza (2009) and Livshits et al. (2014) find that sovereign defaults are associated with increases in the turnovers of incumbent politicians.

Our paper is also related to the large theoretical literature on sovereign debt, which can be traced back to Eaton and Gersovitz (1981) and Bulow and Rogoff (1989). More recent quantitative models include Aguiar and Gopinath (2006), Arellano (2008), Mendoza and Yue (2012), and Perez et al. (2015); for a recent survey, see Aguiar et al. (2014).

We conduct several robustness checks to confirm our benchmark results. We find that the results are robust to substituting yield spreads on Puerto Rican debt for the imputed default probabilities and restricting the sample to the post-U.S. financial crisis period. We control for industry-level exposures to recession risk, the population and housing price declines in Puerto Rico, as well as different types of industry-level shocks, and we find that the main results are robust to these alternative specifications. Finally, we find that our benchmark event study results are robust to controlling for overlapping event windows, alternative event windows, and estimation periods for the market model.

The paper proceeds as follows. Section 3.2 provides a brief historical background and discusses a timeline of the Puerto Rican debt crisis. Section 3.3 presents the data. Section 3.4 documents a breakdown of a cointegrating relationship between Puerto Rico's economic growth and that of the mainland U.S. after 2012. Section 3.5 establishes the relationship between default risk and employment growth in industries relatively more dependent on external finance and government demand. Section 3.6 presents additional tests and robustness checks. Section 3.7 concludes.

3.2 Background: The Puerto Rican Debt Crisis

Puerto Rico officially became a U.S. Commonwealth in 1952. Since then, the island has operated under U.S. judicial, monetary, and tariff systems after being ceded to the U.S. in 1898 at the end of the Spanish-American War. About the size of Ireland, Puerto Rico had a dense population of 3.5 million in 2014 (if it were a state, Puerto Rico would be the 29th most populous state). The island's GDP experienced several decades of catch-up growth relative to the mainland after World War II, especially after the passing of several tax reform acts, particularly the passage of Section 936 of the Tax Reform Act of 1976. Section 936 granted federal tax exemptions to U.S. corporations on income originating in U.S. territories.[3] At the same time, the Puerto Rican government granted foreign subsidiaries a tax exemption on state taxes if the income was repatriated in the

[3]See Collins et al. (2007)

form of dividends. Given the attractive tax breaks, a number of U.S. mainland-based corporations established subsidiaries in Puerto Rico. However, in 1996, given concerns about tax avoidance, the Clinton administration signed legislation that phased out Section 936, to be fully repealed by 2006. Meanwhile, the triple tax exempt status of Puerto Rican debt and Puerto Rico's constitutional guarantee that general obligation debt be paid before any other liability fueled an increase in Puerto Rico's debt-to-GNP ratio.

Following the repeal of Section 936, multinational investment in Puerto Rico declined sharply and the economy fell into a recession from which it is yet to recover. Yields on Puerto Rican debt began rising sharply as Puerto Rico's debt surpassed 100% of GNP in 2012; yields spiked sharply in 2013, with subsequent years being marked by continued downgrades of Puerto Rico's credit rating, which reached junk status in 2014. Puerto Rican yields continued to increase in 2014 and 2015, making it more costly for Puerto Rico to roll over its debt and indicating increased risk of default.

Despite the impending default, Puerto Rico is not allowed access to Chapter 9 of the U.S. Bankruptcy Code under which municipalities of U.S. states, like Detroit, can declare bankruptcy and restructure their debt. Nevertheless, the Contracts Clause of the U.S. Constitution prevents states from passing local laws binding creditors to accept losses. However, Puerto Rico passed several local laws aimed at creating a legal framework for agencies of Puerto Rico to restructure their debt, most notably the Puerto Rico Public Corporations Debt Enforcement and Recovery Act of June 28, 2014. The law was modeled after Chapter 9 of the U.S. bankruptcy code. Puerto Rico argued that if its status as a nonstate prevented it from accessing Chapter 9, then it should also be exempt from the Contracts Clause that applies to states.

On June 28, 2015, the governor of Puerto Rico announced that the $72 billion stock of debt was not payable,[4] and on June 29, 2015, Standards and Poors (2015) downgraded the general obligation bonds of Puerto Rico to 'CCC-' and wrote, "The downgrades are based on our view that a default, distressed exchange, or redemption of the commonwealth's debt appears to be inevitable within the next six months absent unanticipated significantly favorable changes in the issuers' circumstances." Meanwhile, the U.S. district court in Puerto Rico, the U.S. First Circuit Court of Appeals, and ultimately the Supreme Court on June 13, 2016, struck down the Puerto Rico Public Corporations Debt Enforcement and Recovery Act, determining that Puerto Rico was a state for purposes of the Contracts Clause and not a state for purposes of access to Chapter 9. Following the Supreme Court ruling, the matter of Puerto Rico's inevitable inability to meet its obligations was left to the U.S. Congress.

On June 30, 2016, the U.S. Congress passed PROMESA, establishing a formal legal framework for Puerto

[4]http://www.nytimes.com/2015/06/29/business/dealbook/puerto-ricos-governor-says-islands-debts-are-not-payable.html

Rico to restructure its debt. Puerto Rico formally defaulted the next day, missing $779 million dollars in payments on its general obligation debt. PROMESA placed a stay on any litigation against Puerto Rico relating to default and established a court-supervised restructuring process based on Chapter 9, with the additional stricture that any restructuring plan must be the most favorable legally obtainable by creditors. PROMESA also placed Puerto Rico's budget under the authority of a seven-person oversight board with the goal of balancing Puerto Rico's budget.

The story of the run up to Puerto Rico's default provides unique data and identification and yet is not unfamiliar. Puerto Rico's final default on June 30, 2016, was preceded by several years of economic malaise and legal and political uncertainty relating to the form that Puerto Rico's default would take. Figures B.1 and B.2 show that Puerto Rico is no exception to the pattern of pre-default declines in activity that are typically observed for several years prior to sovereign defaults in emerging markets. Figure B.2 also shows that yields on Puerto Rico's debt increased substantially in the years preceding its default, indicating significant anticipation. The data are consistent with the hypothesis of Yeyati and Panizza (2011) that the typically observed pattern of pre-default declines in output and employment are likely driven by default anticipation "independently of whether or not the country ultimately decides to validate it."

3.3 Data

3.3.1 Macro Data

To assess the effect of Puerto Rico's crisis on the cointegrating relationship of Puerto Rico's economy with the U.S., we collect macroeconomic data for Puerto Rico and the U.S. from 2006 until the most recent available, which varies by series. Data on U.S. quarterly seasonally adjusted real GDP in chained 2009 dollars comes from the Federal Reserve Economic Data (FRED) and runs from 2006:Q1-2016:Q2. As quarterly Puerto Rican GDP data are not available, we measure quarterly Puerto Rican economic activity using the monthly GDB economic activity index, aggregated to the quarterly level using averages, and seasonally adjusting the data with Census X-13.[5] The economic activity index is also available from 2006:Q1 to 2016:Q2 and tracks the behavior of four major monthly economic indicators: total nonfarm payroll employment, cement sales, gasoline consumption, and electric power generation. Data on total private employment from the U.S. and Puerto Rico are available from 2006:Q1 to 2016:Q2 and comes from the BLS Employment, Hours, and Earnings section of the Current Employment Statistics Survey. We aggregate the raw monthly data to quarterly values by taking the average and again seasonally adjusting with Census X-13. Data on annual real investment spending for Puerto Rico and the U.S. come from the IMF's World Economic Outlook and are available from 2006 to 2015.

[5]Census X-13 fits an ARIMA model to a time series to perform a seasonal adjustment. See https://www.census.gov/srd/www/x13as/

To document the credit crunch in Puerto Rico, we retrieve data on quarterly call reports from the FDIC for the five banks headquartered in Puerto Rico: Banco Santander Puerto Rico, Scotiabank de Puerto Rico, FirstBank Puerto Rico, Oriental Bank, and Banco Popular de Puerto Rico. We collect data on total assets, commercial and industrial loans, and bank exposure to states and political subdivisions in the U.S. via direct loans and ownership of securities, and total capital. We do not have complete data indicating what share of these items are associated with Puerto Rican government entities as opposed to other U.S. issuers. However, as Oriental Bank also files 10-K reports with the SEC, we confirm that all of Oriental's exposure to states and political subdivisions in the U.S. comes from Puerto Rican municipal issuers.

We extract data on Puerto Rico's annual fiscal balance from the "Statement of Revenue, Expenditures, and Changes in Fund Balances: Governmental Funds" in Puerto Rico's financial statements. Total revenues and expenditures are adjusted to remove intergovernmental transfers, debt service/issuance costs, and interest revenues. We then convert these nominal series to 2016 dollars using U.S. CPI. To investigate the effect of Puerto Rico's discretionary fiscal balance, we calculate the cyclically adjusted primary balance ($CAPB$) as detailed in Fedelino et al. (2009). $CAPB$ measures the structural or discretionary component of the government primary balance (revenues minus expenditures) by accounting for the cyclical nature of automatic spending stabilizers and revenues. The cyclical adjustment is accomplished by measuring the output gap and adjusting the primary balance as follows:

$$\frac{CAPB}{Y_p} = capb = \frac{R}{Y} - \frac{G}{Y_p} \tag{3.1}$$

where Y is output, Y_p is potential output, R is government revenues, and G is government expenditures.[6] R and G are derived from Puerto Rico's financial statements and adjusted as noted above. To calculate Y and Y_p we rely on two data sources and an HP filter. Puerto Rico's Government Development Bank has data on Puerto Rico's annual GNP from 2008-2015, while the World Bank has Puerto Rico's annual GNI from 1960-2013. We convert both series to 2016 dollars using U.S. CPI. As the HP filter's calculation of Y_p is most reliable with a long time series and away from the beginning and end of the time series, we fit the HP filter with the standard annual sensitivity parameter ($\lambda = 100$) to the log of Puerto Rico's real GNI from 1990-2015. As Puerto Rico's GNI is not available in 2014 and 2015, we interpolate GNI in 2014 and 2015 using 2013 log real GNI and the growth rate in log real GNP in 2014 and 2015.[7] We construct Y_p by extracting the trend in log real GNI from

[6]Note this equation requires standard assumptions on the elasticities of revenue and expenditure with respect to the output gap. See Fedelino et al. (2009).

[7]The log growth rates in GNP and GNI are correlated 0.81 where the time series overlap, so we consider this a reasonable approach.

the HP filter's output and taking its exponent. With these data, we calculate $capb$ as described in equation (3.1).

3.3.2 Industry-level Data

In order to study the effect of default risk on employment across industries according to exposure to default risk, we collect data on industry-level employment in manufacturing, industry-level dependence on external finance, and industry-level dependence on government demand for all available time periods from 2000-2016. Data on the monthly employment of Puerto Rican manufacturers at the three digit NAICS level comes from the BLS Quarterly Census of Employment and Wages and is available from 2000 to 2016. This provides data on 19 manufacturing industries. More granular levels of the NAICS classification system reduce the coverage of manufacturing employment in Puerto Rico. We seasonally adjust the time series of employment for each three digit industry using the Census X-13 program.

To measure dependence on external finance at the three digit NAICS level, we use the method described in Rajan and Zingales (1998). That is, we calculate the ratio:

$$EXTFIN = \frac{CAPEX - CFOPER}{CAPEX} \tag{3.2}$$

where $CAPEX$ is total capital expenditures and $CFOPER$ is total cash flows from operations of a given firm over the period 2000-2015. We calculate the ratio for all U.S. firms in the Compustat database over the period 2000-2015, taking the median for each industry at the three digit NAICS level. See Appendix B.2.1 for a more detailed description of the construction of $EXTFIN$. Table B.12 shows $EXTFIN$ for the three-digit NAICS manufacturing industries for which we have Puerto Rican employment data. For robustness, we also utilize the pre-crisis estimation period of 1995-2005 and the narrower period of 2005-2015 to calculate $EXTFIN$. The two alternative estimation periods have correlations of over 0.9 with the benchmark period.

Data to measure the dependence on Puerto Rican government demand (GOV) of each three digit NAICS manufacturing industry come from the 2012 Economic Census of Island Areas of the U.S. Census Bureau. The Census provides the share of products shipped and contract receipts within Puerto Rico by class of customer for manufacturing industries and the value of products shipped and contract receipts by product destination for manufacturing industries, including the share shipped within Puerto Rico. To calculate GOV, we multiply each industry's share of Puerto Rican products shipped and contract receipts to the Commonwealth government by the industry's share of products shipped and contract receipts within Puerto Rico to arrive at each industry's share of total sales to the Puerto Rican government.

3.3.3 Financial Market Data

To measure the default risk of the Puerto Rican government, we use the credit triangle method of White (2013) and credit default swap spread data from JP Morgan's Markit to calculate the five-year risk neutral cumulative default probability on the debt of the Commonwealth of Puerto Rico.[8] That is, the probability of default within five years. The raw data are daily and run from May 2008 to November 2015. Although the data include spreads on contracts ranging from six months to 30 years, there are substantial gaps for all horizons except five years.[9] Due to these gaps, we use the spreads and recovery rates on five-year credit default swaps to approximate the default probability implied by the five year contract as follows:

$$\lambda = \frac{S_5}{1 - R} \tag{3.3}$$

$$P(\text{default within 5 years}) = 1 - \exp(-5\lambda) \tag{3.4}$$

where λ is the hazard rate, S_5 is the par spread paid for five years of insurance against default, and R is the average recovery rate reported by dealers contributing to Markit. We then generate ΔDEF as the change in the monthly average of the probability of default.

To measure the effect of changes in Puerto Rico's credit risk on private borrowing costs, we collect stock return data for publicly traded companies with primary operations in Puerto Rico. There are four publicly traded companies with primary operations in Puerto Rico and a time series of returns covering the span of the rating and legal events we use to identify changes in Puerto Rico's credit risk. These are: OFG Bancorp (OFG), Banco Popular (BPOP), First Bancorp (FBP), and the health insurer Triple-S Management Corp. (GTS). We collect daily return data on these four firms and the S&P 500 index from 2010-2016. Of course, these four companies are not a representative sample of firms in Puerto Rico. However, this feature is an advantage for our identification strategy. As publicly traded companies with audited financial statements, these companies are large and transparent, thus allowing relatively frictionless access to U.S. capital markets. For such firms, we can reasonably treat the supply of funds as perfectly elastic at the risk-adjusted rate.

To measure the effect of changes in Puerto Rico's credit risk on public borrowing costs, we collect data on the yields of all general obligation debt issued by the Commonwealth of Puerto Rico outstanding during some part of the 2010-2016 period from Bloomberg. We treat stale observations of yield as missing values. That is,

[8]The credit triangle method assumes the premium leg of the CDS contract is paid continuously and the hazard rate is constant.

[9]The gaps for contract lengths other than five years results from the fact that the five-year contract is the most popular contract length and the resulting low trading frequency for less popular contract lengths.

if the reported yield of a security does not change on a given day, this is classified as a missing observation.[10] We exclude insured bonds as these embed the credit risk of the insurer. We also exclude bonds that are pre-refunded, as these bonds become risk free when refunded. This results in a sample of 471 securities that meet these restrictions and have yield data during at least some of the events we use to identify changes in credit risk. For each security issue, we compute the daily yield spread as the difference between the tax-adjusted yield on the issue and the yield on a Treasury security with the same number of months remaining until maturity, retrieved from FRED.[11]

3.4 Diverging Growth Rates between Puerto Rico and the U.S. Mainland

In this section, we examine real economic activity in Puerto Rico relative to the U.S. mainland. First, we observe that the spike in Puerto Rican yields beginning in 2013 coincides with a decline in the Puerto Rican economy and constitutes a divergence from its close correlation with the U.S. mainland until then. We then formally test whether the data support the hypothesis that the cointegrating relationship between Puerto Rico and the U.S. mainland breaks down post-2012.

Figure B.1 plots Puerto Rico's real GNP growth along with U.S. real GNP growth, Puerto Rico's debt-to-GNP ratio, and its credit rating. Figure B.1 shows that beginning in 2006, Puerto Rico's economic growth slowed down significantly as investment in Puerto Rico declined following the full repeal of Section 936. Puerto Rico's GNP growth continued its decline through 2008 and with the compounding shock of the U.S. financial crisis reached a trough in 2009. Despite the dual shocks of the repeal of Section 936 and the U.S. financial crisis, Puerto Rico's GNP growth rate began increasing from 2010 to 2012, reaching a positive growth rate in 2012 for the first time since 2006. However, in 2012 Puerto Rico's debt surpassed 100% of GNP with subsequent years marked by continued downgrades of Puerto Rico's credit rating, which reached junk status in 2014. Post-2012, GNP growth rates turned negative once again. The continuing contraction was a striking divergence from the continued recovery of U.S. GNP growth, which Puerto Rico was tracking, albeit anemically. The data suggest that Puerto Rico's credit deterioration coincides with a divergence of Puerto Rico's close ties to U.S. real economic activity.

Figure B.2 uses Puerto Rican and U.S. monthly private employment along with the raw yield on five-Year Puerto Rican general obligation debt to present a closer look at Puerto Rico's recovery from the dual shocks of the repeal of section 936 and the U.S. financial crisis. Similar to Figure B.1, this more granular plot shows that

[10] This is standard practice in the finance literature. See for example, Duffee (1998).

[11] The time to maturity is matched using a cubic spline interpolation of the Treasury yield curve. See Appendix B.2.2 for a description of the process used to adjust the yields of Puerto Rican securities for their tax benefit.

Puerto Rico began to recover from the expiration of Section 936 and the U.S. financial crisis in 2010. Puerto Rican normalized log private employment appears to track U.S. private employment into 2012. However, in 2012 and 2013, private employment stagnates while yields on Puerto Rican debt increased. In mid-to-late 2013, yields spiked and employment began a sharper decline. It appears that the increase in Puerto Rican yields coincides with a drop in Puerto Rican private employment. This reduction in Puerto Rican employment seems to break the cointegrating relationship with U.S. employment that existed before the period of increased yields. Puerto Rican yields continued to rise in 2014 and 2015, making it more costly for Puerto Rico to roll over its debt and indicating an increased risk of default.

Although Figures B.1 and B.2 merely provide visual hints that anticipation of Puerto Rico's default coincides with a decline in Puerto Rico's aggregate real activity, the data are suggestive of the hypothesis that Puerto Rico's economic decline was not a result of a mainland shock. Further, if the hypothesis that anticipation of Puerto Rico's default led to a decline in aggregate activity holds, we would expect that the timing of the divergence of Puerto Rico's activity from that of the U.S. mainland coincides with an increase in Puerto Rico's default risk. We can test whether the aggregate data are consistent with the hypothesis that anticipation of default coincides with a decline in real aggregate activity in Puerto Rico.

To do so, we conduct a difference-in-difference analysis of quarterly private employment growth, quarterly economic activity growth, and annual investment spending growth for 2006-2012 versus post-2012.[12] Our control group for the post-2012 period begins in 2006 as we attempt to identify the effect of Puerto Rico's increased default anticipation on the cointegrating relationship between Puerto Rico's economy and the U.S. economy following the repeal of Section 936. Therefore we limit the pre-2012 period to the years following the full repeal.

In columns 1 and 4 of Table B.1, we regress the growth rates of private employment, economic activity, and investment spending on a constant for the period 2006-2012 for Puerto Rico and the U.S. mainland, respectively.[13] The data indicate a substantial economic contraction in both Puerto Rico and the U.S. mainland for the 2006-2012 period. Columns 2 and 5 examine real activity in the post-2012 period.[14] The coefficient estimates suggest that while the U.S mainland began its recovery from the global financial crisis during this period, Puerto Rico's private employment, economic activity, and investment spending continued to contract. The estimates

[12] As Section 3.3.1 describes, economic activity growth is quarterly real GDP growth for the U.S. and quarterly growth in the economic activity index from Puerto Rico's GDB for Puerto Rico.

[13] Data on employment growth and activity growth is quarterly, while investment spending growth is measured annually.

[14] The data are from 2013Q1 to 2016Q2 for private employment growth and economic activity growth, and the period from 2013 to 2015 for annual growth in investment spending.

in Column 3 confirm that Puerto Rico's economic contraction continued in the post-2012 period. In contrast, the specification in Column 5 shows that the recovery in U.S. real GNP, private employment, and investment spending growth in the post-2012 period is highly statistically significant compared to the pre-2012 period.

Finally, Column 7 presents the difference-in-difference estimates for Puerto Rico less the U.S. mainland for all three variables. The results confirm that the difference in private quarterly employment growth in Puerto Rico and the U.S. mainland pre- and post-2012 is -0.42% and significant at the 1% level. That is, Puerto Rican employment growth from 2013Q1-2016Q2 was -0.42% lower than the rate predicted by its benchmark relationship with U.S. employment growth from 2006Q1-2012Q4. Similarly, Puerto Rican activity growth from 2013Q1-2016Q2 was -0.34% lower than the predicted rate from its relationship with U.S. activity growth from 2006Q1-2012Q4, significant at the 5% level. Puerto Rican investment growth post-2012 was -1.4% below the rate predicted by its relationship with U.S. investment growth pre-2012, significant at the 5% level.

The data confirm that in the post-2012 period, the cointegrating relationship of real activity in Puerto Rico and the U.S. mainland appears to break down. The data appear consistent with the hypothesis that the continued contraction in Puerto Rico's economy post-2012 was due to Puerto Rico specific shocks, rather than shocks originating from the U.S. mainland. Further, recall that in the post-2012 period there was a significant increase in anticipation of a Puerto Rican default. In what follows, we investigate the potential channels through which increased default anticipation can have real effects on Puerto Rico's economy.

3.5 The Real Effects of Sovereign Default Risk

Section 3.4 provides suggestive evidence that an increase in the risk of default is associated with decline in economic activity, particularly in employment. However, problems of reverse causality plague studies that examine whether finance matters for the real economy or how financial crises affect the real economy (e.g., Levine (2005); Mendoza and Terrones (2008); Laeven and Valencia (2013)). To identify causality, we test two hypotheses that rely on alternative theoretical mechanisms through which sovereign default risk may affect the real economy.

The credit channel: We hypothesize that an increase in sovereign default risk disproportionately affects industries that are more dependent on external finance. We adopt a difference-in-difference approach used by Rajan and Zingales (1998) to study the effects of finance on growth and subsequently by Dell'Ariccia et al. (2008) to study the real effects of banking crises. Our premise is that an increase in sovereign default risk could have a negative effect on real economic activity especially if during periods of heightened sovereign default risk there are more adverse consequences for external finance dependent industries.

Intuitively, an increase in sovereign default risk can hurt the supply of credit to Puerto Rican firms. If

Puerto Rican banks tend to hold Puerto Rican government debt on their balance sheets, then an increase in sovereign default risk could adversely impact the balance sheets of these banks and their ability to provide credit to the local economy. Several theoretical papers in the recent literature suggest that this mechanism is prominent behind the "deadly embrace" between the balance sheets of the governments and the financial sector in European economies during recent financial crises (see, inter alia, Farhi and Tirole (2017)). The contraction in the supply of credit could in turn negatively affect firms in industries that are typically more dependent on bank loans for their financing.

One may argue that since Puerto Rico is an open economy that is financially integrated with the U.S. mainland, firms located in Puerto Rico can still seek external finance in the form of loans or equity/debt issuance from non-Puerto Rican banks. Thus, the effect on the local supply of credit may have limited effects on firms located in Puerto Rico. However, evidence suggests that rating agencies tend to have sovereign ceiling policies, which require that firms' ratings remain at or below the rating of their country of domicile (e.g., Almeida et al. (2017)). Under these policies, a downgrade in the rating of the Puerto Rican government bond could negatively affect the ratings of firms located in Puerto Rico, thus negatively affecting firms that are more dependent on external debt. An increase in the perceived risk of firms could also have a negative spillover effect on the ability of firms to seek external finance through equity issuance. To evaluate the plausibility of this mechanism, we will test an additional hypothesis that an increase in the risk of (sub)sovereign default is associated with negative cumulative abnormal returns for listed Puerto Rican firms.

The austerity channel: We hypothesize that an increase in sovereign default risk will disproportionately affect industries that are more dependent on government demand. Our conjecture is that an increase in sovereign default risk would negatively affect the government's borrowing capacity and increase the probability of fiscal austerity implying that industries that are more dependent on government spending would be hurt more severely during a period of heightened sovereign default risk. To evaluate the plausibility of this transmission channel, we will also test an additional hypothesis that an increase in (sub)sovereign default risk is associated with an increase in the interest rates of bonds issued by the government of Puerto Rico.

3.5.1 The Credit Channel

We now evaluate the hypothesis that an increase in (sub)sovereign default risk disproportionately affects industries that are more dependent on external finance. As industry output is only available at the annual frequency while employment is available at the monthly frequency, we focus on the latter for more powerful tests of the effect of default risk.

Summary statistics: Average monthly employment growth for manufacturing industries above the median

dependence on external finance is -0.42%, while employment growth is -0.28% on average for industries below the median of dependence on external finance during the sample period. Figure B.3 presents normalized log employment in manufacturing industries above and below the median of dependence on external finance and default probability. Figure B.3 shows that employment in manufacturing industries more dependent on external finance declines relatively more than employment in industries less dependent on external finance and that employment in all manufacturing industries decline overall. Further, the relative decline in employment in sensitive industries seems to follow increased default risk, suggesting that it may be an important driver of the decline in employment over this period.

Regression analysis: In our benchmark specification, we regress employment growth in industry i in month t on 12 lags of changes in (sub)sovereign default probabilities and a term that captures the interaction of external finance dependence in industry i with changes in default probability in month t. We also control for each industry's lagged share of total private employment to allow for convergence in each industry's share of total private employment.[15] The specification also includes industry and month fixed effects to capture any time-invariant industry characteristics and any industry-invariant month effects.[16] The standard errors are clustered by industry. We estimate the following benchmark regression:

$$\Delta E_{it} = \alpha_i + \mu_t + \nu SH_{it-1} + \sum_{j=1}^{12} \delta_{t-j} * EXTFIN_i^{US} * \Delta DEF_{t-j} + \epsilon_{it} \tag{3.5}$$

where α_i and μ_t are fixed effects; ΔDEF_t is the change in the monthly average of default probability in month t; $EXTFIN_i^{US}$ is the Rajan and Zingales (1998) measure of dependence on external finance for industry i; and SH_{it-1} is the share of total private employment of industry i in month $t-1$.

The set of coefficients δ captures the relationship between dependence on external finance and employment given changes in the probability of default. We exclude contemporaneous values of ΔDEF to avoid contemporaneous correlation. Following Borensztein and Panizza (2010) and given the relatively high frequency of our data, we use several lags of the interaction term to allow some time for changes in financing constraints to affect employment. The coefficient on SH_{it-1} indicates whether industries comprising a larger share of total private employment tend to have lower growth rates.

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[15] Note that as the lagged share of total private employment contains a transformed lag of the dependent variable, it may be correlated with industry fixed effects. Nickel (1981) shows that this bias is of order $1/T$. In our estimation, $T = 90$, so this bias is minimal for our case. Judson and Owen (1999) show the bias is about 8% of the true value for the coefficient on the lagged dependent variable for T=30. However, the expected bias on exogenous regressors, our primary interest, is only about 1-3% of the true value for T=30.

[16] This methodology is motivated by Rajan and Zingales (1998), Dell'Ariccia et al. (2008), Borensztein and Panizza (2009), and Borensztein and Panizza (2010).

We include 12 lags of the interaction term as the effects are insignificant beyond the 12th lag. For robustness, we include three lags of the industry-level employment growth rate (ΔE_{it}).[17] This approach controls for autocorrelation in employment growth rates and potential serial autocorrelation in the errors of the benchmark specification. As an additional robustness check, we use the change in the monthly average yield spread of Puerto Rican five-year bonds in place of the change in default probability. The results remain robust to these tests.

Of course, the primary challenge to any attempt to identify the causal effect of increased default risk on employment is reverse causality. That is, increases in the risk of default may be a consequence of declining economic growth. However, in our benchmark specification, the identification strategy relies on differences in employment growth rates across industries in a given month. Therefore, reverse causality is a concern only if the relative growth of any given industry in a given month affects the probability of default. In our view, this is far less plausible than reverse causality in the aggregate.

Figure B.3 shows the path of DEF over the period of data availability. Table B.2 presents summary statistics for Puerto Rican manufacturing industries and the change in default probabilities over the sample period, which runs from June 2008 to November 2015 given the availability of CDS data. The data show that default probability increases by 0.92 percentage points in an average month. The relative ranking of $EXTFIN$ by industry is the relevant measure and is relatively stable over time.[18] The average monthly employment growth rate is -0.44% for Puerto Rican manufacturing industries over the sample period.

The results are in Table B.3. In column 1, we regress employment growth on a constant and SH_{it-1}, excluding fixed effects. The constant term indicates that the average employment growth rate is -0.37%, for a given value of SH_{it-1}. The unconditional effect of SH_{it-1} is statistically insignificant in predicting employment growth.

In column 2, we include industry fixed effects and SH_{it-1} is negative and significant at the 1% level. The negative coefficient on SH_{it-1} indicates that employment in industries that comprise a larger share of total employment tends to grow at slower rates, once we control for industry fixed effects. The finding is consistent with the hypothesis that industry level shares of total employment tend to converge over time. Specifically, the coefficient of -2.3 indicates that a one standard deviation increase in share of total private employment is associated with a reduction in monthly employment growth of 1.7%. This is a substantial effect, given the

[17] We use three lags of E_{it} because optimal lag selection information criteria selected three lags as optimal.

[18] See Appendix B.2.1. Note that negative average values for this indicator are typical in decades following the original calculations for the 1980s. See Klingebiel et al. (2006).

average monthly employment growth rate of -0.44%.[19]

In column 3, we control for time fixed effects, 12 lags of the interaction of dependence on external finance and the change in monthly default probability. For brevity, we show only the sum of the interaction terms and a test for joint significance of the interaction terms.[20] The sum of the coefficients on the interaction terms is negative and the interaction terms are jointly significant at the 1% level. The results are consistent with the hypothesis that increased default risk is associated with relatively lower employment growth in industries more dependent on external finance.

Table B.4 summarizes the economic significance of the interaction terms using specification 3 of Table B.3. Table B.4 shows that if ΔDEF is at the 25th percentile (-1.9 pp) for the prior 12 months and SH_{t-1} is at its sample average, monthly employment growth for industries at the 25th and 75th percentiles of external finance dependence is predicted to be 0.08% and 0.11%, respectively. Thus, for low values of default risk in the prior year, employment growth is predicted to be 0.03 percentage points higher for industries at higher values of external finance dependence than for industries at lower percentiles-the difference amounts to 6.8% of the monthly average employment growth rate of -0.44%.

Next, we conduct the same sensitivity analysis for high values of ΔDEF at the 75th and 90th percentiles for the prior 12 months. If ΔDEF is at the 75th percentile (3.4 pp) for the prior 12 months, employment growth is predicted to be 0.05 percentage points lower for an industry at the 75th percentile than for an industry at the 25th percentile of dependence on external finance. The magnitude of this difference is 11.0% of the monthly average employment growth rate. Finally, if ΔDEF is at the 90th percentile (9.0 pp) for the prior 12 months, employment growth is predicted to be 0.13 percentage points lower for an industry at the 75th percentile than for an industry at the 25th percentile of external finance dependence which is 29.1% of the monthly average employment growth rate. The coefficients also allow us to predict that monthly employment growth in an industry at the 75th percentile of external finance dependence is 0.08 percentage points lower than in an industry at the 25th percentile when the default probability is at the 75th rather than the 25th percentile. The magnitude of this effect amounts to 17.3% of the monthly average employment growth rate of -0.44%.

[19]Note that the median within-industry standard deviation in the share of total private employment is 5% of the figure for the full sample.

[20]Table B.13 of appendix B.2.3 shows the full specification. The results show that all of the individually significant coefficients are negative, with the largest and most statistically significant coefficient occurring on the third lag of the interaction term.

Default Risk and Bank Lending

The previous subsection provides evidence in support of the hypothesis that an increase in the risk of sovereign default disproportionately affects employment in industries that are more dependent on external finance. The findings rest on the premise that increased sovereign default risk affects the supply of credit via an adverse impact on the balance sheets of Puerto Rican banks that hold Puerto Rican government debt. Following the increased financing constraints associated with increased sovereign default risk, we suggest that banks reduce lending, which disproportionately affects industries more dependent on external finance. Alternatively, the cost of external finance in general increases as yields on Puerto Rican debt go up as default risk increases.

To confirm the data are consistent with the hypothesis that Puerto Rico's crisis and increased default risk are associated with a contraction in credit, we investigate the relationship between default risk and banking in Puerto Rico using balance sheet data for Puerto Rican banks from the FDIC. Figure B.4 shows that commercial and industrial loans as a percentage of GNP declined by 35.9% from 2008 through 2015. This is notable as these loans are directly relevant for our investigation of the effect of the credit channel on employment in manufacturing. Further, loans to Puerto Rican municipal entities total about 40% of capital in Puerto Rico's banks, indicating that Puerto Rican banks are highly exposed to the Puerto Rican government.[21] The data suggest that losses on holding Puerto Rican government debt would create substantial constraints on bank lending in Puerto Rico.

To formally test the relationship between default risk and lending, we conduct Granger causality tests on the monthly first difference in default probability (ΔDEF) and the quarterly first difference in commercial and industrial loans as a percentage of GNP (ΔCIL) as follows:

$$\Delta CIL_t = \alpha_i + \sum_{k=1}^{4} \beta \Delta CIL_{t-k} + \sum_{j=1}^{12} \delta_{t-j} \Delta DEF_{t-j} + \epsilon_{it} \tag{3.6}$$

$$\Delta DEF_t = \alpha_i + \sum_{k=1}^{4} \gamma \Delta CIL_{t-k} + \sum_{j=1}^{12} \eta_{t-j} \Delta DEF_{t-j} + \epsilon_{it} \tag{3.7}$$

where we include the prior four quarters of changes in commercial and industrial lending and the prior four quarters of changes in default probability in both tests (note that k indexes quarters not months). We conduct Wald tests of the hypotheses $H_0 : \delta_1 = ... = \delta_{12} = 0$ and $H_0 : \gamma_1 = ... = \gamma_4 = 0$. The F statistic of 4.71 reported in Table B.5 shows that the set of coefficients δ are jointly significant at the 1% level. That is, that

[21] As noted in Section 3.3.1, we can only confirm these figures on loans to U.S. political subdivisions are loans to Puerto Rican municipal entities for Oriental Bank.

default risk Granger causes commercial and industrial lending. The sum of the coefficients of -0.017 indicates that the data are consistent with the hypothesis that increased default risk for Puerto Rico reduces commercial and industrial lending by Puerto Rican banks. The F statistic of 0.24 indicates that the set of coefficients γ are not jointly significant and suggests that commercial and industrial lending do not Granger cause default risk.

3.5.2 The Government Spending Channel

We now evaluate the hypothesis that an increase in (sub)sovereign default risk disproportionately affects industries that are more dependent on government demand. As in the previous analysis, we focus on employment growth as the dependent variable.

Summary statistics: Figure B.5 presents normalized log employment in manufacturing industries above and below the median of dependence on government demand and default probability. Figure B.5 shows that employment in manufacturing industries more dependent on government demand declines relatively more than employment in industries that are less dependent, while there is an overall decline in employment in all manufacturing. Further, the relative decline in employment in sensitive industries appears to follow increased default risk. Figure B.6 presents normalized log employment in manufacturing industries above and below the median of dependence on government demand and *capb*. Figure B.6 shows that austerity measures by Puerto Rico (increased *capb*) also seem to coincide with decreased employment in more sensitive industries.

Regression analysis: In the benchmark specification we regress employment growth in industry i in month t on 12 lags of changes in (sub)sovereign default probabilities and a term that captures the interaction of government demand dependence in an industry i with changes in default probability in month t. We also control for each industry's lagged share of total private employment to allow for convergence in each industry's share of total private employment.[22,23] The specification also includes industry and month fixed effects to capture any time-invariant industry characteristics and any industry-invariant month effects. The standard errors are clustered by industry. We estimate the following benchmark regression:

$$\begin{aligned}\Delta E_{it} = \alpha_i + \mu_t + \nu SH_{it-1} + \sum_{j=1}^{12} \delta_{t-j} * GOV_i * \Delta DEF_{t-j} + \beta * GOV_i \\ * \Delta capb_{prioryear} + \sum_{j=1}^{12} \gamma_{t-j} * GOV_i * \Delta DEF_{t-j} * \Delta capb_{prioryear} + \epsilon_{it}\end{aligned} \tag{3.8}$$

[22]Note that as the lagged share of total private employment contains a transformed lag of the dependent variable, it may be correlated with industry fixed effects. Nickel (1981) shows that this bias is of order $1/T$. In our estimation, $T = 90$, so this bias is minimal for our case. Judson and Owen (1999) show the bias is about 8% of the true value for the coefficient on the lagged dependent variable for T=30. However, the expected bias on exogenous regressors, our primary interest, is only about 1-3% of the true value for T=30.

[23]This methodology is motivated by Rajan and Zingales (1998), Dell'Ariccia et al. (2008), Borensztein and Panizza (2009), and Borensztein and Panizza (2010).

where α_i and μ_t are fixed effects; ΔDEF_t is the change in the monthly average of default probability in month t; GOV_i is dependence on government demand for industry i; $\Delta capb_{prioryear}$ is the annual first difference in the cyclically adjusted primary balance (expressed as a percentage of potential output) and SH_{it-1} is the share of total private employment of industry i in month $t-1$.

The set of coefficients δ captures the relationship between dependence on government demand and employment given changes in the probability of default. β captures the relationship between dependence on government demand and employment given changes in the cyclically adjusted primary balance. The set of coefficients γ captures the relationship between dependence on government demand and employment given changes in the probability of default and the cyclically adjusted primary balance. That is, heterogeneity in the effect of fiscal policy based on changes in default risk. We exclude contemporaneous values of ΔDEF and $\Delta capb$.

After estimating (3.8), we conduct Granger causality tests on $\Delta capb$ and ΔDEF to capture the lead lag relationship between default risk and fiscal policy as follows:

$$\Delta capb_{annual} = \alpha_i + \beta \Delta capb_{prioryear} + \sum_{j=1}^{12} \delta_{t-j} \Delta DEF_{t-j} + \epsilon_{it} \tag{3.9}$$

$$\Delta DEF_t = \alpha_i + \beta \Delta capb_{prioryear} + \sum_{j=1}^{12} \delta_{t-j} \Delta DEF_{t-j} + \epsilon_{it} \tag{3.10}$$

The Granger causality tests reported in Table B.6 reveal that default risk Granger causes Puerto Rico's cyclically adjusted primary balance and indicate that increased default risk drives austerity. The data suggest that Puerto Rico's cyclically adjusted primary balance does not Granger cause default risk. Puerto Rico's pre-default austerity measures may therefore form a real effect of default anticipation. That is, the results are consistent with the hypothesis that the government responds to increased default risk with austerity, either to reassure markets or due to the increased financing constraints associated with default risk.

Table B.7 presents summary statistics for Puerto Rican manufacturing industries, the change in default probabilities, and the change in the cyclically adjusted primary balance. The data show that default probability increases by 0.92 percentage points in an average month. The average change in the cyclically adjusted primary balance is 0.07 percentage points. Puerto Rican manufacturers depend on the Commonwealth of Puerto Rico for an average of 1.9% of total sales. The average monthly employment growth rate is -.36% for Puerto Rican manufacturing industries over the sample period.[24]

Table B.8 presents the estimates from the benchmark specification of equation (3.8). In Column 1, we

[24]Note that this differs slightly from the average employment growth rate in the credit channel section. This is due to the fact that the data on dependence on government demand are available for only 17 of the 19 industries seen in the credit channel section.

regress employment growth on a constant, SH_{it-1}, and a series of 12 lags of the interaction of dependence on government demand and the change in monthly default probability. For brevity, we show only the sum of the interaction terms and a test for joint significance of the interaction terms.[25] The sum of the coefficients on the interaction terms is negative, and the interaction terms are jointly significant at the 1% level. The results are consistent with the hypothesis that increased default risk is associated with relatively lower employment growth in industries more dependent on government demand. In column 2, we control for an interaction of the prior year first difference in $capb$ and GOV. The coefficient is statistically significant at the 1% level and indicates that increased $capb$ (austerity) is associated with relatively lower employment growth in government demand dependent industries. In column 3, we combine the independent variables of columns 1 and 2 with a triple interaction of ΔDEF, GOV, and $\Delta capb_{prioryear}$. The coefficient on the triple interaction is jointly significant at the 1% level and indicates that the negative effect of default risk on employment growth in industries relatively more dependent on government demand increases when the government undertakes austerity measures. Similarly, the negative effect of austerity on employment growth in industries relatively more dependent on government demand increases when default risk increases.

Table B.9 summarizes the economic significance of the interaction terms using specification 1 of Table B.8. The economic magnitude of the effect is significant. Table B.9 shows that if ΔDEF is at the 25th percentile (-1.9 pp) for the prior 12 months and SH_{t-1} is at its sample average, monthly employment growth for industries at the 25th percentile of dependence on government demand is predicted to be -0.12%. Similarly, monthly employment growth at the 75th percentile of government demand is predicted to be 0.02% if ΔDEF is at the 25th percentile for the prior 12 months. Thus, if ΔDEF is at the 25th percentile for the prior 12 months, employment growth is predicted to be 0.15 percentage points higher for the industry at the 75th percentile of dependence on government demand than in the industry at the 25th percentile of dependence on government demand. The magnitude of this effect amounts to 40.3% of the monthly average employment growth rate of -0.36%.

Next, we conduct the same sensitivity analysis for high values of default risk when ΔDEF is at the 75th and 90th percentiles over the prior 12 months. If ΔDEF is at the 75th percentile, employment growth is predicted to be 0.3 percentage points lower for an industry at the 75th percentile of government demand dependence than in an industry at the 25th percentile. The magnitude of this effect amounts to approximately three-quarters of the average monthly employment growth rate of -0.36%. Finally, if ΔDEF is at the 90th percentile (9.0 pp), the employment growth difference between industries at the 75th percentile and industries at the 25th percentile

[25] Table B.14 of appendix B.2.4 shows the full specification.

is predicted to be 0.68 percentage points. The magnitude of this fall is nearly double the average monthly employment growth rate. Our estimates also predict that employment growth differential between industries at the 75th and 25th percentiles of government demand dependence will be 0.4 percentage points lower when the default probability is at the 75th percentile rather than the 25th percentile-the magnitude is comparable to the average monthly employment growth rate.

Table B.10 conducts the same exercise for the marginal effect of the cyclically adjusted primary balance, $\Delta capb$, as Table B.9 does for ΔDEF, using specification 2. The results show that higher values of $\Delta capb$ (austerity) are associated with relatively lower employment growth in more government demand dependent industries. We observe this pattern for the 75th and 90th percentiles of $\Delta capb$, which are high levels of austerity. The findings indicate that austerity leads to contractionary effects on employment in government demand dependent industries. The estimates predict that when $\Delta capb$ is at the 75th percentile, employment growth is expected to be .13% lower in the industry at the 75th percentile of dependence on government demand versus the industry at the 25th percentile.

To get a better understanding of the relative marginal effects of default risk and fiscal policy, we use specification 3 of Table B.8 to calculate the impact of a one standard deviation increase in $\Delta capb$ when the value of ΔDEF is at the sample average and of a one standard deviation increase in ΔDEF when $\Delta capb$ is at its sample average. The results are in Figure B.7. Figure B.7 shows that a one standard deviation in $\Delta capb$ does not have a significant effect on employment growth when ΔDEF is at its mean. In contrast, a one standard deviation increase in ΔDEF is associated with a significantly reduced employment growth rate when $\Delta capb$ is at its sample mean. The magnitude of this effect increases for more government demand dependent industries. Similar to Table B.9, Figure B.7 shows that a one standard deviation increase in ΔDEF is associated with -2.5% employment growth at the 90th percentile of dependence on government demand. The results suggest that default risk has a significant effects on employment growth when fiscal policy is at its sample average.

To further investigate the interaction of default risk and fiscal policy, we use specification 3 of Table B.8 to calculate the marginal effects of a one standard deviation increase in $\Delta capb$ for different values of ΔDEF and of a one standard deviation increase in ΔDEF for changes in $\Delta capb$. The results are in Figures B.8 and B.9. Figure B.8 shows that the marginal effect of ΔDEF is always negative and higher in magnitude for industries at the 75th percentile of GOV versus the industries at the 25th percentile. The magnitude of the difference between the 75th and 25th percentile of GOV increases when $\Delta capb$ increases. That is, we observe a stronger contractionary effect of default risk on employment growth in more sensitive industries when the government implements austerity measures. Figure B.8 shows that a one standard deviation increase in ΔDEF is associated

with -3.1% employment growth at the 90th percentile of $\Delta capb$ and the 75th percentile of GOV versus -0.6% employment growth at the 90th percentile of $\Delta capb$ and the 25th percentile of GOV. This difference is six times the average monthly employment growth.

So far, the results support the hypothesis that austerity measures are significant when combined with increased default risk. One potential rationale for these results is that agents learn about future government policy when they observe austerity measures in response to increased default risk. To investigate whether the data further support this hypothesis, we estimate (3.9) and (3.10) to determine if the data show that changes in default risk Granger cause fiscal policy measures or vice versa. First, we estimate (3.9) and find that the set of coefficients δ have a positive sum and are jointly significant at the 5% level. Thus, we find that changes in default risk appear to Granger cause changes in fiscal policy. Further, the positive sum of the coefficients indicates that increased default risk is associated with austerity measures. Second, we estimate (3.10) and find that β is not statistically significant. The finding suggests that changes in fiscal policy do not Granger cause changes in default risk. The results support the hypothesis that governments may enact austerity measures when default risk rises to either stave off default or because borrowing constraints become binding when default risk rises.

Overall, the results suggest that employment growth falls in industries that are more exposed to default risk via the government demand channel *relative* to those less exposed. Recall that average monthly employment growth for manufacturing industries above the median dependence on government demand is -0.58% while employment growth is -0.30% on average for industries below the median of dependence on government demand during the sample period. The estimates in this section suggest that increased default risk drives austerity and explains the relative decline in employment growth in more government demand dependent industries. The evidence is consistent with the hypothesis that default risk is an important driver of the decline in Puerto Rican employment over the sample period.

3.5.3 The Effects of Default Risk on Private and Public Borrowing Costs

The previous subsections provide evidence in support of the hypotheses that an increase in the risk of sovereign default disproportionately affects industries that are more dependent on external finance or government demand. These hypotheses were based on the premise that changes in sovereign default risk are transmitted to changes in the borrowing costs for the private sector and for the public sector. In this section, we provide some evidence for this conjecture.

First, we use an event study to test the hypotheses that a decline in the perceived creditworthiness of the Puerto Rican government is correlated with an increase in yields on government debt and an increase in the cost of capital for publicly traded Puerto Rican firms. In particular, we examine the reaction of spreads, yields,

and stock returns to news about rating actions and legal events related to Puerto Rican credit risk with the assumption that markets are semi-strong form efficient.[26] To estimate the effect of rating and legal events on the cost of capital, we first calculate the expected return of all publicly traded Puerto Rican firms using the market return model with the log return on the S&P 500 as the benchmark market index.[27] With the parameters of the market model in hand, we compute cumulative abnormal returns for each firm over a three-day window. Similarly, we investigate the effect of our events on the tax-adjusted yield spreads of the general obligation debt of the Commonwealth of Puerto Rico. We compute the change in the tax-adjusted spread for each maturity as:

$$\Delta S_{mt} = S_{mt} - S_{mt-1}, \tag{3.11}$$

where S_{mt} is the difference between the tax-adjusted yield on Puerto Rican general obligation bond m and a U.S. treasury of the same maturity on day t. For each bond m and event $j \in J$ where J is the set of legal and rating events.

Event Identification

To identify changes in the perceived creditworthiness of Puerto Rico, we study two types of events that convey news about Puerto Rico's creditworthiness. First, we identify rating actions on Puerto Rican government debt.[28] This includes general obligation (GO) debt of the Commonwealth of Puerto Rico as well as the debt of public companies which rely on the Commonwealth for financial support. General obligation debt is backed by the full faith and credit of the Commonwealth and the Puerto Rican constitution requires it to be paid before any other obligations.

The following notable public companies are agencies of the Commonwealth; the Puerto Rican Government Development Bank (GDB), the Puerto Rico Sales Tax Financing Corporation (COFINA), the Puerto Rican Electric Power Authority (PREPA), the Puerto Rican Aqueduct and Sewer Authority (PRASA), the Puerto Rican Highway and Transit Authority (PRHTA), the Puerto Rican Employees Retirement System (PRERS), the University of Puerto Rico (UPR), the Puerto Rican Public Finance Corporation (PRPFC), and the Puerto Rican Housing Finance Authority (PRHFA).[29] Rating actions on these agencies may be important for the perceived

[26] See Mackinlay (1997) and Andrade et al. (2001).

[27] We estimate the market model from 2000 through 2005 for OFG, BPOP, and FBP and from the first available data on December 10, 2007, through December 4, 2009, (30 trading days before the first event in the sample) for GTS.

[28] Rating actions include affirmations of credit rating, changes in credit rating, and changes in outlook. A rating action is classified as negative if it is either a decrease in credit rating or a negative change in outlook and the opposite for positive changes. Neutral actions are no change in rating or outlook.

[29] These agencies would be classified as municipalities of Puerto Rico if it were a state and issue much of Puerto Rico's outstanding debt.

creditworthiness of the Commonwealth because they have either explicit or implicit guarantees from the Commonwealth. Indeed, the rating agencies often downgrade the debt of these agencies and the Commonwealth simultaneously due to these guarantees.

Added to the rating actions, we identify legal events that are relevant to Puerto Rico's creditworthiness. These legal events include the passage of, and legal proceedings regarding, three laws. First, the "Puerto Rico Public Corporations Debt Enforcement and Recovery Act" was enacted by Puerto Rico on June 28, 2014, and attempted to create a legal framework for agencies of Puerto Rico to restructure their debt. The law was modeled after Chapter 9 of the U.S. bankruptcy code under which municipalities of U.S. states can declare bankruptcy and restructure their debt.[30] Second, the "Debt moratorium and Financial Recovery Act," enacted by Puerto Rico on April 6, 2016, attempted to allow Puerto Rico to suspend payment on its debt.

Third, the "Puerto Rico Oversight, Management, and Economic Stability Act" (PROMESA), enacted by the United States on June 30, 2016, and described above, creates a bankruptcy-like legal framework for Puerto Rico to restructure its debt. The passage of these three laws and events related to their litigation are relevant to the likelihood of a default because they are all related to creating a legal framework to allow Puerto Rico to restructure.[31] In Appendix B.2.5, we describe our system for classifying these three laws and related legal actions as credit positive, negative, or neutral. Finally, we identify bankruptcy filings, grantings, and dismissals for U.S. towns, cities, and counties that occur during our sample of rating actions as municipal events. In the online appendix, we list the rating, legal, and municipal events.[32]

We calculate cumulative abnormal returns ($CARs$) for each firm i and each event j and changes in spreads (ΔS_{mt}) for each event j and bond m. We estimate the effect of each class of event on stocks by regressing CAR

Various smaller agencies also rely on the Commonwealth and rating actions on these always coincide with rating actions of one of the major agencies listed. Thus, no news events are omitted by restricting attention to these major agencies.

[30] As we discussed previously, the federal bankruptcy code both reserved this right for states and mandates that states can not pass laws binding creditors to accept losses. Puerto Rico argued unsuccessfully that its status as a nonstate, which proscribed it from using the former also exempted it from the latter.

[31] These events include passage of the laws, filings of suits against the laws, decisions to hear a case, oral arguments before the court, the court's decision, and other relevant proceedings. Minor legal events such as distribution of material for conference or the setting of an argument date are not included.

[32] For the online appendix, please visit https://www.dropbox.com/s/zg9eo3uzqkn6omq/The%20Costs%20of%20%28sub%29Sovereign%20Default%20Risk_Evidence%20from%20Puerto%20Rico_Online%20Appendix.pdf?dl=0. We also document our system for classifying the sign and types of events and cases thereof in Appendix B.2.6. Section 3.6 discusses the effects reclassification on the benchmark results. The online appendix lists the full sample of events and their classifications. We use the most restrictive possible event window of one day for robustness in Section 3.6. Using three-day event windows creates a number of overlapping event windows due to events occurring with less than the required two trading days needed between them to prevent overlap. In such cases, we expand the three-day event windows to contain the overlapping events, until we obtain the smallest possible window which gives us one pre-event day and one post-event day in the enlarged window which does not overlap with the window of another event. In Section 3.6, we use two additional approaches for handling the overlap of the three-day event windows. The results are qualitatively the same as the benchmark results.

on a constant. Note that the rating and legal events we wish to study are common to all firms. Therefore we cluster the standard errors by firm. Similarly, we estimate the effect of the events on yield spreads by regressing $C\Delta S$ for all bonds in the dataset on a constant, clustering the standard errors by bond.

Results

The results are in Table B.11. The results of the event study for the full sample of events show a statistically significant cumulative abnormal return of -0.9% and a statistically significant cumulative change in spread of 8.81 basis points, indicating that the set of events is associated with an increase in the cost of capital for the Puerto Rican government and for Puerto Rican firms. Further, negative events are associated with a statistically significant cumulative abnormal return of -1.6% and a statistically significant cumulative change in spread of 8.4 basis points. Negative rating actions on nongeneral obligation debt are not associated with a statistically significant cumulative abnormal return or a statistically significant cumulative change in spread. This indicates that bad news about the credit risk of Puerto Rico's agencies does not significantly impact the cost of capital for the Puerto Rican government or for Puerto Rican firms.[33]

In contrast, negative rating actions on general obligation debt are associated with a statistically significant cumulative abnormal return of -4.1% and a statistically significant cumulative change in spread of 16.2 basis points. Similarly, negative legal events are associated with a statistically significant cumulative abnormal return of -3.8% and a statistically significant cumulative change in spread of 20.2 basis points. Positive events are associated with statistically significant cumulative abnormal returns of 0.33% and statistically significant cumulative change in spread of 8.6 basis points. The increase in spreads is not the expected result but is far smaller in magnitude than the increases seen for negative general obligation rating events and negative legal events. Neutral and mixed events show no significant effect on cumulative abnormal returns and are associated with a statistically significant cumulative change in spreads of about 9.9 and 9.3 basis points, respectively.

The results in this section confirm that adverse news about Puerto Rico's creditworthiness significantly increases the cost of capital for the government and for private companies. Our earlier findings that an increase in the risk of sovereign default disproportionately affects industries that are more dependent on external finance or government demand are theoretically based on the transmission of sovereign default risk to public and private borrowing costs. Thus, the results in this section support these conclusions.

[33] Note however, that general obligation rating actions often coincide with rating actions on agencies and are classified as general obligation rating actions.

3.6 Robustness

We conduct several tests to ensure the robustness of our results. These results are omitted from the main paper for brevity and are available in the online appendix.[34]

An alternative measure of default probability: To ensure our results are robust to alternative measures of financial distress for the Puerto Rican government, we substitute the change in the monthly average yield spread of Puerto Rican five-year securities for the change in default probability for the credit channel and the government spending channel. The benchmark results remain qualitatively the same.[35]

Restricting the sample to the post GFC Period: One concern about our benchmark results is that spreads on Puerto Rican CDS spreads may have increased and employment may have declined relatively more in external finance and/or government spending dependent industries during the global financial crisis. Indeed, evidence suggests that banking crises have a more adverse impact on the value added of external finance dependent industries (see Dell'Ariccia et al. (2008)). For this reason, we repeat our benchmark specifications and restrict the sample to the year 2010 and thereafter. The benchmark results are qualitatively unaffected. Also, note that including the crisis period in our estimations attenuates the magnitudes of our coefficient estimates.

Alternative calculation periods for $EXTFIN^{US}$ and GOV: To ensure our results are not sensitive to the estimation period used to calculate dependence on external finance, we also repeat our benchmark specifications using the pre-crisis estimation period of 1995-2005 and the narrower period of 2005-2015 to calculate $EXTFIN^{US}$. Similarly, we estimate our benchmark specifications using the average of the GOV measure from the 2012 Economic census and the 2007 Economic Census. Our results remain robust.

Recession risk: Another potential concern about our benchmark estimates is that increased risk of recession may be the cause of increased default probabilities. If true, this could explain relatively lower employment growth in external finance-dependent industries. This follows because lenders may know that recessions have a relatively larger negative impact on the activity of external finance-dependent industries and restrict quantities or increase prices of loans to more exposed industries. Similarly, recession risk could also explain relatively lower employment growth in industries more dependent on government spending as agents may expect that recessions have a differential impact on the employment in these industries.

To allow for these possibilities, we control for each industry's sensitivity to the wider economy. We compute $\Delta DEF_t * CYC_i$ where CYC_i is the sensitivity of employment growth in industry i to economic growth in

[34]For the online appendix, please visit https://www.dropbox.com/s/zg9eo3uzqkn6omq/The%20Costs%20of%20%28sub%29Sovereign%20Default%20Risk_Evidence%20from%20Puerto%20Rico_Online%20Appendix.pdf?dl=0.

[35]The sample of yield spreads for our results begins in 2001. However, the results are robust to restricting the sample to the period used in the benchmark results.

Puerto Rico. To estimate CYC_i, we perform simple regressions of employment growth on growth in the Puerto Rican Economic Activity Index from January 1990 through December 2007.[36] We use the coefficients from these regressions as a measure of CYC_i and include 12 lags of $DEF_t * CYC_i$ in our benchmark models. The benchmark results remain robust.

Industry-specific shocks: We also address the potential endogeneity of industry-specific shocks. It is conceivable that there is a correlation between increases in Puerto Rican default probabilities and negative U.S. mainland-wide shocks to certain manufacturing industries, especially if such industries represent an outsized portion of Puerto Rico's tax base. If such industries also tend to be more dependent on external finance or government demand, this would bias our benchmark results. To control for this possibility, we include 12 lags of U.S. growth of industrial production and employment in each industry in our benchmark models.[37] The results indicate that our benchmark results are robust.

Puerto Rican industry-specific shocks: Industry-specific shocks unique to Puerto Rico are another potential endogeniety concern if they occur in industries that represent a relatively large share of Puerto Rico's tax revenues, affect default risk, and occur in industries more reliant on external finance or government spending. We do not have data on industry-specific shares of Puerto Rican tax revenues. However, we posit that industries that comprise a larger share of Puerto Rico's private employment would also tend to make up a relatively larger share of Puerto Rico's tax revenues. If this endogeneity problem exists, we would expect that industries that are more dependent on external finance or government demand and make up a relatively larger share of Puerto Rico's private employment may drive our benchmark findings.

To test this hypothesis, we generate an indicator H_{EXTFIN}, which takes the value of one when an industry has both above the median dependence on external finance and above the median share of total private employment. We also we generate an indicator H_{GOV} which takes the value one when an industry has both above the median dependence on external government spending and above the median share of total private employment. We include 12 lags of the interaction $H_{EXTFIN} * EXTFIN_i^{US} * \Delta DEF_t$ in our benchmark model for the external finance channel and of the interaction $H_{GOV} * GOV_i * \Delta DEF_t$ in our benchmark model for the government spending channel. The results are consistent with the hypothesis that industry-specific shocks unique to Puerto Rico do not appear to drive our benchmark results.

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[36] We use the period beginning with the first available employment data and ending just before the sample for our benchmark regression to prevent endogeniety of the CYC_i measure to employment growth.

[37] U.S. industrial production is only available for 16 of the 19 manufacturing industries in our benchmark sample. In addition, production in six of these industries is aggregated with another industry, providing only 13 unique monthly series. For example, industrial production for the industries 311 and 312 are reported as the sum of the two. We seasonally adjust growth in industrial production and U.S. employment using Census X-13.

Population shocks: We also consider the possibility that Puerto Rico's population decline drove default risk and employment declines in industries more dependent on external finance or government spending. To control for this possibility, we include the interaction $\Delta POP_{prioryear} * EXTFIN^{US}$ in our benchmark model for the external finance channel and the interaction $\Delta POP_{prioryear} * GOV$ in our benchmark model for the government spending channel, where $\Delta POP_{prioryear}$ is the growth rate of Puerto Rico's population in the prior year.[38] Our benchmark results are robust.

Housing price shocks: The housing price decline in Puerto Rico is another major characteristic of the crisis that could drive default risk and employment declines in industries more dependent on external finance or government spending. To control for this possibility, we include four lags of the interaction $\Delta HP * EXTFIN^{US}$ in our benchmark model for the external finance channel and four lags of the interaction $\Delta HP * GOV$ in our benchmark model for the government spending channel, where ΔHP is the quarterly growth rate of Puerto Rico's housing price index.[39] Our benchmark results are robust.

Interactions between the credit channel and the government spending channel: A further potential concern about our benchmark results is that dependence on external finance may be related to dependence on government spending. If so, our benchmark estimates for the credit channel and the government spending channel may suffer from omitted variable bias. For this reason, we control for the external finance channel in our government spending specifications. The results are similar to the benchmark for each channel except that the magnitude increases. The sum of the coefficients on the external finance interactions are about three times the benchmark specifications and increase in joint significance. The sum of the coefficients on the government spending interactions also increase in magnitude and joint significance.

Alternative lags of the dependent variable: In the benchmark specifications for the credit channel and the government spending channel.[40] This approach controls for autocorrelation in employment growth rates and serial correlation in the benchmark errors. The benchmark results are qualitatively the same.

Event study checks: We also conduct a number of tests to ensure the robustness of our event study estimations. We begin by repeating our benchmark event study using three-day windows, which may overlap, rather than using larger windows where overlap occurs. We also repeat our benchmark event study exercise using one-day windows. In addition, we use a more traditional estimation window for the market model beginning

[38] We retrieve annual population in Puerto Rico from WDI.

[39] We retrieve the purchase-only quarterly, seasonally adjusted housing price index for Puerto Rico from the FHFA.

[40] We chose three lags because optimal lag selection information criteria select three lags as optimal and because the standard errors of the regressors stabilize at the third lag.

280 trading days before each event and ending 30 days before it to calculate the abnormal return. Further, we extend the estimation window to use all pre-2010 data for all four firms. The results remain robust to all these alternative specifications.

3.7 Conclusion

This paper uses Puerto Rico's debt crisis to develop a novel identification strategy to extract the real costs of (sub)sovereign default risk. We use Puerto Rico as a case study because Puerto Rico's unique characteristics as a U.S. territory allow us to examine the channels through which (sub)sovereign default risk can have real effects on the macroeconomy.

Puerto Rico's (sub)sovereign default crisis differs from existing cases of sovereign default. Specifically, Puerto Rico's unique legal relationship with the United States effectively eliminates the risk of a currency crisis, a banking crisis, or government interference in private contracts, which make it difficult to isolate default risk other instances of sovereign default. An important advantage is the availability of Puerto Rican data on macro-indicators such as employment at higher frequencies and disaggregated at the industry level.

We examine the real effects of anticipation of Puerto Rico's default in several ways. First, using activity for the mainland U.S. as a control, we investigate whether the deterioration in Puerto Rico's credit rating and credit spreads that occurred after 2012 led to a significant divergence in Puerto Rico's real economic activity from the rest of the U.S.. We find that post-2012, during the period of increased default probabilities, the cointegrating relationship between real activity in Puerto Rico and the U.S. mainland breaks down and Puerto Rico experiences a significant decline. While these results do not causally link default anticipation and Puerto Rico's economic decline, they establish that increased (sub)sovereign risk coincided with a negative and significant aggregate divergence of Puerto Rico's economy from the rest of the U.S. mainland.

Second, we use an approach similar to Rajan and Zingales (1998) to establish that increased default risk reduces employment in industries that are ex-ante more exposed or sensitive to a default event due to greater dependence on external finance or government demand. We use this approach to address the concern that declines in economic activity may drive increased default probability and thus confound identification of the effect of default risk on employment. We find that increased default probabilities lead to lower employment in sectors that are relatively more dependent on external finance and exposed to Puerto Rican government demand. These findings are both statistically and economically significant. Further, the magnitude of the negative effect of default risk on employment growth in government demand dependent industries increases when the government undertakes austerity measures. One potential rationale for these results is that agents learn about future government policy when they observe austerity measures respond to increased default risk. We also find that

increased default risk Granger causes austerity, indicating the government may undertake austerity in response to borrowing constraints or to reassure investors.

Finally, we use an event study framework to investigate whether changes in Puerto Rico's credit risk affected yields on government debt or the stock returns of public Puerto Rican firms. We identify changes in Puerto Rico's credit risk using rating actions on Puerto Rican debt and legal events related to the legal rights of Puerto Rican government entities to restructure their debt. We find that negative credit events are correlated with significant increases in credit spreads on Puerto Rican debt and significant decreases in stock returns for Puerto Rican firms. These findings show that increased credit risk significantly increased the cost of capital for both the Puerto Rican government and for Puerto Rican firms.

The lessons learned from Puerto Rico's crisis apply on a smaller scale to state and municipal governments throughout the United States. Tax preferences can create large-scale economic bubbles, tax-exempt bonds can inflate debt levels, and delaying comprehensive tax reform can cause substantial fiscal problems when a shock arrives (e.g., the global financial crisis) that increases government default risk. When default risk increases, losses to banks result in increased financing costs and reduced investment. Increased default risk following such a shock can also drive the government to cut spending, which can reduce output and employment, especially in industries directly reliant on government demand. Importantly, firms can anticipate government spending cuts and reduce hiring when default risk increases.

While the literature explores the effects of default risk on financial intermediation, existing models that embed sovereign default risk do not allow for demand-driven recessions. For example, we find that a government demand channel operates for the case of Puerto Rico. To incorporate the demand channel, future extensions of theoretical models could embed New Keynesian frictions into small open economy models with sovereign default risk.

APPENDIX A

APPENDIX FOR CHAPTER 2: THE PRICING OF CONTRACT PROVISIONS AND LAW: THE CASE OF PUERTO RICO

A.1 Tables and Figures

Table A.1: Puerto Rican Law GO Debt has been Outstanding Significantly Longer and has a Significantly Lower Face Value than NY Law GO Debt

Variable (units)	NY law bonds (1 issue, 598 Obs.)				PR law bonds (18 issues, 10,764 Obs)				Difference
	Mean	Median	25th pctile	75th pctile	Mean	Median	25th pctile	75th pctile	
YM (years)	20.19	20.17	19.58	20.75	20.24	20.42	17.17	23.67	0.056
AGE (years)	1.15	1.17	0.58	1.75	7.48	7.08	3.92	10.75	6.33***
FV (mil. $'s)	3,500	3,500	3,500	3,500	181.39	124.49	65.54	263.54	-3,318.61***
YTM (%)	10.33	10.05	9.19	11.35	8.71	8.87	8.17	9.68	-1.62***
RISK (rat. cat.)	15.95	17.00	12.00	20.00	-	-	-	-	-

Notes: The table reports the summary statistics for New York law and Puerto Rican law GO debt. The time series begins March 12, 2014 and ends June 30, 2016. YM is the number of years remaining to maturity. AGE is the number of years since issue. FV is the face value in millions. $RISK$ is the S & P Long Term issuer rating measured as a categorical variable ranging from 1 (AAA) to 22 (D). The final column reports the difference in means between the two samples, assuming unequal variances, and a t-test of statistical significance. Table A.9 describes the variables listed here. - indicates that a test or data is not relevant or superfluous. ***, **, and * indicate significance at the 99%, 95%, and 90% levels, respectively.

Table A.2: P.R. Debt Issued Under New York Law Trades at Significantly Higher Yields than P.R. Debt Issued under Puerto Rican Law

	(1)	(2)	(3)	(4)
NY	1.621***	1.621***	1.865***	17.39**
	(5.40)	(5.26)	(4.44)	(2.19)
RISK			0.0861***	0.114***
			(4.14)	(4.03)
YM			-0.580	-1.055*
			(-1.00)	(-1.96)
YM^2			0.0151	0.0299*
			(1.06)	(1.86)
AGE				-0.0111
				(-0.06)
FV				-0.00463*
				(-2.03)
Constant	8.705***	9.063***	12.66**	16.48***
	(29.00)	(23.98)	(2.13)	(3.56)
Observations	11,362	11,362	11,362	11,362
Number of Bond Issues	19	19	19	19
R^2	0.058	0.285	0.315	0.423
Day Fixed Effects	N	Y	Y	Y

Notes: The table uses a bond-level sample of securities ranging from the issuance of New York Law debt on March 11, 2014 to July 1, 2016. NY is a dummy indicating if an issue is governed by New York law. $RISK$ is the S & P Long Term issuer rating measured as a categorical variable ranging from 1 (AAA) to 22 (D). YM is the number of years remaining to maturity. AGE is the number of years since issue. FV is the face value in millions. The model is estimated using OLS. ***, **, and * indicate significance at the 99%, 95%, and 90% levels, respectively. Standard errors are clustered by bond issue. T-statistics are in parentheses. Table A.9 describes the variables listed here.

Table A.3: Increased Credit Risk is Associated with a Larger Yield Differential Between P.R. law P.R. Debt and New York Law P.R. Debt

	(1)	(2)
NY	1.865***	-0.535*
	(4.44)	(-1.90)
RISK	0.0861***	0.0744***
	(4.14)	(3.96)
NY × RISK		0.151***
		(9.02)
YM	-0.580	-0.580
	(-1.00)	(-0.99)
YMˆ2	0.0151	0.0151
	(1.06)	(1.06)
Constant	12.66**	12.83**
	(2.13)	(2.15)
Observations	11,362	11,362
Number of Bond Issues	19	19
R^2	0.315	0.322
Day Fixed Effects	Y	Y

Notes: The table uses a bond-level sample of securities ranging from the issuance of New York Law debt on March 11, 2014 to July 1, 2016. NY is a dummy indicating if an issue is governed by New York law. $RISK$ is the S & P Long Term issuer rating measured as a categorical variable ranging from 1 (AAA) to 22 (D). YM is the number of years remaining to maturity. The model is estimated using OLS. ***, **, and * indicate significance at the 99%, 95%, and 90% levels, respectively. Standard errors are clustered by bond issue. T-statistics are in parentheses. Table A.9 describes the variables listed here.

Table A.4: Summary Statistics: Puerto Rican Law GO Debt has Significantly Shorter Maturity, has been Outstanding for a Longer Time and has a Significantly Higher Face Value than COFINA Debt

Variable (units)	GO bonds (24 issues, 26,568 Obs.)				COFINA bonds (5 issues, 5,535 Obs)				Difference
	Mean	Median	25th pctile	75th pctile	Mean	Median	25th pctile	75th pctile	
YM (years)	5.66	5.08	3.67	6.75	20.65	23.67	19.17	25.92	-14.98***
AGE (years)	10.53	11.67	7.58	13.42	2.42	2.42	1.33	3.50	8.11***
FV (mil. $'s)	36.03	18.79	12.17	49.51	17.94	5.23	3.41	15.14	18.10***
YTM (%)	8.46	5.79	4.12	9.60	7.35	7.12	5.54	8.64	1.11***
RISK (rat. cat.)	13.02	11.00	10.00	17.00	-	-	-	-	-

Notes: The table reports the summary statistics for senior COFINA and Puerto Rican law GO debt selected for the benchmark analysis. The time series begins on April 3, 2012 when the last issue of such debt occurred and ends June 30, 2016. YM is the number of years remaining to maturity. AGE is the number of years since issue. FV is the face value in millions. YTM is the yield to maturity. $RISK$ is the S & P Long Term issuer rating measured as a categorical variable ranging from 1 (AAA) to 22 (D). The final column reports the difference in means between the two samples and a t-test of statistical significance. Table A.9 describes the variables listed here. - indicates that a test or data is not relevant. ***, **, and * indicate significance at the 99%, 95%, and 90% levels, respectively.

Table A.5: COFINA Debt Trades at Significantly Lower Yields than GO Debt

	(1)	(2)	(3)
COFINA	-1.111+	-1.111+	-3.064**
	(-1.69)	(-1.66)	(-2.27)
RISK			0.778***
			(7.42)
YM			-1.204***
			(-3.00)
YMˆ2			0.0405***
			(2.98)
AGE			-0.204
			(-1.45)
FV			-0.0270**
			(-2.41)
Constant	8.465***	4.042***	5.737**
	(12.85)	(16.71)	(2.49)
Observations	32,103	32,103	32,103
Number of Bond Issues	29	29	29
R^2	0.004	0.373	0.450
Day Fixed Effects	N	Y	Y

Notes: The table uses a bond-level sample of GO and COFINA securities ranging from the period were both sets of securities had been issued on April 3, 2012 to July 1, 2016. $COFINA$ is a dummy indicating if the bond is COFINA rather than GO. $RISK$ is the S & P Long Term issuer rating measured as a categorical variable ranging from 1 (AAA) to 22 (D). YM is the number of years remaining to maturity. AGE is the number of years since issue. FV is the face value in millions. The model is estimated using OLS. ***, **, *, and + indicate significance at the 99%, 95%, 90%, and 85% levels, respectively. Standard errors are clustered by bond issue. T-statistics are in parentheses.

Table A.6: Increased Credit Risk is Associated with a Larger Yield Differential Between GO Debt and COFINA Debt

	(1)	(2)
COFINA	-3.064**	-0.839
	(-2.27)	(-0.25)
RISK	0.778***	0.783***
	(7.42)	(5.55)
RISK × COFINA		-0.163
		(-0.72)
YM	-1.204***	-1.128***
	(-3.00)	(-2.80)
YMˆ2	0.0405***	0.0378**
	(2.98)	(2.74)
AGE	-0.204	-0.195
	(-1.45)	(-1.36)
FV	-0.0270**	-0.0275**
	(-2.41)	(-2.48)
Constant	5.737**	5.190*
	(2.49)	(1.82)
Observations	32,103	32,103
Number of Bond Issues	29	29
R^2	0.450	0.451
Day Fixed Effects	Y	Y

Notes: The table uses a bond-level sample of GO and COFINA securities ranging from the period were both sets of securities had been issued on April 3, 2012 to July 1, 2016. $COFINA$ is a dummy indicating if the bond is COFINA rather than GO. $RISK$ is the S & P Long Term issuer rating as a categorical variable ranging from 1 (AAA) to 22 (D). YM is the number of years remaining to maturity. The model is estimated using OLS. ***,**,and * indicate significance at the 99%, 95%, and 90% levels, respectively. Standard errors are clustered by bond issue. T-statistics are in parentheses. Table A.9 describes the variables listed here.

Table A.7: Summary Statistics: PROMESA

Variable (units)	Mean	Median	25th pctile	75th pctile	SD	Obs.
YM (years)	3.54	2.67	1.58	4.17	3.41	4,263
AGE (years)	13.28	14.25	13.42	14.67	3.41	4,263
FV (mil. $'s)	33.85	17.40	9.60	49.61	39.09	4,263
Δ YTM (basis points)	3.41	0.60	-4.70	14.10	29.57	4,263

Notes: The table reports the summary statistics for 21 GO security issues selected for the benchmark analysis. The time series begins one month before the first event on 11/19/15 and ends one month after the last event on 6/30/16. YM is the number of years remaining to maturity. AGE is the number of years since issue. FV is the face value in millions. ΔYTM is the daily change in yield in basis points. Table A.9 describes the variables listed here.

Table A.8: The Significance of PROMESA Announcements Varies by Event

Date	Event	Two-Day Change in Yield (Basis Points)
11/19/2015	First Version	-3.34
	Introduced in Senate	(0.61)
4/12/2016	First Version	-10.92
	Released in House	(0.23)
5/18/2016	Introduced in	-13.06
	House Committee	(0.20)
5/25/2016	Passed Committee	-4.58
		(0.65)
6/9/2016	Passed House	-0.55
		(0.92)
6/29/2016	Passed Senate	15.14*
		(0.10)
6/30/2016	President Signs	23.26***
		(0.00)
	All Events	0.81
		(0.84)

Notes: The table reports the results from a panel regression of the change in the daily yield estimated using OLS with standard errors clustered by security issue. Two day changes result from the sum of dummy variables for the event day and the post event day. Significance is determined using an F-test of the null hypothesis that the sum of the coefficients is zero. P-values from F-tests are reported in parentheses. The time series begins one month before the first event on 11/19/15 and ends one month after the last event on 6/30/16. ***, **, and * indicate significance at the 99%, 95%, and 90% levels, respectively.

Figure A.1: Governing Law and Yields

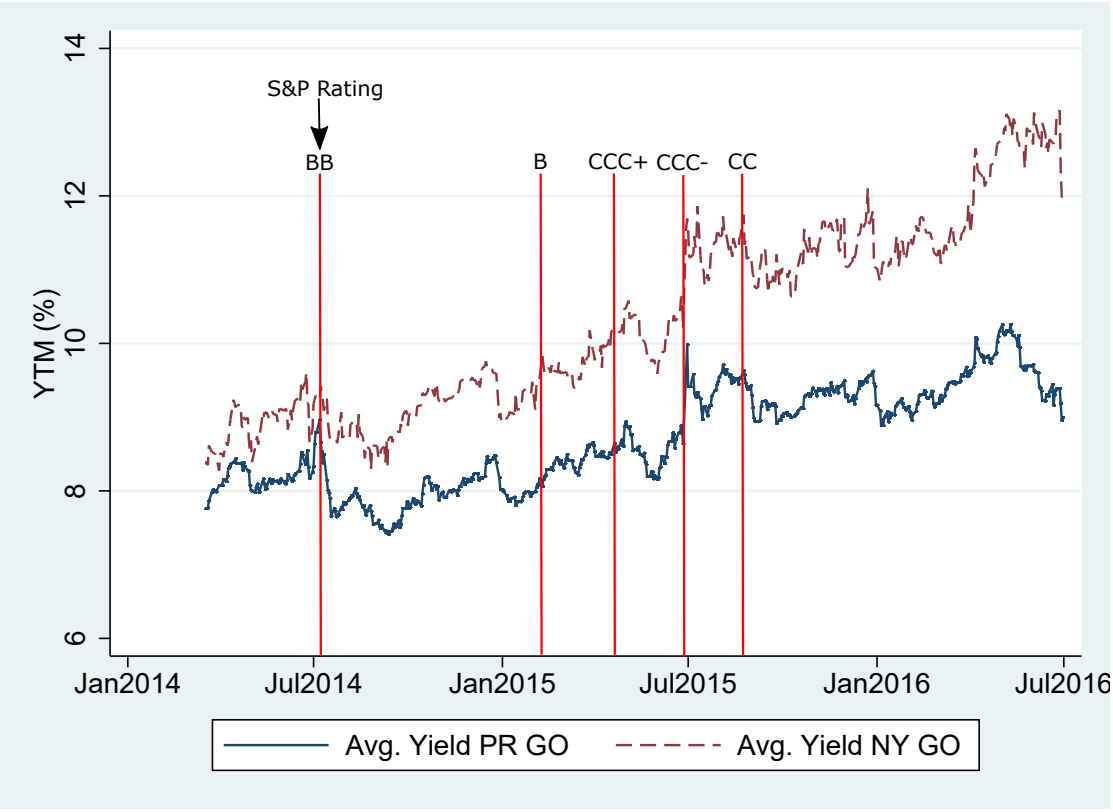


Figure A.2: Governing Law and Yields: Maturity Matched

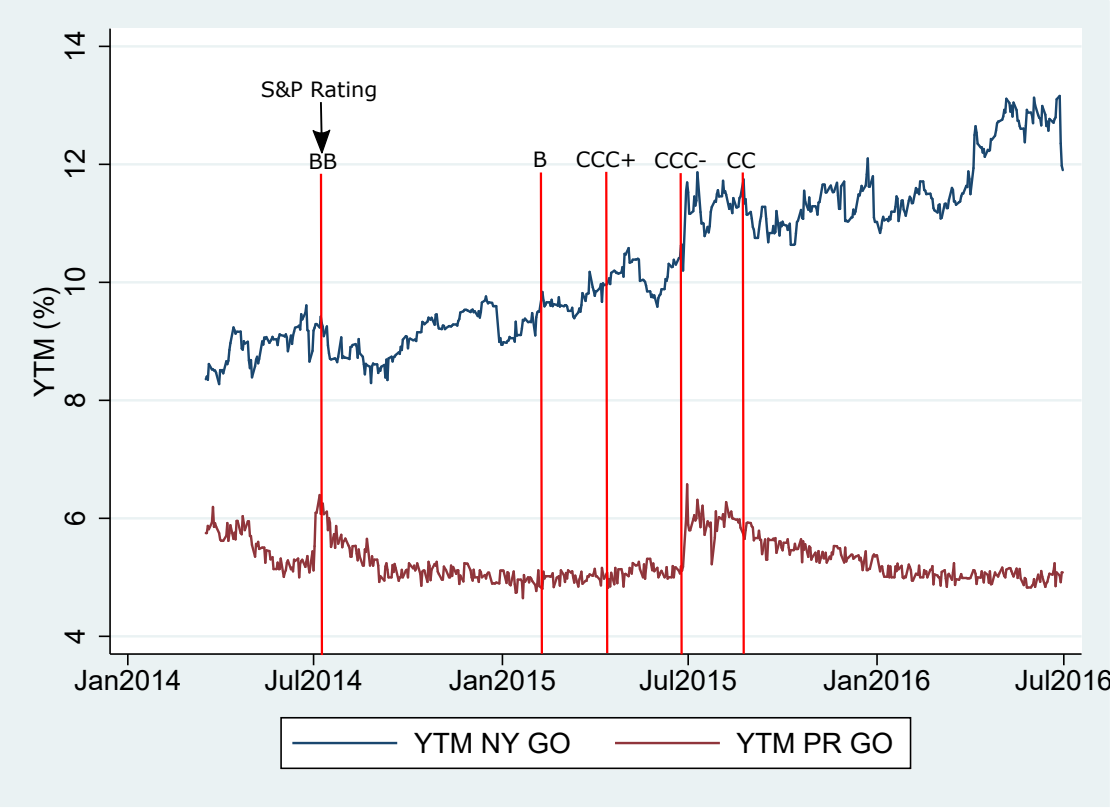


Figure A.3: Marginal Effect of NY Across $RISK$ with 90% C.I.

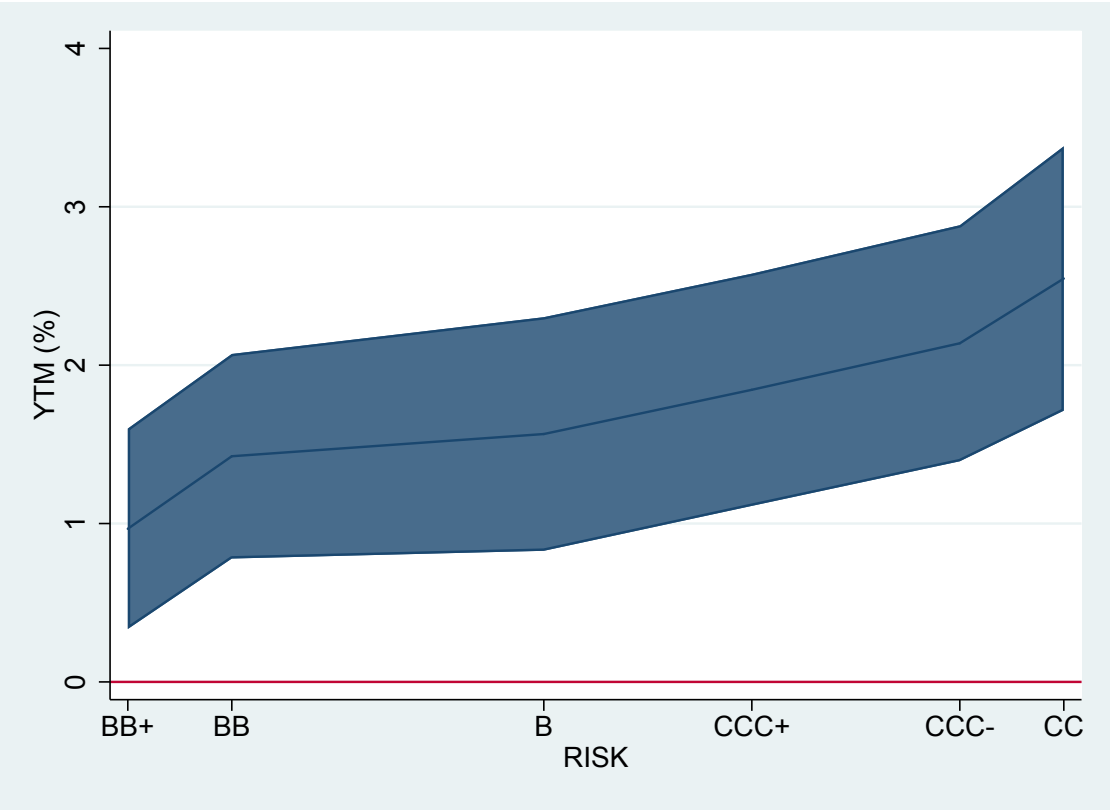


Figure A.4: COFINA and Yields

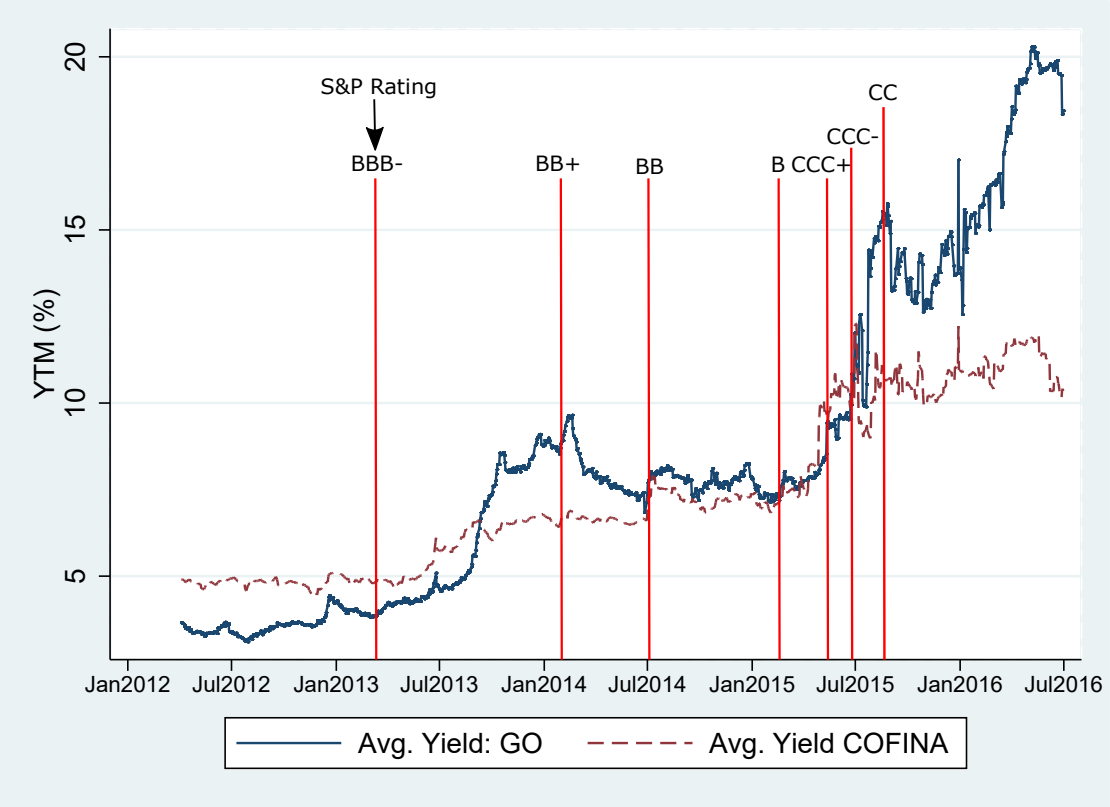
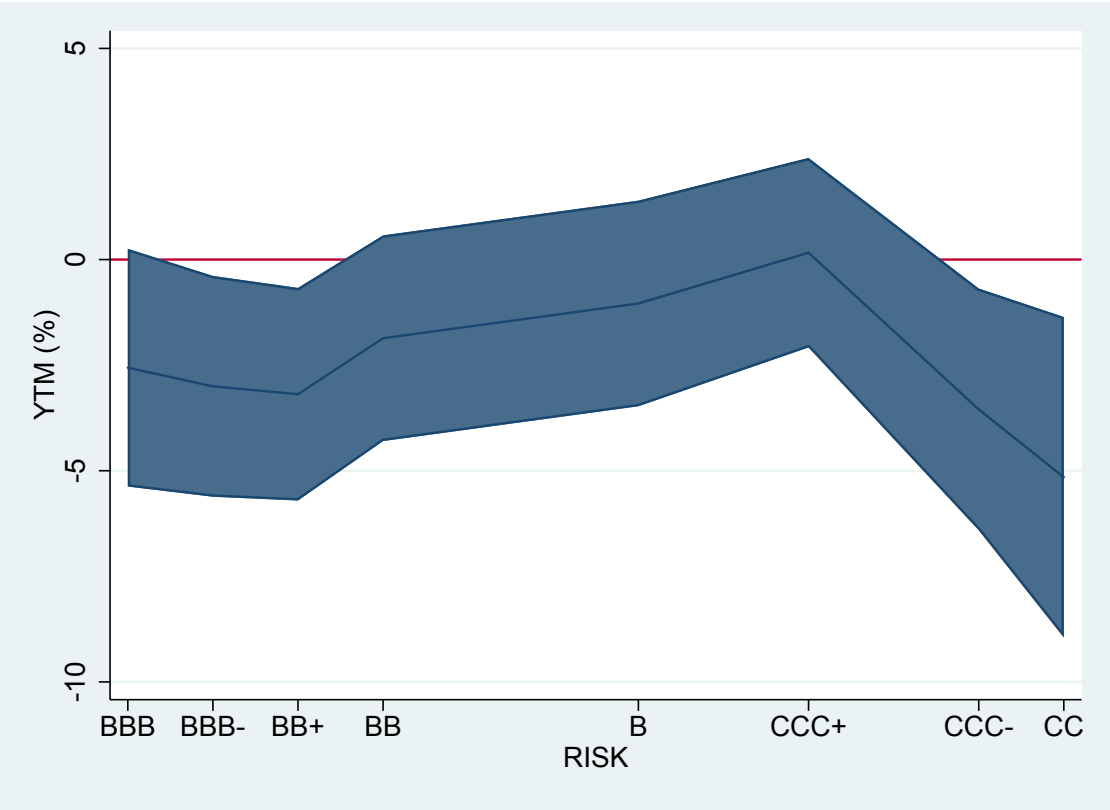


Figure A.5: Marginal Effect of $COFINA$ Across $RISK$ with 90% C.I.



A.2 Variable Descriptions

Table A.9: Variable Descriptions

Variable Name	Description
NY	NY Law: Dummy variable indicating whether the bond was issued under New York law
COFINA	Dummy variable indicating whether the bond was issued by COFINA
RISK	S & P Long Term Issuer Rating for PR: Categorical variable ranging from 1 for AAA to 22 for D
YM	The number of years remaining until maturity
AGE	Time Since Issue (Years)
FV	Face Value (Millions)
YTM	Yield to maturity (%)
Δ YTM	Daily first difference in yield to maturity in basis points

A.3 Data Appendix for Section 2.3

New York law GO bonds have the following characteristics: they mature on July 1, 2035; they are exempt from local, Puerto Rican, and federal taxes; they are not pre-refunded (which would render them essentially risk free); they are not insured; they are sinkable and callable; they are not puttable; and they have fixed rate coupons. The New York law GO debt is relatively liquid, with non-stale yields observed in each of the 598 trading days in the sample period.

The sample of Puerto Rican law GO bonds used for comparison to New York law GO bonds are selected to match the criteria observed in New York law GO bonds. That is, they are also exempt from local, Puerto Rican, and federal taxes; they are not pre-refunded; they are not insured; they are sinkable and callable; they are not puttable; and they have fixed rate coupons. I further require that the selected bonds do not mature during the sample period, have between 1 and 30 years until maturity, and have non-stale yield observations in at least 300 of the 598 trading days in the sample period.[1]

Table A.10 shows the breakdown of security characteristics in the filtering process to select a sample of Puerto Rican law GO debt that matches the characteristics of New York law GO debt. The filtering process results in 18 Puerto Rican law GO security issues that meet the criteria outlined above. These securities have a maturity amount of about $3.2 billion versus $3.5 billion for the New York law sample. The two most important filters which serve to reduce the size of the final Puerto Rican law GO sample versus the baseline sample are non-sinkable securities and securities which traded in less than 300 of the 598 trading days.

Table A.10: Much of Puerto Rican Law GO Debt is Similar to NY Law GO Debt

	NY Law # Issues	NY Law: Face Value ($ mln)	PR Law # Issues	PR Law: Face Value ($ mln)
Baseline	1	3,500	378	15,118
Issued before NY Law Debt	1	3,500	378	15,118
Triple Tax Exempt	1	3,500	366	14,990
Non-Pre Refunded	1	3,500	336	13,946
Uninsured	1	3,500	336	13,946
Sinkable	1	3,500	77	7,269
Callable	1	3,500	74	7,113
Non-Puttable	1	3,500	70	6,889
Fixed Rate	1	3,500	66	6,873
Matures After Sample Period	1	3,500	64	6,640
Maturity between 1 and 30 Years	1	3,500	64	6,640
Trades During at least 300 Days	1	3,500	18	3,265
Final Sample	1	3,500	18	3,265

Notes: The table summarizes the number of bond issues and the total maturity amount at each phase of the screening process for construction of the PR law GO sample for comparison to NY law GO debt. The baseline sample includes all GO debt with an observed yield during the sample period (which runs from March 12, 2014 to June 29, 2016) issued under PR or NY law where the maturity amount is available. The remaining rows summarize the sample after each filter is applied.

[1] I add the latter restriction to exclude securities which do not have updated pricing information throughout the sample. As 300 trading days is an arbitrary requirement, I relax this assumption for robustness.

A.4 Data Appendix: Section 2.4

As a baseline, I also only include bonds which do not mature during the sample period. To generate a matched sample of GO and COFINA debt, I first summarize the characteristics of senior COFINA and GO debt issued under Puerto Rican law, to determine the selection of characteristics which allow the largest sample and identification of the pricing of each issuer's legal protections. These summary statistics are in Table A.11. The table shows that the two samples have comparable characteristics. Most GO and senior COFINA debt are triple tax exempt, not pre-refunded, uninsured, non-sinkable, callable, non-puttable, and fixed rate. Given the comparability of the samples, I simply restrict the matched sample to securities with the characteristics that comprise the majority of both samples, with one exception - I utilize non-callable bonds in order to prevent the valuation of the option from confounding the identification of legal protections. As before, I also restrict the matched sample to securities with between 1 and 30 years to maturity and that trade in at least half of the sample trading days, in this case in at least 525 of the 1,052 trading days.[2]

Table A.12 shows the breakdown of security characteristics in the filtering process to select a sample of Puerto Rican law GO debt and COFINA debt that have matching characteristics. The filtering process results in 24 Puerto Rican law GO security issues with a total maturity value of $865 million and 5 senior COFINA security issues with a total maturity value of $90 million. The two most important filters which serve to reduce the size of the final sample versus the baseline sample are callable securities and securities which traded in less than 525 of the 1,052 trading days.

[2]Again, I include this restriction to exclude securities which do not have updated pricing information throughout the sample. As 525 trading days is an arbitrary requirement, I relax this assumption for robustness.

Table A.11: COFINA and GO Debt Have Comparable Characteristics, Making them Suitable for Sample Matching

Variable	COFINA bonds (86 issues, 95,202 Obs.)				PR law GO bonds (297 issues, 328,779 Obs)			
	Mean	Median	25th pctile	75th pctile	Mean	Median	25th pctile	75th pctile
Not Triple Tax Exempt	0.12	0.00	0.00	0.00	0.02	0.00	0.00	0.00
Pre-Refunded	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00
Insured	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sinkable	0.14	0.00	0.00	0.00	0.27	0.00	0.00	1.00
Callable	0.80	1.00	1.00	1.00	0.81	1.00	1.00	1.00
Puttable	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00
Fixed Rate	1.00	1.00	1.00	1.00	0.93	1.00	1.00	1.00
Days Issue Trades	661.63	990.50	195.00	1,042.00	352.73	228.50	1.00	594.00
Years to Maturity	21.16	19.75	14.33	25.50	10.75	9.25	5.58	15.33
Years Since Issue	5.32	5.58	3.92	7.08	8.92	8.67	4.58	12.58
Face Value (Millions)	71.36	26.53	7.43	91.01	45.58	20.63	11.52	52.95

Notes: The table reports the summary statistics for senior COFINA and Puerto Rican law GO debt which do not mature during the sample period. The time series begins on April 3, 2012 when the last issue of such debt occurred and ends June 30, 2016. Note that the first seven variables are dummies. For example, 100% of COFINA bonds are fixed rate while 93% of GO bonds are fixed rate.

Table A.12: The Filtering Process Produces a Sample of 29 Securities

	GO # Issues	GO: Face Value ($ mln)	COFINA # Issues	COFINA: Face Value ($ mln)
Baseline	294	13,506	86	6,137
Triple Tax Exempt	289	13,473	76	5,575
Non-Pre Refunded	263	12,462	76	5,575
Uninsured	263	12,462	76	5,575
Non-Sinkable	189	5,453	68	3,353
Non-Callable	50	2,420	15	948
Non-Puttable	44	1,444	15	948
Fixed Rate	43	1,411	15	948
Maturity between 1 and 30 Years	43	1,411	13	841
Trades In at Least 525 Days	24	865	5	90
Final Sample	24	865	5	90

Notes: The table summarizes the number of bond issues and the total maturity amount at each phase of the screening process for construction of the PR law GO debt and COFINA sample. The baseline sample includes all securities with an observed yield during the sample period (which runs from April 3, 2012 to June 29, 2016), issued during the sample period and not maturing during the sample period. The remaining rows summarize the sample after each filter is applied.

A.5 Marginal Effects

Table A.13: Increased Credit Risk is Associated with a Larger Yield Differential Between P.R. law P.R. Debt and New York Law P.R. Debt

	(1)	(2)
NY	-0.535*	0.967**
	(-1.90)	(2.65)
NY × RISK	0.151***	
	(9.02)	
RISK	0.0782***	
	(4.43)	
RISK=BB+		0
		(.)
RISK=BB		-0.151
		(-1.14)
RISK=B		0.256*
		(1.82)
RISK=CCC+		0.287**
		(2.45)
RISK=CCC-		0.623***
		(3.64)
RISK=CC		0.692***
		(4.39)
NY × RISK=BB+		0
		(.)
NY × RISK=BB		0.458***
		(9.24)
NY × RISK=B		0.598***
		(6.71)
NY × RISK=CCC+		0.878***
		(9.94)
NY × RISK=CCC-		1.171***
		(11.12)
NY × RISK=CC		1.580***
		(9.92)
YM	-0.580	-0.580
	(-0.99)	(-0.99)
YMˆ2	0.0151	0.0151
	(1.06)	(1.06)
Constant	12.79**	13.66**
	(2.14)	(2.33)
Observations	11,362	11,362
Number of Bond Issues	19	19
R^2	0.322	0.322
Day Fixed Effects	Y	Y

Notes: The table uses a bond-level sample of securities ranging from the issuance of New York Law debt on March 11, 2014 to July 1, 2016. NY is a dummy indicating if an issue is governed by New York law. $RISK$ is the S & P Long Term issuer rating measured as a categorical variable ranging from 1 (AAA) to 22 (D). $RISK = \_$ is a dummy variable indicating each observed credit rating during the sample period. YM is the number of years remaining to maturity. The model is estimated using OLS. ***, **, and * indicate significance at the 99%, 95%, and 90% levels, respectively. Standard errors are clustered by bond issue. T-statistics are in parentheses. Table A.9 describes the variables listed here.

Table A.14: Increased Credit Risk is Associated with a Larger Yield Differential Between GO Debt and COFINA Debt

	(1)	(2)
COFINA	-0.839	-2.560
	(-0.25)	(-1.55)
RISK × COFINA	-0.163	
	(-0.72)	
RISK	0.806***	
	(5.80)	
RISK=BBB		0
		(.)
RISK=BBB-		4.349***
		(10.86)
RISK=BB+		3.564***
		(7.35)
RISK=BB		2.574***
		(4.20)
RISK=B		3.047***
		(4.30)
RISK=CCC+		5.066***
		(5.78)
RISK=CCC-		8.492***
		(6.17)
RISK=CC		12.34***
		(4.49)
COFINA × RISK=BBB		0
		(.)
COFINA × RISK=BBB-		-0.441
		(-1.16)
COFINA × RISK=BB+		-0.628
		(-0.93)
COFINA × RISK=BB		0.698
		(0.80)
COFINA × RISK=B		1.521
		(1.49)
COFINA × RISK=CCC+		2.723**
		(2.22)
COFINA × RISK=CCC-		-0.987
		(-0.51)
COFINA × RISK=CC		-2.594
		(-1.02)
YM	-1.128***	-1.144***
	(-2.80)	(-2.78)
YM^2	0.0378**	0.0384**
	(2.74)	(2.72)
AGE	-0.195	-0.197
	(-1.36)	(-1.37)
FV	-0.0275**	-0.0274**
	(-2.48)	(-2.46)
Constant	5.014*	12.36***
	(1.73)	(4.57)
Observations	32,103	32,103
Number of Bond Issues	29	29
R^2	0.451	0.455
Day Fixed Effects	Y	Y

Notes: The table uses a bond-level sample of GO and COFINA securities ranging from the period were both sets of securities had been issued on April 3, 2012 to July 1, 2016. $COFINA$ is a dummy indicating if the bond is COFINA rather than GO. $RISK$ is the S & P Long Term issuer rating measured as a categorical variable ranging from 1 (AAA) to 22 (D). $RISK = \_$ is a dummy variable indicating each observed credit rating during the sample period. YM is the number of years remaining to maturity. The model is estimated using OLS. ***,**,and * indicate significance at the 99%, 95%, and 90% levels, respectively. Standard errors are clustered by bond issue. T-statistics are in parentheses. Table A.9 describes the variables listed here.

A.6 Liquidity Discussion

The controls for liquidity in Table A.2 merit further discussion. In column 4, the coefficient on FV is significant at the 90% level and indicates that issues with higher face values tend to have lower yields. As increased face values are associated with increased liquidity, the results indicate that more liquid debt trades at a liquidity premium. Indeed, the substantial increase in the economic importance of governing law predicted by specification 4 over specification 3 can be explained by the fact that the far larger face value of New York law debt embeds a substantial liquidity premium, meaning the model predicts that were New York law debt as illiquid as Puerto Rican law debt - the relatively modest increase in yields associated with New York law debt observed in specification 1, 2, and 3 would be much greater.

I introduce the liquidity controls in a separate specification to be mindful of the significant difference in the range of the face value across samples seen in Table A.1. In fact, the face value of New York law debt ($3.5 billion) is far outside the scope of the sample of Puerto Rican law debt which has a maximum face value of $.633 billion. This sample limitation makes the results of specification 4 suspect. That is, the fact that the range of the included liquidity controls in the Puerto Rican law sample does not remotely cover the range of the same variables in the New York law sample, it is plausible that they do not accurately reflect the differences in liquidity between the two samples.

In addition to the concerns about the range of the liquidity controls in the Puerto Rican law sample, the fact that New York law debt is on the run also raises the concern that the included liquidity controls may not adequately control for the liquidity premium which may be present in New York law debt. However, note from specifications 1, 2, and 3 that New York law debt trades at significantly higher yields than Puerto Rican law debt. If New York law debt carries a significant liquidity premium, the estimates in specifications 1, 2 , and 3 would certainly underestimate the positive effect New York governing law has on yields. For this reason, specifications without liquidity controls provide the most conservative estimate of the effect of governing law.

APPENDIX B

APPENDIX FOR CHAPTER 3: THE COSTS OF (SUB)SOVEREIGN DEFAULT RISK: EVIDENCE FROM PUERTO RICO

B.1 Tables and Figures

Table B.1: Puerto Rico and U.S. Growth

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent Variable	P.R. Growth [2006-2012]	P.R. Growth [2013-]	Post-2012 Growth Relative to Pre-2012 Growth (P.R.)	U.S. Growth [2006-2012]	U.S. Growth [2013-]	Post 2012 Growth Relative to Pre-2012 Growth (U.S.)	Diff-in-Diff
Private Employment Growth	-.0034** (.020)	-.0021* (.061)	.0013 (.233)	-.00004 (.978)	.0054*** (.000)	.0055*** (.000)	-.0042*** (.001)
N	28	14	14	28	14	14	14
Economic Activity Growth	-.0055*** (.000)	-.0059*** (.000)	-.0005 (.674)	.0024* (.094)	.0053*** (.000)	0.0029** (.016)	-.0034*** (.008)
N	28	14	14	28	14	14	14
Investment Spending Growth	-.0149 (.140)	-.0158** (.042)	-.0009 (.812)	-.0038 (.690)	.0097*** (.002)	.0135*** (.001)	-.0144** (.050)
N	7	3	3	7	3	3	3

Notes: Each column represents a regression of the variable listed on a constant. Column 1 shows the results of regressing either quarterly or annual log growth rates for 2006-2012 on a constant for P.R. Column 2 shows the results of the same exercise for 2013Q1-2016Q2 in the case of the first two variables, and 2013-2015 in the case of the third. Column 3 regresses the difference between the post-2012 growth rates and the pre-2013 average on a constant. I.e. a regression of the difference between the variable in column 2 and the average of the variable in column 1 on a constant. Columns 4-6 conduct an identical exercise for the U.S. Column 7 shows the difference in the difference for PR relative to the US or the difference between the variable in column 3 and the variable in column 6. P-Values are in parentheses.
***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table B.2: Summary Statistics: The Credit Channel

	Mean	Median	Std. Dev.	25th pctile	75th pctile	Obs.
ΔDEF	0.0092	0.0026	0.0828	-0.0192	0.0341	90
$EXTFIN^{US}$	-0.3951	-0.4496	0.5802	-0.6572	-0.2014	19
ΔE	-0.0044	-0.0031	0.0347	-0.0134	0.0049	1,710
SH	0.0064	0.0031	0.0075	0.0018	0.0078	1,710

Notes: ΔDEF is the change in the monthly average of the five-year cumulative default probability for the Commonwealth of Puerto Rico. $EXTFIN^{US}$ is the Rajan and Zingales (1998) measure of sector-level dependence on external finance, calculated for the 2000-2015 period. ΔE is the sector-level monthly employment growth rate. SH is the sector-level share of total private employment.

Table B.3: Increased Default Probability is Associated with Statistically Significant Lower Employment Growth in Industries More Dependent on External Finance

	(1)	(2)	(3)
Constant	-0.0037***	0.0110**	0.0189**
	(0.0009)	(0.0044)	(0.0078)
SH_{t-1}	0.0301	-2.3129***	-2.7585***
	(0.0877)	(0.7042)	(0.7085)
$\sum_{j=1}^{12} EXTFIN^{US} * \Delta DEF_{t-j}$			-0.0313
Observations	1,501	1,501	1,501
Sector Fixed Effects	N	Y	Y
Time Fixed Effects	N	N	Y
F test $EXTFIN^{US} * \Delta DEF$ jointly significant			25.90***
Prob¿F			0.0000

Notes: ΔDEF is the change in the monthly average of the five-year cumulative default probability for the Commonwealth of Puerto Rico. $EXTFIN^{US}$ is the Rajan and Zingales (1998) measure of sector-level dependence on external finance, calculated for the 2000-2015 period. This table presents the aggregated coefficient on 12 lags of the $EXTFIN^{US} * \Delta DEF$ variable. Appendix Table A3 presents the dis-aggregated coefficients on the 12 lags. SH_{t-1} is the lagged sector-level share of total private employment. The model is estimated using OLS. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. Standard errors are in parentheses and are clustered by industry.

Table B.4: Increased Default Probability is Associated with Economically Significant Lower Employment Growth in Industries More Dependent on External Finance

	ΔDEF 25th pctile	ΔDEF 75th pctile	ΔDEF 90th pctile
$EXTFIN^{US}$ 25th pctile	0.0008	0.0019	0.0031
$EXTFIN^{US}$ 75th pctile	0.0011	0.0015	0.0018
Difference	0.0003	-0.0005	-0.0013
Percent of average monthly employment growth	6.8%	11.0%	29.1%

Notes: Each figure in the body of the table comes from this formula: $\hat{\alpha} + \hat{\nu} * \bar{SH} + \sum_{j=1}^{12} \hat{\delta_{t-j}} * EXTFIN^{US} * \Delta DEF$. The cells vary according to values of $EXTFIN^{US}$ and ΔDEF. The coefficients used are from the benchmark regression in Table B.3 Column 3.

Table B.5: Default Risk Granger Causes Commercial and Industrial Lending

	ΔCIL_t	ΔDEF_t
Constant	-0.0014***	0.0062
	(0.0005)	(0.0108)
$\sum_{j=1}^{12} \Delta DEF_{t-j}$	-0.017	-0.8538
$\sum_{k=1}^{4} \Delta CIL_{t-k}$	-0.1541	1.6753
Observations	79	79
F test ΔDEF jointly significant	4.71***	1.01
Prob¿F	0.0000	0.4548
F test ΔCIL jointly significant	2.14*	0.24
Prob¿F	0.0858	0.9156

Notes: ΔDEF is the change in the monthly average of the five-year cumulative default probability for the Commonwealth of Puerto Rico. ΔCIL is the quarterly first difference in commercial and industrial loans as a percentage of GNP. The model is estimated using OLS. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. Standard errors are in parentheses.

Table B.6: Default Risk Granger Causes Discretionary Fiscal Policy

	$\Delta capb_{annual}$	ΔDEF_t
Constant	0.0036***	0.0046
	(0.0012)	(0.0104)
$\sum_{j=1}^{12} \Delta DEF_{t-j}$	0.2637	-1.0163
$\Delta capb_{prioryear}$	0.0282	0.5656
	(0.0282)	(0.8880)
Observations	79	79
F test ΔDEF jointly significant	2.27**	1.18
Prob¿F	0.0178	0.3142

Notes: ΔDEF is the change in the monthly average of the five-year cumulative default probability for the Commonwealth of Puerto Rico. $\Delta capb$ is the annual first difference in the cyclically adjusted primary balance. The model is estimated using OLS. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. Standard errors are in parentheses.

Table B.7: Summary Statistics: The Demand Channel

	Mean	Median	Std. Dev.	25th pctile	75th pctile	Obs.
ΔDEF	0.0092	0.0026	0.0828	-0.0192	0.0341	90
$\Delta capb$	0.0007	-0.0037	0.0130	-0.0073	0.0140	7
GOV	0.0191	0.0139	0.0187	0.0058	0.0281	17
ΔE	-0.0036	-0.0031	0.0292	-0.0123	0.0048	1,343
SH	0.0059	0.0030	0.0070	0.0018	0.0074	1,343

Notes: ΔDEF is the change in the monthly average of the five-year cumulative default probability for the Commonwealth of Puerto Rico. $\Delta capb$ is the first difference in the cyclically adjusted primary balance (expressed as a percentage of potential output). GOV measures industry-level dependence on government demand. ΔE is the sector-level monthly employment growth rate. SH is the sector-level share of total private employment.

Table B.8: Increased Default Probability & Austerity Associated with Significantly Lower Employment Growth in Government Demand Dependent Industries

	(1)	(2)	(3)
Constant	0.0116	0.0024	0.0154*
	(0.0076)	(0.0035)	(0.0086)
SH_{t-1}	-2.2381***	-.3906	-2.7585***
	(0.6420)	(0.4102)	(0.6194)
$GOV * \Delta capb_{prioryear}$		-4.1315***	2.1801
		(1.7557)	(1.9881)
$\sum_{j=1}^{12} GOV * \Delta DEF_{t-j}$	-3.3875		-6.8103
$\sum_{j=1}^{12} GOV * \Delta DEF_{t-j} * \Delta capb_{prioryear}$			-283.9732
Observations	1,343	2,907	1,343
Sector Fixed Effects	Y	Y	Y
Time Fixed Effects	Y	Y	Y
F test $GOV * \Delta DEF$ jointly significant	5.67***		9.95***
Prob$> F$	0.0009		0.0000
F test $GOV * \Delta DEF * \Delta capb_{prioryear}$ jointly significant			108.47***
Prob$> F$			0.0000

Notes: ΔDEF is the change in the monthly average of the five-year cumulative default probability for the Commonwealth of Puerto Rico and runs from June 2008 to November 2015. GOV measures sector-level dependence on government sales from the 2012 Economic Census. $\Delta capb_{prioryear}$ is the prior year first difference in the cyclically adjusted primary balance, expressed as a percentage of potential output. SH_{t-1} is the lagged sector-level share of total private employment. This table presents the aggregated coefficient on 12 lags of the $EXTFIN^{US} * \Delta DEF$ variable and $\Delta capb_{prioryear} * \Delta DEF$. Appendix Table A4 presents the dis-aggregated coefficients on the 12 lags of the interaction terms between GOV and $\Delta capb_{prioryear}$ with ΔDEF. The model is estimated using OLS. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. Standard errors are in parentheses and are clustered by industry.

Table B.9: Increased Default Probability is Associated with Economically Significant Lower Employment Growth in Industries More Dependent on Government Demand

	ΔDEF 25th pctile	ΔDEF 75th pctile	ΔDEF 90th pctile
GOV 25th pctile	-0.0012	-0.0023	-0.0034
GOV 75th pctile	0.0002	-0.0049	-0.0102
Difference	0.0015	-0.0026	-0.0068
Percent of average monthly employment growth	40.3%	71.2%	188.9%

Notes: Each figure in the body of the table comes from this formula: $\hat{\alpha}+\hat{\nu}*\bar{SH}+\sum_{j=1}^{12}\hat{\delta_{t-j}}*GOV*\Delta DEF$. The cells vary according to values of GOV and ΔDEF. The coefficients used are from the benchmark regression in Table B.8 Column 1.

Table B.10: Austerity is Associated with Economically Significant Lower Employment Growth in Industries More Dependent on Government Demand

	$\Delta capb$ 25th pctile	$\Delta capb$ 75th pctile	$\Delta capb$ 90th pctile
GOV 25th pctile	0.0003	-0.0002	-0.0004
GOV 75th pctile	0.0009	-0.0015	-0.0025
Difference	0.0007	-0.0013	-0.0020
Percent of average monthly employment growth	18.7%	35.8%	56.3%

Notes: Each figure in the body of the table comes from this formula: $\hat{\alpha}+\hat{\nu}*\bar{SH}+\sum_{j=1}^{12}\hat{\delta_{t-j}}*GOV*\Delta DEF+\hat{\beta}*GOV*\Delta capb_{prioryear}+\sum_{j=1}^{12}\hat{\gamma_{t-j}}*GOV*\Delta DEF*\Delta capb_{prioryear}$. The cells vary according to values of GOV and $\Delta capb$. The coefficients used are from the benchmark regression in Table B.8 Column 2.

Table B.11: Event Study: Three Day Window Benchmark

	CAR	$C\Delta S$	Observations
All Events	-0.0087**	8.8089***	372:14,386
	(0.002216)	(1.1379)	
Negative Events	-0.0162***	8.3891***	200:8,150
	(0.0022)	(0.8667)	
Negative Non-GO Ratings Events	0.0042	0.9453	108:4,378
	(0.004)	(0.7728)	
Negative GO Ratings Events	-0.0408**	16.1850***	72:2,985
	(0.0072)	(1.3055)	
Negative Legal Events	-0.0384*	20.2285***	20:787
	(0.0146)	(4.2431)	
Positive Events	0.0033**	8.6225***	60:2,101
	(0.0006)	(2.5692)	
Neutral Events	-0.0019	9.9154***	80:2,944
	(0.0038)	(1.5276)	
Mixed Events	-0.0013	9.2752***	32:1,191
	(0.0058)	(2.9655)	

Notes: ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. Each variable is a regression on a constant for the indicated stratum of events. Standard errors are clustered by firm for CAR and by bond for $C\Delta S$. CAR is expressed as the sum of log differences in stock price, and $C\Delta S$ is expressed in basis points.

Figure B.1: Puerto Rico GNP vs. U.S. GNP

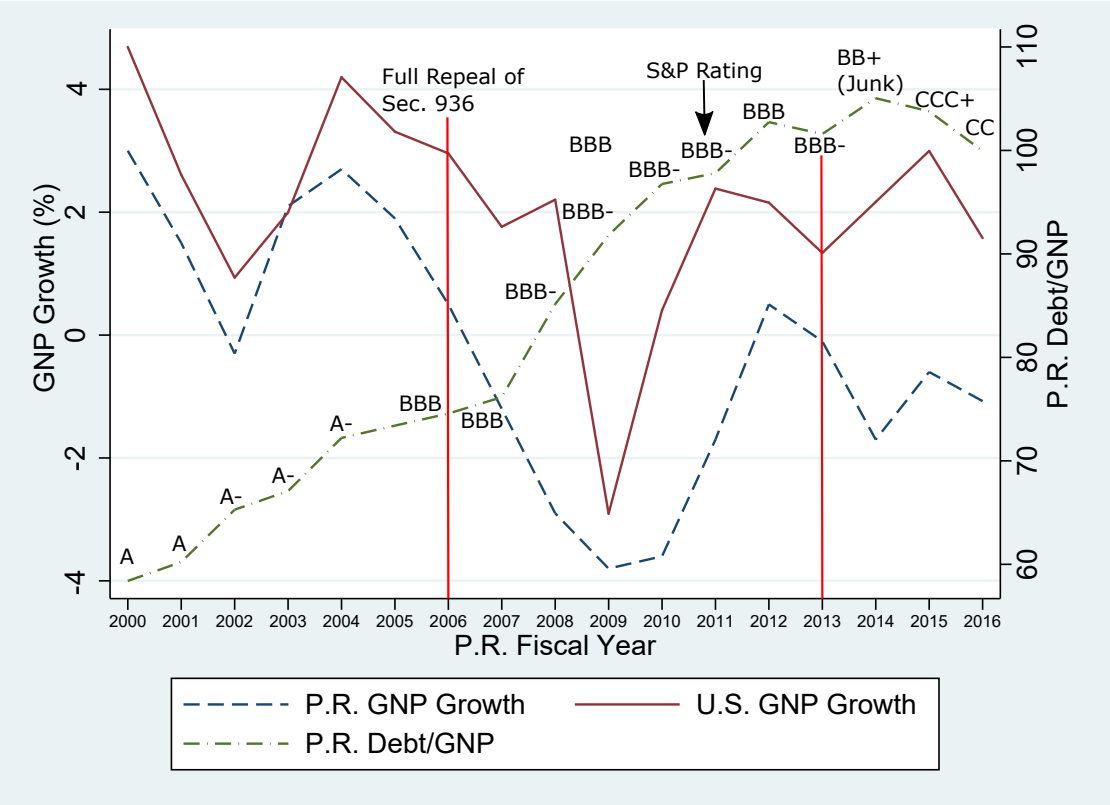


Figure B.2: Employment and Yields

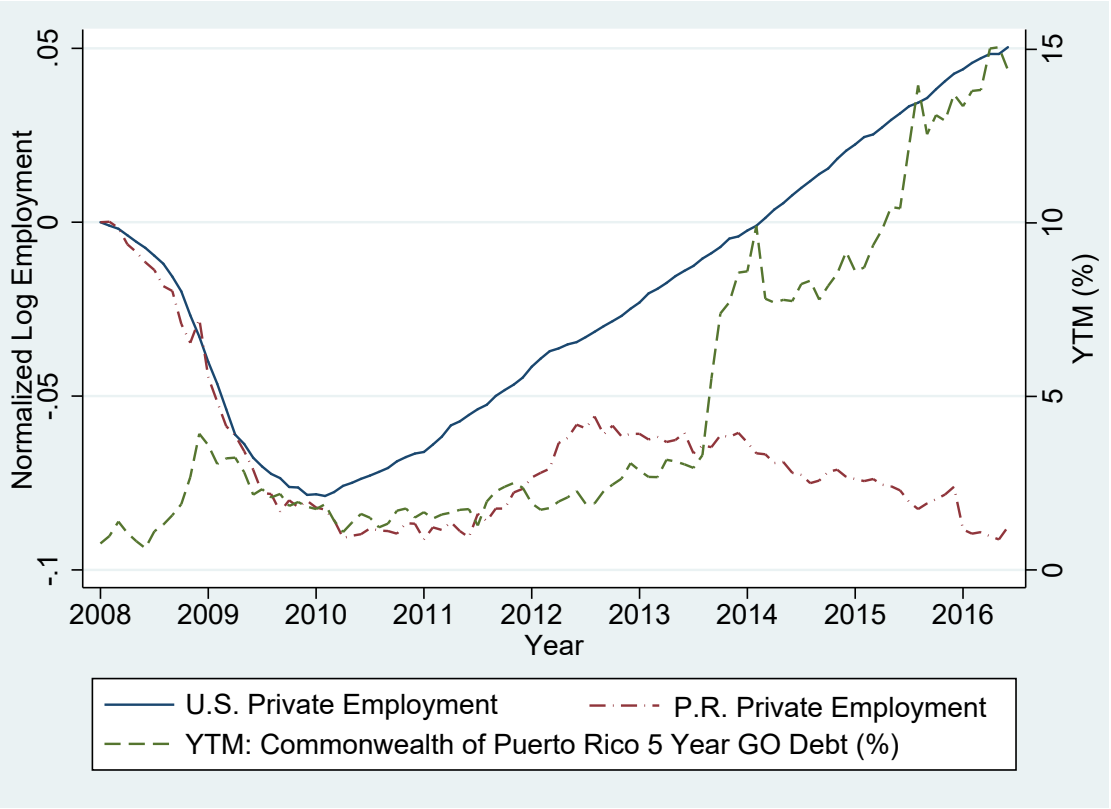


Figure B.3: Employment by Dependence on External Finance and Default Probability

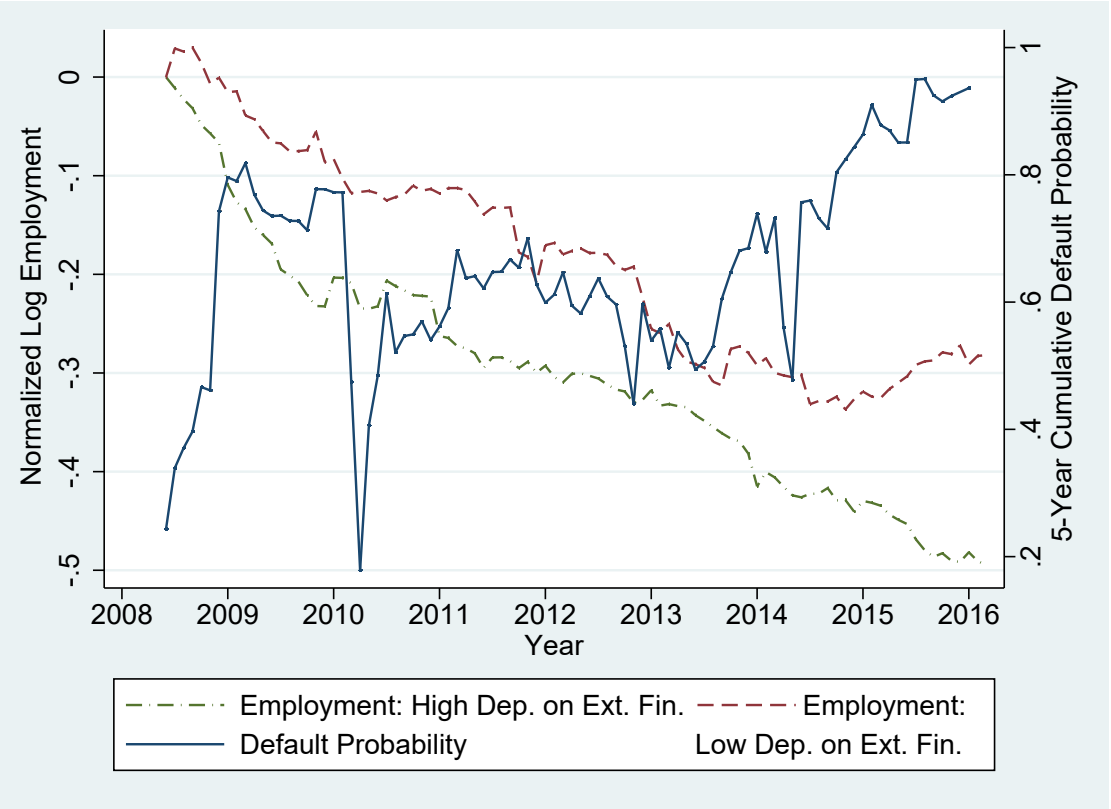


Figure B.4: Banking and Puerto Rico's Crisis

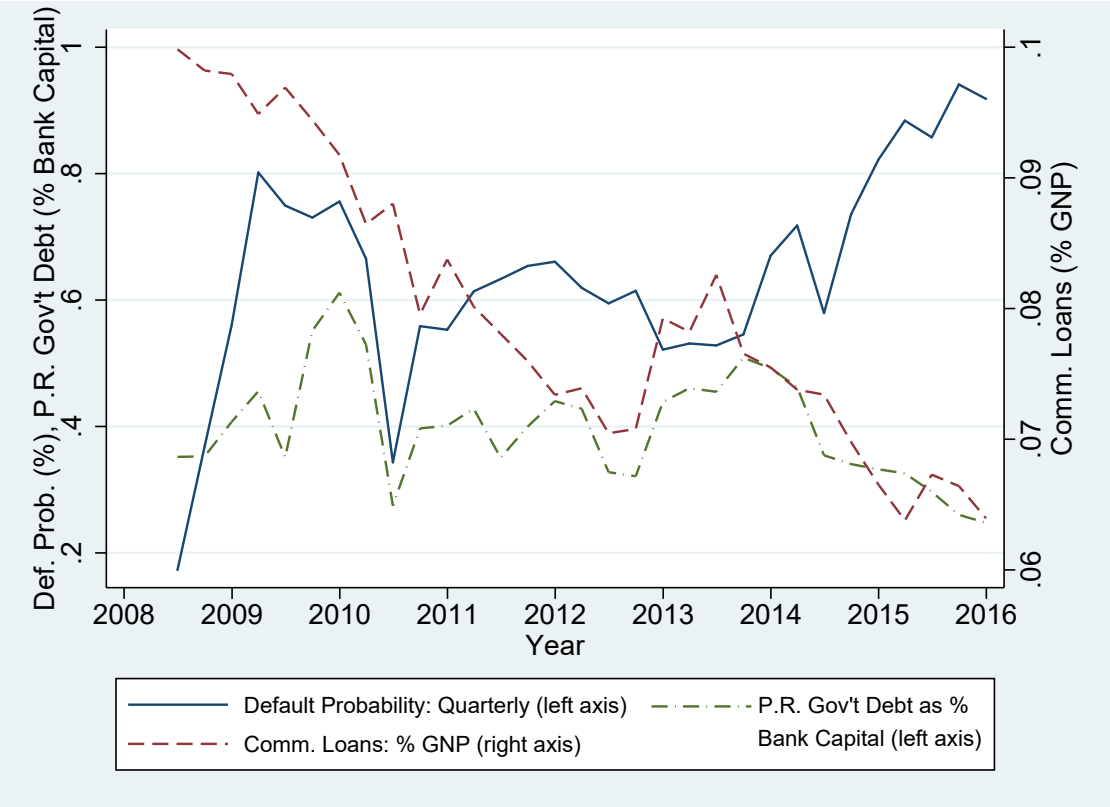


Figure B.5: Employment by Dependence on Government Demand and Default Probability

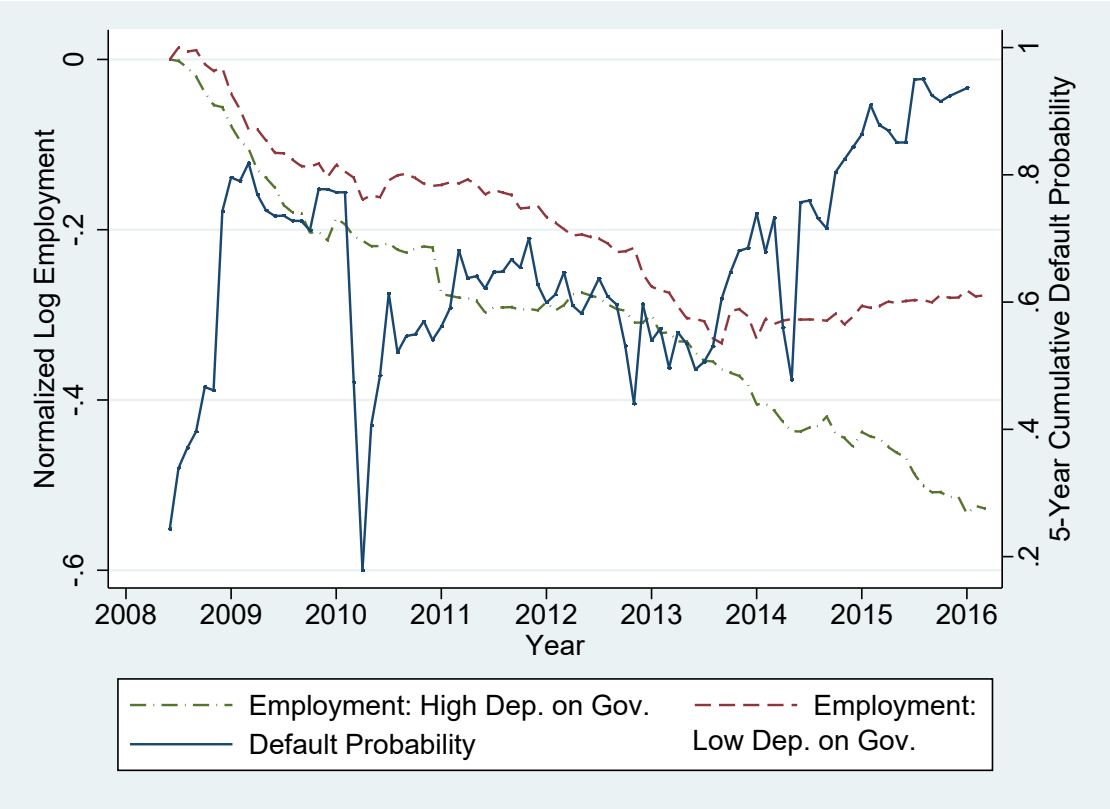


Figure B.6: Employment by Dependence on Government Demand and Austerity

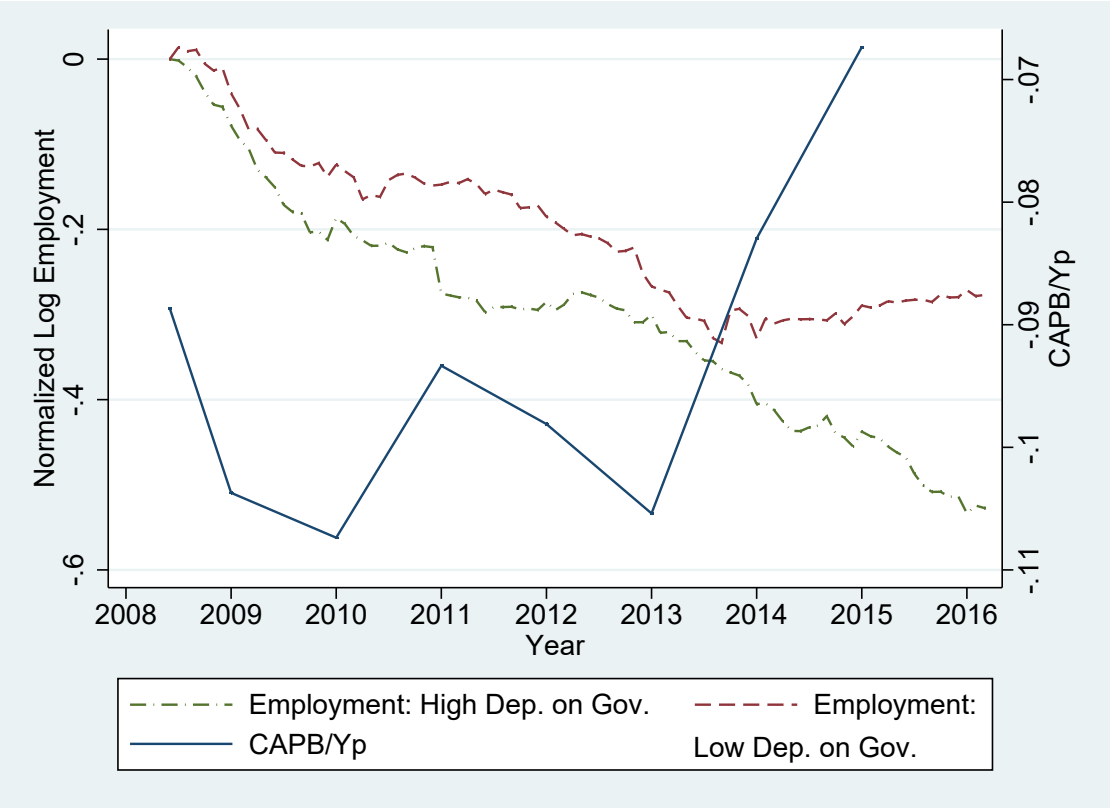


Figure B.7: Marginal Effects of Austerity and Default Risk

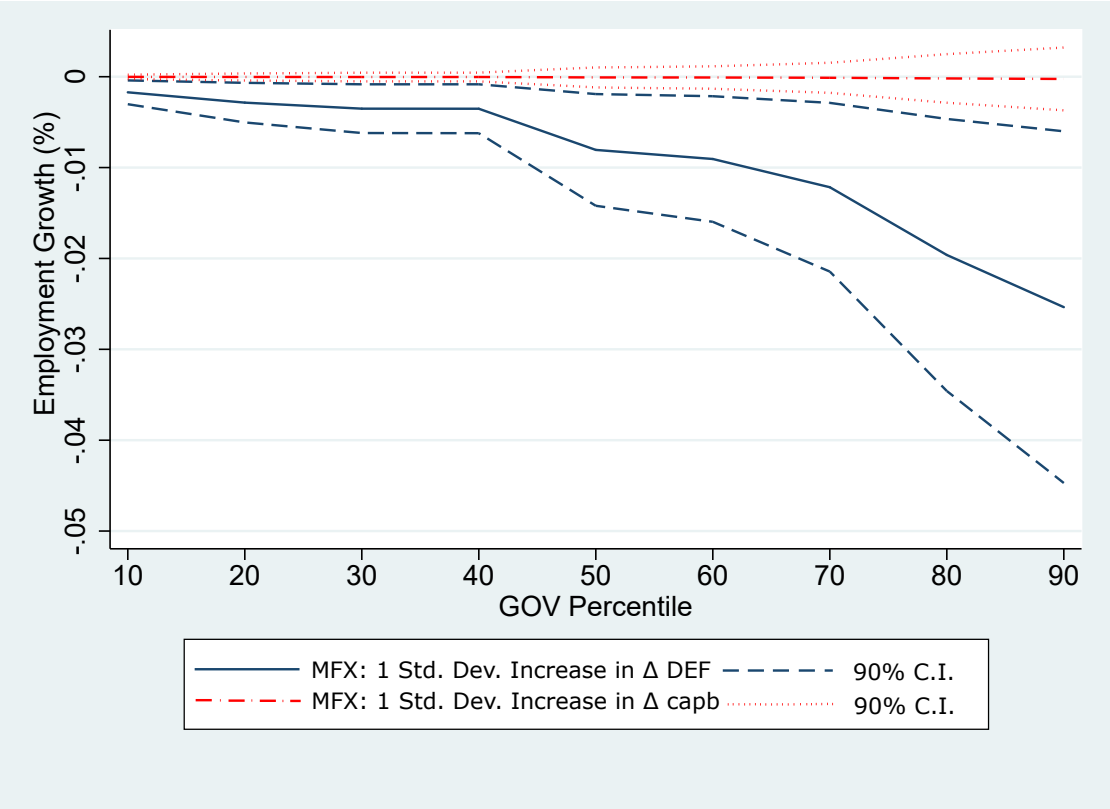


Figure B.8: Marginal Effects of Default Risk Across Austerity

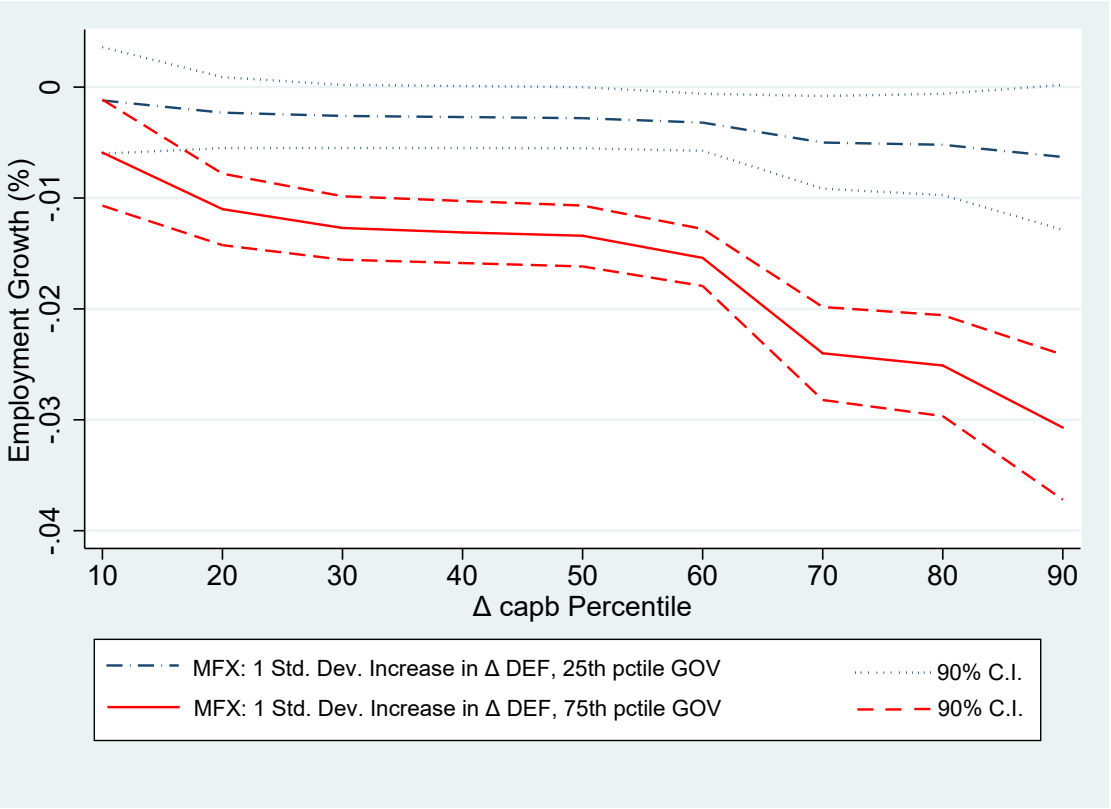
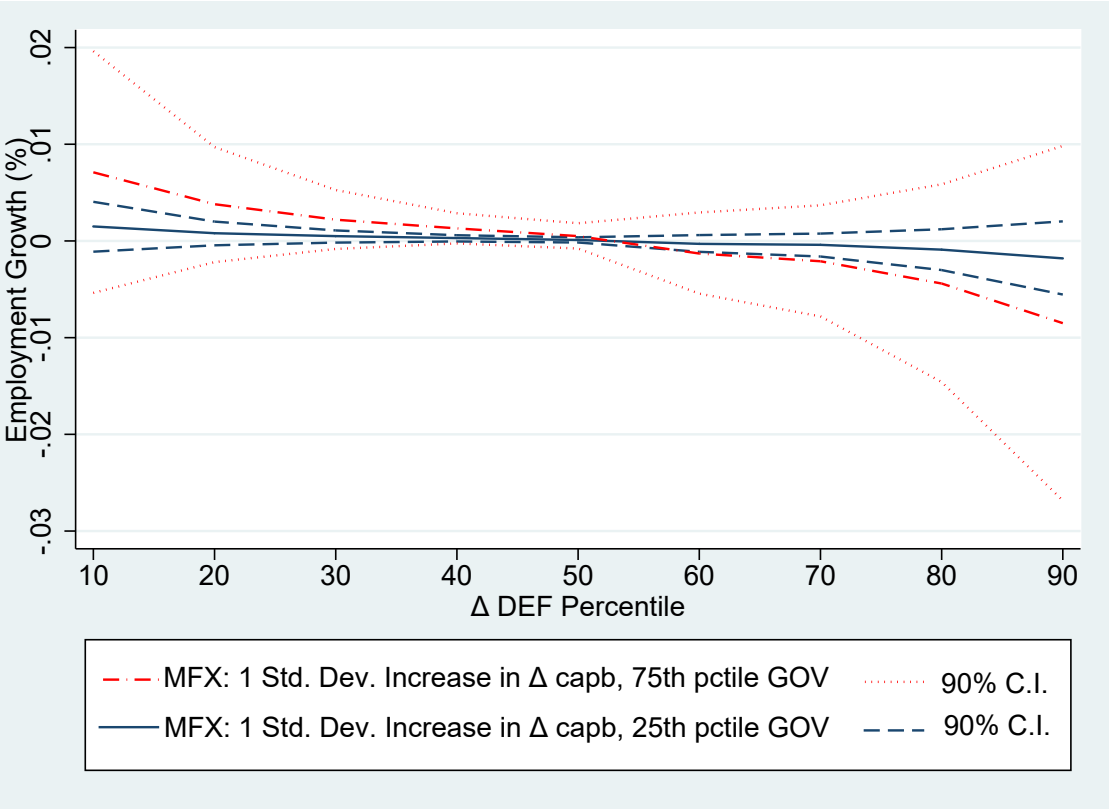


Figure B.9: Marginal Effects of Austerity Across Default Risk



B.2 Data Construction

B.2.1 Construction of Industry Level Dependence on External Finance

Following Rajan and Zingales (1998), we base our calculation of industry-level dependence on external finance on firm-level data from Compustat. Given our benchmark sample period of 2008-2015 and our sample period used in robustness checks of 2001-2015, we calculate dependence on external finance for 2005-2015 and 2000-2015. We use the 2000-2015 calculation period in our benchmark results as this extended period reduces fluctuations related to the financial crisis. For an additional robustness check, we also calculate dependence on external finance for the years 1995-2005, capturing pre-crisis dependence on external finance.

As a first step, we merge the Compustat annual fundamentals database with the CRSP database based on firm cusip numbers and years. Following Rajan and Zingales (1998), we use CRSP SIC codes to classify each firm's industry.[1] Then, we match each four-digit SIC code in the merged Compustat-CRSP database with NAICS three-digit industry codes using the concordance tables provided by the Census. If four-digit SIC codes are not matched, we match them at the three-digit and then the two-digit level. With each firm matched with one or more NAICS three-digit industries, we calculate each firm's dependence on external finance using the following formula:

$$EXTFIN = \frac{CAPX - CFOPER}{CAPX} \tag{B.1}$$

where $CAPX$ is total capital expenditures and $CFOPER$ is total cash flows from operations of a given firm over each of the periods of calculation discussed above. The calculation of $CAPX$ and $CFOPER$ follow Rajan and Zingales (1998). Finally, we take the median value of $EXTFIN$ for U.S. firms in each NAICS three-digit industry. Table B.12 shows industry medians of dependence on external finance for each three-digit NAICS manufacturing industry for which we have Puerto Rican employment data, ranked using the benchmark period 2000-2015. Note that average dependence on external finance is lowest during the periods 2000-2015 and 2005-2015, which include the financial crisis, indicating a tendency for firms to retain cash flow from operations rather than invest in capital expenditures. However, note the ranking of industries by dependence on external

[1] Although CRSP does provide NAICS codes, they are only available beginning in 2004.

Table B.12: External Finance Dependence Across United States Manufacturers

NAICS Code	Industrial Sector	External Dependence 2000-2015	External Dependence 2005-2015	External Dependence 1995-2005
315	Apparel Manufacturing	-1.1710	-1.5495	-0.5531
323	Printing and Related Support Activities	-1.1321	-1.5563	-0.4805
316	Leather and Allied Product Manufacturing	-1.0902	-1.5862	-0.2819
321	Wood Product Manufacturing	-0.7230	-0.8197	-0.2726
311	Food Manufacturing	-0.6711	-0.7194	-0.4889
326	Plastics and Rubber Products Manufacturing	-0.6572	-0.9288	-0.2062
335	Electrical Equipment˙ Appliance˙ and Component Manufacturing	-0.5638	-0.6961	-0.0826
336	Transportation Equipment Manufacturing	-0.5637	-0.8203	-0.1092
327	Nonmetallic Mineral Product Manufacturing	-0.5215	-0.6989	-0.1295
332	Fabricated Metal Product Manufacturing	-0.4496	-0.6718	0.1046
324	Petroleum and Coal Products Manufacturing	-0.4441	-0.5795	-0.2895
331	Primary Metal Manufacturing	-0.3813	-0.7437	-0.2090
333	Machinery Manufacturing	-0.3021	-1.0246	0.2885
322	Paper Manufacturing	-0.2329	-0.5081	0.4896
339	Miscellaneous Manufacturing	-0.2014	-0.7525	0.4058
337	Furniture and Related Product Manufacturing	-0.1022	-0.7456	0.4691
334	Computer and Electronic Product Manufacturing	0.0108	-1.0150	0.5639
312	Beverage and Tobacco Product Manufacturing	0.1276	-0.3693	0.5041
325	Chemical Manufacturing	1.5617	1.1730	1.4019
Average		-0.3951	-0.7691	0.0592
Correlation with 2000-2015			0.9140	0.9268

finance is fairly stable, and that the measure is highly correlated across the three calculation periods.

B.2.2 Tax Adjustment

We compute the tax-adjusted yield using the following formula:

$$1 - \tau = (1 - \tau^{fed})(1 - \tau^{state-weighted})(1 - PRshare) + (1 - \tau^{PR})(PRshare) \tag{B.2}$$

$$y_{it}^{TA} = \frac{y_{it}}{1 - \tau} \tag{B.3}$$

where τ^{fed} is the federal top marginal income tax rate, $\tau^{state-weighted}$ is the population and incentive weighted average state top marginal income tax rate, τ^{PR} is Puerto Rico's top marginal income tax rate, y_{it} is the raw yield on the Puerto Rican security, and y_{it}^{TA} is the tax-adjusted yield on a Puerto Rican security. The first term adjusts for the fact that state income tax payments are deductible from federal taxable income for residents of U.S. states (see Schwert (2017)). Puerto Rican residents do not pay federal income tax, so the second term does not contain a correction for this deduction. In order to arrive at the tax-adjusted yield, we need assumptions regarding the residence of holders of Puerto Rico's debt and their tax rates.

First, we compute the average top marginal state income tax rate of mainland U.S. residents holding Puerto

Rican debt. As we do not have data on geographical holdings of Puerto Rican debt, we assume that Puerto Rican debt is held by mainland residents according to each state's population and tendency to hold tax exempt debt, which enjoys the same tax benefits as Puerto Rican debt held in each state using the following formula:

$$\tau^{state-weighted} = \sum_{i=1}^{50} t_i w_i \tag{B.4}$$

$$w_i = \frac{Pop_i s_i}{\sum_{i=1}^{50} Pop_i s_i} \tag{B.5}$$

where t_i is the top marginal income tax rate in state i, Pop_i is the population of state i and s_i is the share of the total municipal debt of state i held by state funds from Babina et al. (2015). We find $\tau^{state-weighted} = 6.86\%$.

We also need an assumption regarding the share of Puerto Rican municipal debt held by Puerto Rican residents ($PRshare$). We do not have any data on this share, so we assume Puerto Rican residents hold 50.58% of Puerto Rican municipal debt. This figure follows Babina et al. (2015), who find that state funds hold an average of 50.58% of state debt held by all funds in the U.S. states with the highest state income tax rates and hence the greatest incentives to hold local debt. Puerto Rico's top marginal income tax rate of 33% would make it the state with the highest top marginal income tax rate. The federal income tax top marginal tax rate was 35% from the beginning of the sample through 2012, and 39.6% thereafter. For robustness, we repeat the benchmark results assuming that all Puerto Rican municipal debt is held by mainland investors in the state with the highest income tax (California 13.3%), by investors in a state with an income tax rate of 0%, of which there are several, and by Puerto Rican residents. The results are robust to all of these alternatives.

B.2.3 External Finance Channel: Dis-aggregated Lags

Table B.13: Increased Default Probability is Associated with Statistically Significant Lower Employment Growth in Industries More Dependent on External Finance

	(1)	(2)	(3)
Constant	-0.0037***	0.0110**	0.0189**
	(0.0009)	(0.0044)	(0.0078)
SH_{t-1}	0.0301	-2.3129***	-2.7585***
	(0.0877)	(0.7042)	(0.7085)
$EXTFIN^{US} * \Delta DEF_{t-1}$			0.0295
			(0.0441)
$EXTFIN^{US} * \Delta DEF_{t-2}$			-0.0147
			(0.0133)
$EXTFIN^{US} * \Delta DEF_{t-3}$			-0.0339***
			(0.0114)
$EXTFIN^{US} * \Delta DEF_{t-4}$			-0.0069
			(0.0212)
$EXTFIN^{US} * \Delta DEF_{t-5}$			-0.0187*
			(0.0104)
$EXTFIN^{US} * \Delta DEF_{t-6}$			-0.0008
			(0.0092)
$EXTFIN^{US} * \Delta DEF_{t-7}$			0.0051
			(0.0202)
$EXTFIN^{US} * \Delta DEF_{t-8}$			-0.0029
			(0.0028)
$EXTFIN^{US} * \Delta DEF_{t-9}$			0.0109
			(0.0138)
$EXTFIN^{US} * \Delta DEF_{t-10}$			-0.0183
			(0.0237)
$EXTFIN^{US} * \Delta DEF_{t-11}$			0.0117
			(0.0079)
$EXTFIN^{US} * \Delta DEF_{t-12}$			0.0077
			(0.0068)
Observations	1,501	1,501	1,501
Sector Fixed Effects	N	Y	Y
Time Fixed Effects	N	N	Y
F test $EXTFIN^{US} * \Delta DEF$ jointly significant			25.90***
Prob¿F			0.0000

Notes: This table presents disaggregated coefficients on all 12 lags on the $EXTFIN^{US}$ variable interacted with ΔDEF. Table 3 presents the summation of the coefficients on the 12 lags. ΔDEF is the change in the monthly average of the five-year cumulative default probability for the Commonwealth of Puerto Rico. $EXTFIN^{US}$ is the Rajan and Zingales (1998) measure of sector-level dependence on external finance, calculated for the 2000-2015 period. SH_{t-1} is the lagged sector-level share of total private employment. The model is estimated using OLS. ***,**,and * indicate significance at the 1%, 5%, and 10% levels, respectively. Standard errors are in parentheses and are clustered by industry.

B.2.4 Government Demand Channel: Dis-aggregated Lags

Table B.14: Increased Default Probability and Austerity are Associated with Statistically Significant Lower Employment Growth in Industries More Dependent on Government Demand

	(1)	(2)	(3)
Constant	0.0116	0.0024	0.0154*
	(0.0076)	(0.0035)	(0.0086)
SH_{t-1}	-2.2381***	-0.3906	-2.2528***
	(0.6420)	(0.4102)	(0.6194)
$GOV * \Delta capb_{prioryear}$		-4.1315**	2.1801
		(1.7557)	(1.9881)
$GOV * \Delta DEF_{t-1}$	-0.5352		-0.8477*
	(0.3883)		(0.4273)
$GOV * \Delta DEF_{t-2}$	-1.3099**		-2.4579**
	(0.5517)		(0.9241)
$GOV * \Delta DEF_{t-3}$	0.3883		0.1233
	(0.5235)		(0.7205)
$GOV * \Delta DEF_{t-4}$	-0.9426		-1.8671***
	(0.5887)		(0.6350)
$GOV * \Delta DEF_{t-5}$	0.5832**		0.0415
	(0.2345)		(0.3918)
$GOV * \Delta DEF_{t-6}$	-1.0592		-1.1126
	(0.7718)		(0.7054)
$GOV * \Delta DEF_{t-7}$	-0.5001		0.0907
	(0.4634)		(0.7654)
$GOV * \Delta DEF_{t-8}$	-0.3141		-0.1884
	(0.3053)		(0.2785)
$GOV * \Delta DEF_{t-9}$	0.0909		-0.2080
	(0.6757)		(0.5577)
$GOV * \Delta DEF_{t-10}$	-0.0580		-0.6486
	(0.5809)		(0.7644)
$GOV * \Delta DEF_{t-11}$	-0.1724		-0.2171
	(0.5049)		(0.6867)
$GOV * \Delta DEF_{t-12}$	0.4416		0.4816
	(0.3930)		(0.3401)
$GOV * \Delta DEF_{t-1} * \Delta capb_{prioryear}$			-15.1763
			(48.7624)
$GOV * \Delta DEF_{t-2} * \Delta capb_{prioryear}$			-126.9472*
			(63.0551)
$GOV * \Delta DEF_{t-3} * \Delta capb_{prioryear}$			-8.2246
			(69.0388)
$GOV * \Delta DEF_{t-4} * \Delta capb_{prioryear}$			-79.4172
			(46.1591)
$GOV * \Delta DEF_{t-5} * \Delta capb_{prioryear}$			-44.1985
			(44.3249)
$GOV * \Delta DEF_{t-6} * \Delta capb_{prioryear}$			-6.2832
			(36.0750)
$GOV * \Delta DEF_{t-7} * \Delta capb_{prioryear}$			91.8706
			(90.3562)
$GOV * \Delta DEF_{t-8} * \Delta capb_{prioryear}$			6.6506
			(19.6297)
$GOV * \Delta DEF_{t-9} * \Delta capb_{prioryear}$			-23.1996
			(54.0526)
$GOV * \Delta DEF_{t-10} * \Delta capb_{prioryear}$			-83.9926
			(66.4269)
$GOV * \Delta DEF_{t-11} * \Delta capb_{prioryear}$			10.8382
			(25.3079)
$GOV * \Delta DEF_{t-12} * \Delta capb_{prioryear}$			-5.8934
			(25.8329)
Observations	1,343	2,907	1,343
Sector Fixed Effects	Y	Y	Y
Time Fixed Effects	Y	Y	Y
F test $GOV * \Delta DEF$ jointly significant	5.67***		9.95***
Prob> F	0.0009		0.0000
F test $GOV * \Delta DEF * \Delta CAPB_{prioryear}$ jointly significant			108.47***
Prob> F			0.0000

Notes: This table presents disaggregated coefficients on all 12 lags on the GOV variable. Table 6 presents the summation of the coefficients on the GOV variable interacted with ΔDEF. ΔDEF is the change in the monthly average of the five-year cumulative default probability for the Commonwealth of Puerto Rico and runs from June 2008 to November 2015. GOV measures sector-level dependence on government sales from the 2012 Economic Census. $\Delta CAPB_{prioryear}$ is the prior year first difference in the cyclically adjusted primary balance, expressed as a percentage of potential output. SH_{t-1} is the lagged sector-level share of total private employment. The model is estimated using OLS. ***,**,and * indicate significance at the 1%, 5%, and 10% levels, respectively. Standard errors are in parentheses and are clustered by industry.

B.2.5 Legal Event Classification

Unlike ratings actions, legal events are not by definition good or bad news for Puerto Rico's creditworthiness. The first step in classifying the legal events is to classify the laws themselves as good or bad news for Puerto Rico's creditworthiness. With these classifications, we then classify legal proceedings against a law by how they affect the expected outcome of the case. First, we classify the "Puerto Rico Public Corporations Debt Enforcement and Recovery Act" and the "Debt Moratorium and Financial Recovery Act" as credit negative events, or bad news about Puerto Rico's creditworthiness. We make this judgment for several reasons. First, Puerto Rico passed these laws intending to create a legal framework allowing Puerto Rico to default, signaling an inability to meet its obligations or unwillingness to do so. Further, the terms were of course relatively favorable for Puerto Rico. Second, the ratings agencies expressly downgraded Puerto Rican debt due to these laws. Third, major holders of Puerto Rico's debt sued to attempt to overturn these laws. The latter clearly indicates the belief of lenders that the laws were credit negative. With these classifications, we classify any filing of a legal case against these laws as credit positive, indicating news of an increased probability the laws will be overturned. Similarly, attempts by Puerto Rico to have rulings against the laws overturned via appeal and the decision of a court to hear an appeal are credit negative, indicating news of an increased probability that the laws will be upheld. Arguments before the court are judged based upon publicly available information, including the transcripts of the arguments and news coverage. If the questions asked by judges during oral arguments indicate they intend to overturn these laws or uphold a ruling against them, this is classified as credit positive and vice versa. We complement our own reading of oral arguments with contemporaneous opinions of legal scholars regarding what the arguments reveal about the likely outcome of the case. Regarding other important legal events such as filings by Puerto Rico, its creditors, and friends of the court, there is no objective way to determine the strength of the argument and hence their likely influence on the outcome of the case. Searches of news sources provided no meaningful contemporaneous legal opinions about the likely effect of these filings. These events are classified as neutral, meaning we do not have a sign for the news conveyed by the event.

We classify the passage of PROMESA by the United States as credit positive for several reasons. First,

the law received positive commentary from the funds that hold Puerto Rican debt, indicating they believe it improved their recovery rates. Second, Moody's reviewed it favorably in an issuer comment and considered it credit positive. Third, there is the law itself and its contrast with the Chapter 9 process undergone by insolvent mainland municipalities. Municipal bankruptcies under Chapter 9 of the bankruptcy code differ significantly from bankruptcies of private entities. Broadly, Chapter 9 is significantly more lenient for the debtor, stemming in part from the sovereign rights of states as defined in the Tenth Amendment to the United States Constitution. Under Chapter 9, assets of municipalities can not be seized and liquidated, nor can their operating decisions such as expenditures and raising of revenue be interfered with as part of a settlement or the litigation. Further, only the municipality itself may file a restructuring plan with the court. The process outlined in PROMESA is based on Chapter 9 of the bankruptcy code but is significantly more restrictive from the perspective of the debtor. PROMESA establishes a seven-member oversight board that has the sole authority to propose restructuring plans and has authority over Puerto Rico's budget. The board members were selected by the president, however PROMESA gave the right to the following individuals to create approved lists from which to select the following number of board members: speaker of the House, two members; Senate majority Leader, two members; House minority leader, one member; Senate minority leader, one member; president of the United States, one member. This gave effective control over a voting majority of the board members to the Republican party. Further, the court was only authorized to approve a restructuring plan if it was in the best interest of creditors. That is, if the presiding judge deemed that the bond holders could not achieve more favorable terms through other legal means. In summary, PROMESA allows an outside body with more than the debtor's interest in consideration to propose restructuring plans, control the debtor's fiscal process, and mandate the court to take a harder line against the debtor than under Chapter 9 and the similar "Recovery Act."

It is important to note that this law also placed a stay on any litigation against Puerto Rico relating to default and created a legal framework for restructuring where none existed before. On the surface, this may seem credit negative as without this law Puerto Rico had no legal right to restructure nor to avoid payment. However, note that the Puerto Rican governor stated his intent to prioritize public services over debt service regardless of this

legal limbo. As in other sovereign crises, the threat of forcing repayment without restructuring is not credible nor espoused. Also note the statements of the speaker of the House promising some kind of restructuring plan. These stated intentions, among others, indicate a clear realization by all parties, especially following the Supreme Court's decision against Puerto Rico's Recovery Act, that some form of legislated restructuring framework was inevitable. Given this, we find the eventual form to be beneficial to creditors and thus credit positive.

B.2.6 Mixed Event Classification

We identify three scenarios that give us a priori reason to reclassify mixed events. First, as neutral ratings events signify no change, we classify combinations of signed (positive or negative) ratings actions and neutral ratings actions with the sign of the signed ratings action. Second, in cases where we have positive and negative ratings actions on the same day, we use the sign of a GO ratings action if present, as these are the most direct news about the commonwealth's creditworthiness. Third, in cases where signed legal events and signed ratings actions occur on the same day, we look at the relative importance of the events from a legal standpoint. We find four mixed events that fall into one of these groups and merit reclassification. The event window of the first begins 6/26/2015. The event includes the governor's statement that the debt was not payable and the nine associated ratings downgrades. The one included positive event is the affirmation by the 1st Circuit Court of Appeals of the earlier decision against Puerto Rico's Recovery Act. Although the event is certainly credit positive, questions asked by the three judges of the 1st Circuit during earlier oral arguments had already revealed apparently unanimous opposition to Puerto Rico's case. This, combined with the significance of Governor Padilla's statement that the debt was not payable and its reception by the ratings agencies merits a credit negative classification for this series of events. We classify this as a ratings action. The second event window begins on 4/1/2016. This includes one credit positive event, a filing of a suit over GDB revenue diversion. It also includes two credit negative events, the passage of the Debt Moratorium Act by Puerto Rico's House and Senate. We classify the combined event as credit negative because the Debt Moratorium Act would have allowed Puerto Rico to delay payments on its debt. This is more significant for Puerto Rico's credit than the lawsuit over revenue diversion. The third window is a mixed rating action beginning 3/8/2013. It includes an improvement

in the UPR credit rating and downgrades of GO and PREPA. We classify it by the GO rating action. Finally, the event window beginning June 25, 2014, includes the credit negative passage of the Recovery Act and a series of related ratings downgrades. All of these events are negative so the overall sign is negative. We classify the overall type as a legal event as the ratings actions directly resulted from the legal event. Section 3.6 shows the robustness of our benchmark results to these reclassifications.

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