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Abstract

What went wrong? Why did seemingly rational bond investors continue to purchase Puerto Rican debt with only a modest risk premium, even though the macroeconomic fundamentals were dismal? Why did financial markets fail to exercise market discipline and restrict capital flows to Puerto Rico? Given gloomy macroeconomic fundamentals and relatively low risk premia, investors were either stunningly myopic/misinformed, or Puerto Rican debt was implicitly insured by the U.S. government. This paper examines the latter hypothesis, which we label the "Treasury Put." The expectation of a federal bailout was perfectly reasonable given past behavior by the federal government, starting with the prior bailout of the city of New York. Evaluating the Treasury Put hypothesis with a minimal set of assumptions is possible given three unique features – the dire fiscal and economic conditions in Puerto Rico, a fortunate characteristic of Puerto Rican bond issuance, and a "seismic shock." Regarding the second feature, Puerto Rico issued both uninsured and insured general obligation bonds on the same day and, in many cases, with the exact same maturity. The associated bond price data allow for an accurate computation of the risk premia on Puerto Rican bonds. The third feature is the non-bailout of the city of Detroit in 2013 that effectively extinguished the Treasury Put. Puerto Rican risk premia were stable before the Detroit bankruptcy and bracketed by the risk premia on Corporate Aaa and Baa bonds. However, after the Detroit bankruptcy, risk premia rose dramatically, thus identifying a sizeable Treasury Put of at least 300 basis points and a significant misallocation of capital to Puerto Rico. In effect, the Treasury Put was a form of regulatory forbearance. Institutional reforms that would eliminate the Treasury Put are considered, but none are found satisfactory.

JEL-Codes: H810, H740, G180, G010.

Keywords: Puerto Rican debt crisis, government guarantees, capital misallocation, bond interest rates.

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The Puerto Rican Debt Crisis, The "Treasury Put," And The Failure Of Market Discipline

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After years of propping up a struggling economy with
unsustainable borrowing, Puerto Rico's financial reckoning
was inevitable.

New York Times (January 24, 2018)

[Puerto Rico's] financial and economic woes
don't appear to be reflected in its bond yields.

Barron's (August 27, 2012)

Current general obligation credit spreads [on Puerto Rican debt],
with yields about 200 basis points above AAA benchmarks,
do not reflect bondholder risk.

Schankel (July 27, 2012)

Introduction

What went wrong? Why did seemingly rational bond investors continue to purchase Puerto Rican debt with only a modest risk premium, even though the macroeconomic fundamentals were dismal? Why did financial markets fail to exercise market discipline and restrict capital flows to Puerto Rico? Since 2002, the Commonwealth of Puerto Rico (which is a territory of the United States, not a state per se) has run a budget deficit each year. Starting in 2006, population growth turned negative and the decline accelerated in recent years (Figure 1). Between 2005 and 2016, population fell by 11%. The employment-to-population ratio also declined sharply (Figure 2). Not surprisingly given these developments, real GDP began to contract severely (Figure 3). Between 2005 and 2016, real GDP declined by 12%. In 2006, a very favorable tax credit for U.S. corporations operating in Puerto Rico was finally eliminated.[1]

[1] Section 936 of the Internal Revenue Code allowed for a tax credit for U.S. corporations operating in Puerto Rico. This tax credit was repealed by the Small Business Job Protection Act of 1996. However transition rules allowed firms, which had been credit claimants in 1996, to continue to receive the credit for income generated in Puerto Rico through the end of 2005. From 2006 onward, the tax credit was completely eliminated. The extent to which this elimination contributed to the reduction in economic activity is not clear. In 1995 (the year before repeal), there were 440 companies claiming the tax credit with gross income over $40 billion. In the final year of the 10 year transition interval, the comparable figures are 157 companies and $18 billion (GAO, 2018, p. 32). (Note that the Puerto Rican price level was approximately constant between 1995 and 2005.) Additional factors that might explain the economic

In its July 2012 report on the Puerto Rican economy, the Federal Reserve Bank of New York (2012) concluded that "[t]he task of putting the Island on a path of robust, sustainable, and inclusive growth remains a work in progress."[2] Per the above quotation from the *New York Times*, the outcome "was inevitable." On August 3, 2015, Puerto Rico began to default on some of its bond commitments; bankruptcy was effectively declared (under Title III) on May 2, 2017.[3]

The fiscal situation has been precarious for many years. As shown in Figure 4 (see Appendix A for details) the ratio of government liabilities -- debt plus unfunded pension liabilities -- to nominal GDP has grown dramatically over the past 15 years. (Unless otherwise stated, GDP and GNP are in nominal terms.) In 2000, it was 70%; by 2015, this ratio had increased by more than half to 109%. Figure 5 shows that budget deficits were persistent and growing. The 2013 figure of 6.3% exceeds the comparable figure of 4.1% for the U.S. federal government. This graph is on a budgetary (or cash) basis. Krueger, Teja, and Wolfe (2015, p. 11) have noted several concerns with these figures: not stated on an accrual basis; omitting capital expenditures and the deficit-creating activities of several government agencies. When some of these concerns are addressed, the adjusted deficit rises by about 84% in recent years (calculations are presented in Appendix B). This figure includes debt service. To present data closer to an operating deficit, which is a standard measure for assessing fiscal health,[4] we remove

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decline beginning in 2006 are the imposition of a 7% sales tax, the slowdown in the U.S. mainland economy, and the rise in oil prices.

[2] As far back as the 1830's, there have been numerous reports documenting the problems and opportunities facing the Puerto Rican economy. See the preface and essays collected in Collins, Bosworth, and Soto-Class (2006) and the report by Krueger, Teja, and Wolfe (2015).

[3] It is important to distinguish between default -- failing to honor contractually mandated payments – and bankruptcy -- a legal status determined by a court of law usually after a creditor or debtor initiates a legal proceeding. For a complicated set of reasons related to the Commerce Clause in the U.S. Constitution, states and territories (such as Puerto Rico) cannot file for bankruptcy and a possible reconfiguration of their contractual obligations and other liabilities. (However, municipalities (e.g., Detroit, New York City) can seek protection under Chapter 9 of the bankruptcy code.) In light of this restriction, the Puerto Rico Oversight, Management and Economic Stability Act (PROMESA) was enacted on July 1, 2016, and the PROMESA board was empowered to suspend debt payments and renegotiate debt contracts on behalf of Puerto Rico, thus mimicking traditional bankruptcy procedures that facilitate reorganization. PROMESA was not created to provide any direct fiscal assistance to Puerto Rico, but rather "The purpose of the Oversight Board is to provide a method for a covered territory to achieve fiscal responsibility and access to the capital markets" (U.S. Congress, 2016, p. 5).

[4] See the extended discussion of predictors of municipal fiscal distress in Gordon (2018, especially p. 28 and the cited references).

the expenditures associated with debt service. This downward adjustment nearly cancels the upward adjustments to the deficit noted above. Thus, at least for the latter years, Figure 5 approximates the operating deficit (though it may be somewhat overstated because it is difficult to remove all debt payments from publicly available sources). A more important omission that severely understates the reported deficit is the failure to account for financing gaps in legacy liabilities stemming from, among other sources, employee retirement plans. By any measure, the fiscal picture has been dismal and deteriorating for many years.

These persistent deficits reflect a limited fiscal capacity. In 2016, the Puerto Rican median household income was $19,606. Comparable figures for the United States and its poorest state (Mississippi) are $55,322 and $40,528, respectively. Moreover, the demographics are very unfavorable, owing in part to the absence of restrictions for migrating to and working in the United States (Puerto Ricans are U.S. citizens). As shown in Table 1 for 2015, the median age of 36.4 years in Puerto Rico is well above the median age for the Caribbean region and only slightly below that for the United States. The projected growth rate over the next 25 years is also relatively unfavorable. By 2040, the Puerto Rican population will be older than those for the Caribbean region, the United States, and the more developed and less developed groups of countries. With falling real GDP, ongoing government operating deficits, and an aging population, the debt level was clearly unsustainable and default inevitable.

The risk premium on Puerto Rican government debt did not reflect these economic realities, per the other two quotations above. For example, based on a matched pair of uninsured and insured bonds issued in April 2012 with the exact same maturity of 10 years (match #37 in Appendix C), the Puerto Rican risk premium of 146 basis points was greater than that on Corporate Aaa bonds by 41 basis points and less than that on Corporate Baa bonds by 85 basis points. Baa bonds are quite creditworthy; "[o]bligations rated Baa are subject to moderate credit risk; they are considered medium-grade and as such may possess speculative characteristics" (see Appendix D for further information on Moody's ratings). The Puerto Rican risk premium was much lower than that for Non-Investment grade ("junk") bonds, 428 basis points, though this comparison should be done with caution due to the substantial liquidity premium for junk bonds. The official statement associated with this bond issue was pessimistic, reporting that growth in employment and an economic activity index were both negative in 2011 and 2012.

Notwithstanding this latter pessimism, the risk premium for Puerto Rican bonds is surprisingly low in the face of serious doubts about Puerto Rico's ability to honor its financial obligations.

Given these gloomy macroeconomic fundamentals and relatively low risk premium, either investors were stunningly myopic/misinformed or Puerto Rican debt was implicitly insured by the U.S. government. While some myopia and misjudgments are surely possible, the widely-reported, overwhelming weakness of the Puerto Rican economy rules out the former explanation. This paper examines the latter hypothesis, which we label the "Treasury Put." Three unique features allow us to identify and measure the implicit guarantee from the U.S. government as perceived by investors:

1. The dire fiscal and economic conditions of Puerto Rico that make the Treasury Put a live option,
2. The simultaneous issuance of insured and uninsured bonds that allows us to compute the risk premium,
3. A seismic event – the absence of federal assistance to Detroit in the face of its bankruptcy – that extinguished the Treasury Put in July 2013 and allows us to estimate its magnitude.

In effect, we are estimating a difference-in-difference model on uninsured vs. insured bonds based on the "Detroit treatment," which is independent of events in Puerto Rico. Moreover, given the three extraordinarily favorable circumstances listed above, the analysis can be successfully executed with simple statistics and in a narrative format.[5] The approach taken in this paper is no less powerful than formal econometric methods needed to separate signal from noise in less fortunate empirical environments. A further benefit of studying Puerto Rican bonds is that this debt is not held to any great extent by Puerto Rican banks, and hence we do not need to control for strategic complementarities (the "diabolic loop") between sovereign and bank debt (Brunnermeier, Garicano, Lane, Pagano, Reis, Santos, Thesmar, van Nieuwerburgh, and Vayanos, 2016; Esposito, 2018).

Our quantitative evaluation of the Treasury Put hypothesis proceeds as follows. Section 1 documents the existence of a Treasury Put. Starting with the 1975 bailout of New York City, a long list of government rescue plans of distressed borrowers led investors to the expectation of a bailout in the event of a Puerto Rican default. (In this paper, "bailout" describes any government action that commits taxpayer resources to support a financially distressed entity whether or not

[5] Narratives have proven very useful in a variety of applications; see, among other studies, Hamilton (1985), Romer and Romer (1989, 2017), and Ramey and Shapiro (1998).

this commitment proves to be profitable.) We carefully examine the historical record to construct the information set for Puerto Rican bond investors before the Detroit bankruptcy.

Section 2 describes the model for estimating the risk premium, a task made relatively easy because Puerto Rico issued both uninsured and insured general obligation bonds. These bonds were issued on the same day and, in many cases, with the exact same maturity. These characteristics allow us to compute accurately the risk premium on Puerto Rican bonds and to avoid several potential biases arising from an imprecise estimate of the marginal income tax rate for the marginal municipal bond investor, the "municipal puzzle" of an excessively upward sloping yield curve, differential liquidity between uninsured and insured bonds, the creditworthiness of insurers, and general shocks to the municipal market. Our procedure for estimating the risk premium is then compared to several other more parametric approaches.

Section 3 discusses data requirements. Only five series are needed to estimate the risk premium: the yield to maturity for uninsured and insured Puerto Rican bonds, the yield curve for U.S. Treasury securities, the Corporate Aaa yield, and the marginal income tax rate for the marginal municipal bond investor.

Section 4 presents results based on the risk premium for Puerto Rican bonds both before and after the seismic shock of the Detroit bankruptcy. The risk premium is relatively low before Detroit, but increases sharply thereafter. This 300^{+} basis point increase is our estimate of the Treasury Put. The increase in borrowing costs following the elimination of the Treasury Put quantifies the resource misallocation associated with this implicit government guarantee.

Section 5 summarizes our results and relates them to ongoing discussions about the role of government guarantees in financial markets. The Treasury Put is implicit insurance that explains this puzzling behavior and, in effect, is a form of regulatory forbearance. Institutional reforms that would extinguish the Treasury Put are considered, but none are found satisfactory. How to extinguish the Treasury Put on an ongoing basis in a democratic society remains an open question.

1. The "Treasury Put"

The "Treasury Put" is the implicit guarantee -- as perceived by investors -- from a government agency to provide support in the event of financial distress by the issuer of Puerto

Rican bonds.[6] In the event of a default by Puerto Rico, investors would, in effect, "place" their debt with the federal government, which would then return to investors the value of the securities at near face value through a bailout, either a direct payment or government guarantee. Measuring perceptions at a point in time is a difficult matter. In this section, we review a set of historical circumstances that allow us to infer the perceptions of a "reasonable investor." In effect, we are reconstructing investors' information sets during the years prior to the Puerto Rican default.

The expectation of a federal bailout was perfectly sensible given past behavior. In 1975, New York City was on the verge of bankruptcy.[7] Initially, the federal government explicitly refused to offer any financial assistance. Republican president Gerald Ford stated on October 29, 1975 that "[t]he people of this country will not be stampeded. They will not panic when a few desperate New York officials and bankers try to scare New York's mortgage payments out of them" (*New York* Times, December 28, 2006). President Ford's position was encapsulated in a famous (though perhaps apocryphal) headline in the *New York Daily News* the next day: "Ford to City: Drop Dead. Vows He'll Veto Any Bail-Out." However, the federal government relented, and financial assistance was authorized on December 10, 1975 in the form of $2.3 billion in loans. This bailout is equivalent to between $15.5 and $7.8 billion in 2013 if adjusted for growth in current dollar GDP per capita or in the GDP price deflator, respectively).[8] What is particularly noteworthy about that bailout is that New York City was led by a liberal Democratic mayor, while President Ford was a fiscally conservative Republican.

In the face of financial distress, federal financial assistance has been the norm:

1. Lockheed, 1971: federal guarantee of $0.25 billion of Lockheed debt (*New York Times*, 1979). [$2.4 : $1.1]. Figures in brackets are the nominal figure adjusted to

[6] This phrase is in the spirit of the "Greenspan Put" of Miller, Weller, and Zhang (2002). As a technical matter, contractual obligations for bond payments reside with the "obliger," who is frequently, but not always, the issuer.

[7] Municipalities like New York City can file for bankruptcy. This protection is not available to U.S. states and territories; cf. fn. 3.

[8] Washington D.C. also received substantial financial assistance from the Treasury in 1997. This bailout included the assumption of $5 billion in pension liabilities and a complicated set of financial flows involving increases and decreases in payments to the District and Treasury-backed loans (Brookings, n.d., pp. 89-98). However, given the special legal relationship of Washington D.C. to the federal government, it is not clear that a reasonable investor would have seen these actions as a precedent for other municipalities and Puerto Rico.

2013 dollars by the growth rate in nominal GDP per capita : growth rate in the implicit GDP price deflator, respectively.

2. Chrysler, 1980: federal guarantee of $1.5 billion of Chrysler debt (*Washington Post*, 1984). [$6.3 : $3.6].

3. Savings and Loan Crisis, 1986 to 1995: resolution costs to taxpayers of $124 billion (Curry and Shibut, 2000,Table 4). [$273 : $199; computations based on 1990 values].

4. Mexican Peso Crisis, 1995: federal guarantee of $20 billion of Mexican government debt, part of a total aid package exceeding $50 billion with additional contributions from the IMF, the BIS, Canada, and several Latin American countries (Lustig, 1995, p. 20). [$37 : $28].

5. Bear Stearns, 2008: loan from the Federal Reserve System of $29 billion for the purchase of toxic mortgage-related assets (Blinder, 2013, p. 107). [$32 : $31].

6. Fannie Mae + Freddie Mac, 2008 to 2012: capital injections from the U.S. Treasury of $140 billion (Blinder, 2013, pp. 118-119). [$155 : $150; computations based on an average of 2008 and 2009 values].

7. American International Group (AIG), 2008 to 2009: combination of loans from the Federal Reserve System and funding from TARP of $182 billion (Blinder, 2013, pp. 136-137). [$201 : $195; computations based on an average of 2008 and 2009 values].

8. Troubled Asset Relief Program (TARP), 2008 to 2009: authorization for the U.S. Treasury to spend $700 billion to support institutions and households affected by the Financial Crisis, though only $499 billion was dispersed or used for guarantees: $250 billion to banks, $80 billion to General Motors and Chrysler (again), $68 billion to AIG, $45 billion for the FHA Refinance Program, $37 billion to foreclosure prevention programs, and $19 billion to credit market programs (U.S. Treasury, 2017, Table 1, p. 19). [$552 : $535; computations based on an average of 2008 and 2009 values].

Mervyn King, former head of the Bank of England, noted that "[a]ll banks, and large ones in particular, benefited from an implicit taxpayer guarantee, enabling them to borrow cheaply to finance their lending" (King, 2016, p. 96). This view was confirmed formally by Kelly, Lustig, and van Nieuwerburgh (2016); using data on options, they document government guarantees of the U.S banking industry as a whole, though not individual banks, during the financial crisis. The "Geithner Doctrine" – "no significant financial institution would be allowed to fail" (Kay, 2015, p. 256) – coupled with the calamitous events that followed the Lehmann Brothers bankruptcy when the Doctrine was disregarded, led rational investors to expect government support of the $100+ billion in Puerto Rican liabilities.

Government willingness to use its position to assist investors in recent times extends to other countries. When speaking about the fragility of the Euro, ECB President Mario Draghi (2012) offered the following famous remark (emphasis added),[9]

> But there is another message I want to tell you. Within our mandate, the ECB is ready to do whatever it takes to preserve the euro. And believe me, it will be enough.

During the European debt crisis, several severely impaired economies received bailouts from the ECB and the other two members of the Troika, the European Commission and the IMF. In September 2007, Northern Rock bank, a substantial presence in the British mortgage market, faced a liquidity crisis. Motivated by a desire to avoid setting a precedent and cultivating moral hazard, the Bank of England initially declined Northern Rock's request for assistance. This refusal of a bailout was immediately followed by a classic bank run. The Bank of England relented within 24 hours and provided funds (initially £10 billion, eventually rising to £37 billion) to Northern Rock, earning the Governor of the Bank of England the appellation "Swervin' Mervyn."

Government intervention on behalf of investors has a long tradition. Foreign interference in U.S. politics is not solely a 21st century phenomenon. In the aftermath of the debt default by eight U.S. states and one territory circa 1840,[10] British financial interests aggressively lobbied for intervention by the U.S. federal government (Jenks, 1938, pp. 105-106):

> Baring Brothers [a British merchant bank] began an agitation to persuade the federal government to assume the responsibility for the state debts. … London merchants easily gathered the impression that Whigs of the Webster school [a faction of a U.S. political party at the time] were likely to carry out this policy. And so the Whig cause in the campaign of 1840 received generous support from England.

The non-Webster faction of the Whigs won the election and then enacted the Bankruptcy Act of 1841. This Act was detrimental to the interests of British bondholders and other creditors because it allowed for the first time debtors to initiate bankruptcy, resulting in over 33,000

[9] In a sophisticated econometric analysis, Delatte, Fouquau, and Portes (2016) document that Draghi's remark returned bond yield spreads to their pre-crisis levels within one year on his speech.

[10] The only other state to default on its debt obligations has been Arkansas in 1933 (Ratchford, 1941, Chapter XV; Ergungor, 2016).

bankruptcy filings in less than 17 months (Federal Judicial Center, n.d.) amounting to approximately 23% of GNP (Warren, 1935, p. 81 and authors' calculations). This relief was temporary, and the 1841 Act was repealed two years later, a pattern of legislation that parallels a "tax holiday." U.S. States were not covered by the 1841 Act; somewhat over half their delinquent debts were repaid voluntarily, presumably to maintain future access to foreign capital markets (English, 1996). The British government was also actively involved in supporting British business interests, as described 80 years ago by Hobson (1938, p. 56, emphasis added, quoted in Goetzmann, 2016, p. 418) in his book on *Imperialism*,

> Investors who have put their money in foreign lands, upon terms which take full account of risks connected with the political conditions of the country, desire to use the resources of their Government to minimize these risks, and so to enhance the capital value and the interest of their private investments.[11]

Based on a plethora of past precedents, investors would surely have expected that, given the size of the outstanding Puerto Rican debt, it benefited from an implicit government guarantee that would, in turn, dampen risk premium. Puerto Rican bond investors held a Treasury Put.

2. Computing The Risk Premium

This section presents the model for computing the risk premium on Puerto Rican general obligation bonds. Key to the derivation is the existence of both uninsured and insured bonds issued on the same day with maturities that are equal or nearly equal. Potential biases with our procedure are then examined. We conclude by comparing our procedure for estimating the risk premium to several others taking more parametric approaches.

A. Model

Municipal bonds generally enjoy a favorable tax status. All municipal bonds issued in the United States are exempt from federal income tax and, in most cases, they are also exempt from income taxes assessed in the state in which they are issued. Puerto Rican bonds enjoy the most favorable tax status of any municipal bond, as they are "triple tax-free" -- exempt from all federal, state, and local income taxes (though the latter exemption is of no practical importance).

[11] Hobson has rather harsh words for creditor-initiated arrangements such as PROMESA (cf. fn. 3): "But more frequently the insufficient guarantee of an international loan gives rise to the appointment of a financial commission by the creditor countries in order to protect their rights and guard the fate of their invested capital. The appointment of such a commission literally amounts in the end, however, to a veritable conquest" (p. 54, emphasis added).

Given this favorable tax status, the taxable-equivalent-yield (TEY) on a bond issued by Puerto Rico (P), uninsured (uni), and with a maturity m years is modeled as the yield-to-maturity observed in the bond market, stated on a pre-tax basis by dividing by one minus the marginal income tax rate for the marginal municipal bond investor (τ),

$$(1) \qquad \frac{r^{P,uni,m}}{(1-\tau)} \equiv r^{f} + s + \ell + \mu^{m} + \sigma \ .$$

The TEY depends on five factors: the risk-free rate (r^{f}), an aggregate or municipal market-wide shock (s), and three premia for liquidity (ℓ), maturity (μ^{m}), and risk (σ).[12] The object of the analysis in this section is to isolate the latter in terms of observables.

The companion TEY on an insured (ins) Puerto Rican bond with maturity of n years is modeled in a similar manner,

$$(2) \qquad \frac{r^{P,ins,m}}{(1-\tau)} \equiv r^{f} + s + \ell + \mu^{n} + \phi \ .$$

Equation (2) differs from equation (1) by allowing the bond to have a different maturity ($n \neq m$) and replacing the risk premium on the uninsured bond by a default risk premium for the bond insurer (ϕ). Equations (1) and (2) do not include time subscripts because both bonds are matched exactly by issue day (also known as the dated date).

The risk premium on uninsured bonds is obtained in three steps. First, equation (2) is subtracted from equation (1), thus eliminating the risk free rate, the liquidity premium and aggregate/market-wide shock,

$$(3) \qquad \left(\frac{r^{P,uni,m}}{(1-\tau)}\right) - \left(\frac{r^{P,ins,m}}{(1-\tau)}\right) = \left(\mu^{m} - \mu^{n}\right) - \phi + \sigma \ .$$

Second, a Treasury bond of maturity k ($r^{T,k}$) is modeled as the sum of the risk-free yield and a maturity premium (μ^{k}, $k = \{m, n\}$), where k extends over the entire Treasury yield curve,

[12] The liquidity premium is an important component of municipal debt. Longstaff (2011) documents that the liquidity premium is quantitatively important for short-term municipal securities; even in a rather liquid segment of the market, it averages 56 basis points for the period 2001-2009. Ang and Green (2011, citing Ang, Bhansali, and Xing (n.d.)) report that the liquidity premium on municipals averages 112 basis points. Passadore and Xu (2018) show that the liquidity premium varies substantially by default state, accounting for one-half of the sovereign spread during periods of financial distress but only a negligible amount otherwise.

(4) $$r^{T,k} = r^{f} + \mu^{k} .$$

Subtracting equation (4) from equation (3) twice with k equal to m and n and rearranging, we eliminate the maturity premia,

(5) $$\left(\frac{r^{P,uni,m}}{(1-\tau)} - r^{T,m} \right) - \left(\frac{r^{P,ins,n}}{(1-\tau)} - r^{T,n} \right) = -\phi + \sigma$$

Third, the risk premium for insurers is modeled as the difference between the yields on a 20-year Corporate Aaa bond ($r^{C,Aaa,20}$) and a 20-year Treasury bond ($r^{T,20}$),

(6) $$\phi = r^{C,Aaa,20} - r^{T,20} .$$

Using equation (6) to eliminate ϕ in equation (5), we obtain the following final expression defining the risk premium on uninsured Puerto Rican bonds in terms of observables,

(7) $$\sigma = \left(\frac{r^{P,uni,m}}{(1-\tau)} - r^{T,m} \right) - \left(\frac{r^{P,ins,n}}{(1-\tau)} - r^{T,n} \right) + \left(r^{C,Aaa,20} - r^{T,20} \right) .$$

B. Potential Biases

This sub-section evaluates the impact of five potential biases with using equation (7) to estimate the risk premium. First, a bias will occur if the marginal income tax rate for the elusive "marginal investor" used in this study differs from the true tax rate. While τ is an important variable in computing the gross-of-tax return, it is of second-order importance in computing the risk premium on Puerto Rican bonds because it enters the yields for both the uninsured and insured bonds. As we shall see in Section 4, the difference between the uninsured and insured yields is small, and hence so is the potential bias. Our procedure is based on the highest possible marginal income tax rate for a household investor. Using different methodologies on very different samples, Feenberg and Poterba (1991) and Longstaff (2011) both find that the marginal tax rate for the marginal municipal investor is close to the maximum statutory federal tax rate for households, though this issue remains unsettled (Longstaff, 2011, fn. 1). Notwithstanding this evidence, it is nonetheless useful to assess the bias if the appropriate marginal tax rate is lower than the one used in these baseline computations. From equation (7), σ falls with lower values of τ. If the "true" tax rate is less than the maximum rate used in our procedure, estimates of σ reported below would be biased upward, a bias that would militate against our assertion that the risk premium on Puerto Rican bonds was too low.

Second, when studying municipal bonds, a bias may arise because of the well-documented "municipal puzzle" of an excessively upward sloping yield curve for municipals. A consensus solution to this puzzle does not exist. Kalotay and Dorigan (2008) claim it is due to the callability of municipals with maturities of 10 or more years, but Chalmers (1998) finds no support for this hypothesis when comparing Treasuries to municipal bonds backed by Treasuries via advanced refunding (so called defeased bonds). Our results are not sensitive to this puzzle and potential bias since our estimate of the risk premium is based on bonds with exact or nearly exactly maturities. The effect of the "municipal puzzle" from whatever source cancels due to differencing (cf. $(\mu^m - \mu^n)$ in equation (3)).

Third, the derivation was based on the assumption that the liquidity premia on uninsured and insured bonds was identical, and hence cancelled in step 1. Since insured bonds may appeal to a broader set of investors, it is possible that their liquidity premium is lower than that for uninsured bonds. In this case, an additional term would be subtracted from equation (7), $(\ell^{uni} - \ell^{ins}) \geq 0$. Thus, as with the marginal tax rate, the estimates of σ reported below would be biased upward in the face of a positive liquidity differential, a bias that would again weigh against our central thesis that the risk premium on Puerto Rican bonds was too low.

Fourth, the results are sensitive to a proper specification of the creditworthiness of bond insurers, as represented by ϕ. In econometric parlance, σ is identified by its exclusion from equation (2), conditional on ϕ (as well as the other variables appearing in both equations (1) and (2)). During the financial crisis, several bond insurers experienced severe financial difficulties. If the solvency of companies insuring bonds is seriously questioned, then equation (6) underestimates the true insurer's risk premium and, per equation (7), this underestimate would lead to a downward bias in the estimate of σ. Such a potential bias would not seem of concern here. The insured bonds in our sample were backed by five insurers (listed in Appendix C, column 6). As of December 2007, all five insurers had been rated by Moody's as Aaa. Some of these insurers had expanded into insuring derivative products, and they faced financial stress during the Global Financial Crisis because of their exposure to mortgage-related assets. However, all but one of the 33 bonds in our sample issued since October 2004 have been insured by only two of these companies, AGC and FSA/AGM. They have maintained their Aaa ratings through October 2008. The next month, their ratings were lowered to Aa2 and Aa3,

respectively. One year later, AGC's rating was lowered to that of FSA/AGM. (S&P viewed AGC and FSA/AGM more favorably, lowering their credit rating from AAA to AA+ (equivalent to Aaa and Aa1, respectively, on Moody's rating scale) on October 25, 2010.) The Aa3 ratings for AGC and FSA/AGM were lowered to A3 and A2, respectively, in January 2013 (after the last issue date for the bonds in our sample, April 3, 2012). In November 2016, Moody's examined these two insurers and concluded that "[o]ur two pro-forma analyses support our belief that, despite Puerto Rico's financial stress and uncertainty about the ultimate outcome of the negotiation between Puerto Rico and its creditors, the capital positions of our rated guarantors are supportive of their current ratings" (Moody's, 2016, p. 2). The same study reports that total Puerto Rican exposures represent only 41% of total claims paying resources.[13] Investors in Puerto Rican bonds insured by AGC and FSA/AGM "… continue to receive uninterrupted full and timely payment of scheduled principal and interest in accordance with the terms of Assured Guaranty's insurance policies (Assured Guaranty, 2018). The default risk of insurers appears to be adequately captured by equation (6). Nonetheless, the robustness of our computations will be examined in Section 4.A.

Fifth, concern about the financial stability of some insurers of municipal securities can affect the municipal market as a whole and is an example of a sector-specific shock. Other shocks that have important impacts on municipal yields are unanticipated changes in regulations (e.g., Dodd-Frank, advanced refunding), legal precedents, and monetary policy. These important drivers of municipal yields are accounted for in our estimate of σ by the shock variable, s.

C. Alternative Approaches

Our procedure for identifying and estimating the Treasury Put relies on the unique circumstances surrounding the Puerto Rican debt market. Its simplicity is its strength. In this sub-section, we contrast it to three parametric approaches.[14]

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[13] See Moody's (2016, Exhibit 7, p. 6). The 41% figure is a weighted-average of the entries for AGC and FSA/AGM.

[14] An additional alternative approach exploits unique judicial rulings to estimate the impact of government guarantees. Feld, Kalb, Moessinger, and Osterloh (2017) use an interesting quasi-natural experiment to estimate a government guarantee. When a ruling by a Swiss court removed the explicit liability of cantons for the debt of its municipalities, the risk premium on cantonal debt fell by 26 basis points. This estimate is much smaller than our estimate of the Treasury Put because the fiscal situation of the municipalities was much stronger than that of Puerto Rico and the implicit liability remained. Heppke-Falk and Wolff (2008) document that the relative yields of German länder bonds respond

One approach forecasts defaults with a procedure similar to the Z-score method (Altman, 2000). The risk premium is measured by the difference between the bond return consistent with this expected default and the actual bond return. While Z-scores are a mainstay for corporate credit analysis, it is quite difficult to implement this approach for municipal bonds because of their very low default rates.

An alternative method to measure the value of government guarantees uses option price data and an explicit pricing model. Kelly, Lustig, and van Nieuwerburgh (KLN, 2016) combine the powerful insights from the Black-Scholes option pricing formula and out-of-the-money options prices for a basket of bank stocks and an index for the financial sector as a whole to estimate changes in risk premia during the financial crisis. The latter index did not rise pari passu with the former. They link this differential to implicit insurance for the financial sector as a whole and conclude that, during the financial crisis, this government guarantee lowered "the insurance premium for financial index crash insurance by 73 percent on average" (KLN, p. 1280). This parametric approach relies on the correct specification of a somewhat complicated jump-diffusion pricing model. Bai, Goldstein, and Yang (2017) have argued that a "leverage effect" impacting equity volatility needs to be considered. In this expanded model, the financial crisis has a differential impact on the two options prices considered by KLN, and this differential could explain their results independent of any government guarantee. This concern aside, an options-based approach is not feasible in the current situation because there is no market for out-of-the-money options on Puerto Rican uninsured bonds.

In a recent paper, Atkeson, d'Avernas, Eisfeldt, and Weill (AAEW, forthcoming) also estimate the value of the government guarantee for banks. They decompose the market/book equity ratio into the fair value and a residual. If book equity and fair value are measured accurately and the latter captures the value of all future "cash flows associated with bank assets and liabilities not considering the contribution to bank value from government guarantees" (p. 3), then the residual is the value of government guarantees. Based on their forecasting equations, AAEW find that, from 2008 to 2017, approximately one-half the movement in the bank

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positively to debt per capita but, oddly, negatively to interest payments/revenue. The latter paradoxical result is interpreted in terms of a unique ruling by a German court that used this ratio as an indicator of extreme financial distress, hence a predictor of the likelihood of a bailout. This interpretation is reinforced by estimating the same model on only the financially beleaguered Berlin Land. The coefficient on the interest payments/revenue variable is more than twice as large for Berlin compared to the other länder.

valuations (as measured by market to book equity) can be accounted for by variations in the value of government guarantees.

Neither parametric nor non-parametric approaches dominate in estimating the value of government guarantees. Rather, these different approaches illustrate the fundamental tradeoff between simple, non-parametric models (such as the one used in the current study) that are relatively robust but less efficient and more complicated procedures relying on an explicit theory and parameterization that are more efficient but fragile in the face of possible model misspecification or noisy data.[15]

3. Data

Our computation of the risk premium on Puerto Rican bonds requires five time series. The primary data source for municipal bond market data is the Electronic Municipal Market Access database (EMMA, http://www.emma.msrb.org) published by the Municipal Securities Rulemaking Body (MSRB). We restrict our search to government general obligation (GO) bonds, those that are backed by the full faith and credit of the Puerto Rican government and do not have any specific revenue streams associated with them. We thus avoid problems with having to evaluate the creditworthiness of those revenue streams. The yields on Puerto Rican uninsured and insured GO bonds ($r^{P,uni,m}$ and $r^{P,ins,n}$, respectively) are obtained from a careful review of all GO bonds from January 1, 2000 to December 13, 2013. Our initial exploration of the EMMA data identified 279 uninsured and 205 insured GO bonds since January 2000. Entries with maturities less than one year and without sufficient information to compute the yield or determine the issue date or maturity are excluded. A tedious examination of the remaining GO bonds (for each bond offering, reading the Official Statements, cross-checking with online data sources, and resolving discrepancies) identified 45 uninsured bonds that could be matched to 45 insured bonds. Details are provided in Appendix C; specific comments on data collection are in Appendix E.

The quality of the matches is quite good. For each of the 45 matched pairs, the uninsured and insured bonds were issued on the same day (column 5 of Appendix C). Call

[15] In the econometrics literature, a similar tradeoff exists between robustness and efficiency. Consider estimating a coefficient of interest in a single equation that is part of a set of simultaneous equations and choosing between 2SLS and 3SLS techniques. The latter is relatively more efficient, but the coefficient of interest may be estimated inconsistently if any of the equations in the system are misspecified. The 2SLS technique trades off these efficiency gains for robustness.

features are very similar among the paired bonds (column 8). Maturities tend to be long: 26 are greater than 20 years; 18 are between 11 and 20 years, and one is less than 10 years (column 9). The maturity matches are exact for 33 pairs (columns 10). For the remaining 12 pairs, the average discrepancy in maturities is two years. The resulting bias on our estimate of σ is likely to be modest (column 11; cf. table note 6, for a definition of bias). What bias exists is likely to raise σ (an upward bias exists in seven cases, a downward bias in five cases), a result that weighs against the proposition that the risk premium was too low.

The Corporate Aaa yield and Treasury yield curve are obtained from the FRED database. Data for the Treasury yield curve does not always match exactly the maturities of the Puerto Rican bonds. We address this problem with the following two-step procedure. For a Puerto Rican bond of maturity m at time t, we examine the Treasury yield curve at that t (this match on a date can be done exactly) and determine the points on the yield curve immediately below and above maturity m. We then compute a linear approximation based on the location of the Puerto Rican bond maturity relative to the interval defined by the low and high Treasury yields.[16] For example, if the period t Puerto Rican bond has a maturity of 8+ years, we compute the appropriate point on the yield curve as the yield on the 7 year Treasury bond plus the difference in yields on the 10 and 7 year Treasury bonds, divided by the number of days over this 3 year interval, all multiplied by the number of days the Puerto Rican bond with a maturity of 8+ years exceeds the number of days of the 7 year Treasury bond.

The FRED database also provides the yields on Corporate Baa and Non-Investment grade bonds used to compute risk premia for comparative purposes.

The fifth series is the marginal income tax rate for the marginal municipal bond investor (τ). We assume that this investor is a household facing the highest marginal rate on interest income (alternative assumptions are explored in section 4.A). Recall that income from Puerto Rican bonds is triple-tax free. In order to facilitate comparisons between tax-free Puerto Rican and taxable bonds, the latter is grossed-up for income taxation. Several steps are involved; see Appendix F for details. Most importantly, we must distinguish between regular and alternative

[16] We believe that his linear approximation between the two points closest to the maturity date on the Puerto Rican bond is likely to be more accurate than using approximations based on the entire yield curve, such as the six-point approximation of Gürkaynak, Sack, and Wright (2007) because of the flatness of the Treasury yield curve at the longer maturities that populate our sample. Note that this adjustment for the maturity premium is not of quantitative importance in this study because of the exact ($m = n$) or near-exact ($m \approx n$) maturity matches for most pairs of uninsured/insured bonds (cf. equation (3)).

minimum tax (AMT) regimes. In either case, we assume that the marginal investor has a high income and is subject to several taxes applicable to high-income investors (generally, adjusted gross income above $200,000).[17] The following discussion is keyed to the entries in Table F1 in Appendix F with row numbers indicted in brackets.

For a taxpayer in the regular tax status, the income from a Treasury bond is subject to taxation at the federal [1] and state levels [2]. The latter is usually deductible against the former, and this deductibility lowers the effective tax rate. Thus, the combined federal and state tax rate is the summation of the two preceding rates less the product of the two rates [3]. We assume that the marginal investor is subject to the highest marginal statutory tax rates at the federal and state levels. Given our assumption that the marginal investor has a high income, Treasury interest income is subject to a three additional taxes: the net investment income tax surcharge [4, known as the "Medicare tax"] and phase-outs of the personal exemption [5] and select itemized deductions [6, known as the "Pease Limitation"]. These phase-outs increase the tax on Treasury interest income. The regular marginal tax rate on interest income (item [7]) is the summation of these three effective marginal tax rates and the combined federal and state tax rate.

The AMT regime imposes a different set of marginal income tax rates, as well as two marginal income tax rates from the regular regime. We again assume that the marginal investor faces the highest tax rate [8] and, given this high income, is subject to a phase-out of the AMT exemption [9]. As in the regular tax regime, the AMT investor is also subject to the state income tax [2] and the net investment income tax surcharge [4]. The AMT marginal tax rate on interest income is the summation of these four effective marginal tax rates [10].

In order to compute a single marginal tax rate, we form a weighted average of the regular and AMT marginal tax rates [14], where the weights are the percentage of select returns filed in the two regimes [11, 12, 13]. Since financial assets are disproportionately held by higher income taxpayers, we count only those returns with AGI in excess of a threshold of $200,000.[18] This

[17] Note that we focus on "high," not the "highest" income. In the latter case for very wealthy households, several of the phase-outs discussed below will have been exhausted, and the marginal tax rate for very wealthy households will be lower than that for the merely prosperous. That is, for a potential municipal bond investment, the marginal income tax rate for a household consisting of two economics full professors (filing jointly) will be higher than the marginal income tax rate for Jeff Bezos and Bill Gates.

[18] Ideally, we would have varied the threshold level by year, but such a refined calculation was not feasible given the presentation of the IRS data. The modest rate of inflation during this period and the

marginal tax rate varies from 42.7% in 2000 to a low of 39.0% in 2010 and a high at the end of the sample of 46.3% in 2016.

4. Results

This section contains our empirical results divided into three sections: before the Detroit bankruptcy of July 2013 when the Treasury Put was live, after the Detroit bankruptcy when the Treasury Put was extinguished, and misallocation costs associated with the Treasury Put and inappropriately low interest rates on Puerto Rican securities.

A. Before Detroit

The Detroit bankruptcy occurred in July 2013. We examine the 13 bond issue dates comprising 45 sets of matched GO bonds that occurred between January 1, 2000 and the bankruptcy. We study Puerto Rican matched bonds at the initial offering price on or near the issue date. This is the period when bonds are most liquid, institutional interest highest, and prices closest to fundamental value. (The risk premium for all 45 matched Puerto Rican bonds is presented in column 12 of Appendix C, which also contains information about issue (dated) date, bond insurer, amount of the issue, call year, maturity, quality of and, if any, bias from the maturity match.) The risk premium on Puerto Rican bonds is uniformly quite low – relative to Baa bonds -- with two exceptions. The 13th match has a high risk premium of 2.35 driven by a very low yield on the matched insured bond, which is difficult to understand and out-of-line relative to the other insured bond issued on the same day (match #14) and insured bonds issued five months earlier (match #12). The second occurrence of a high risk premium (relative to Baa bonds) is for bonds issued in May 2008. This month is at the beginning of the financial crisis (the Bear Stearns collapse occurred in March 2008) when markets were severely disrupted.

The results are summarized in Table 2, which aggregates the 45 risk premia into their 13 issue dates and compares them to the risk premia on Corporate Aaa, Corporate Baa, and Non-Investment grade bonds (computed as the difference between the bond yield for a given asset class and the date-comparable yield on a 20-year Treasury bond). As discussed above, the risk premium on Puerto Rican bonds (column 2) generally lies between the risk premia for Corporate Aaa and Baa bonds (columns 1 and 3, respectively). Averaged over all 13 sets of GO bonds issued since 2000, the risk premium on Puerto Rican GO bonds exceeds the comparable risk

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presence of the bias in both the numerator and denominator of the percent of returns filed under regular tax status suggest that this omission will not result in a large error.

premium on Corporate Aaa bonds by 68 basis points. Relative to Corporate Baa bonds, the risk premium on Puerto Rican bonds is lower by 30 basis points. That gap widens considerably when computed with respect to Non-Investment grade bonds, and it is a substantial 279 basis points.

These results are robust to variation in the marginal tax rate and insurer creditworthiness. In Panel B, we replace the highest marginal tax rate for the marginal *household* municipal bond investor with highest marginal tax rate for the marginal *corporate* municipal bond investor, the latter defined as the sum of the federal corporate rate (35.0%) and an average of state corporate rates (6.5%, Chirinko and Wilson, 2017, Figure 2). By happenstance, this figure equals the unweighted average (2000 to 2016) of the household tax rate used in Panel A. This alternative tax rate leads to a trivial two basis point increase in the average risk premium. Panel C returns to the baseline tax rate used in Panel A and reduces it by 50%. The average risk premium falls by 17 basis points, amplifying somewhat the puzzle of an excessively low risk premium. As discussed in Section 2.B, the results could be sensitive to the creditworthiness of bond insurers. To assess this sensitivity, we focus on only those bonds insured by the two most creditworthy insurers (AGC and FSA/AGM) and recompute the average risk premium without issues 1 to 5 listed in Table 2. For Puerto Rican bonds insured by these two high quality firms, the average risk premium rises by only two basis points relative to the baseline in Panel A.

Table 2 documents that the compensation for default risk on Puerto Rican bonds was exceptionally low, an outcome that was eminently reasonable given the expectation of financial support from the U.S. government.

B. After Detroit

That expectation was upended by a seismic shock to the municipal bond market. On July 18, 2013, Detroit filed for bankruptcy with liabilities of $18 to $20 billion; this event was widely anticipated.[19] No federal assistance was forthcoming; this event was totally unexpected. The absence of a bailout is particularly surprising when compared to the New York City bailout of $2.3 billion. A comparable bailout in 2013 would have been between $15.5 to $7.8 billion

[19] Detroit's woes were well known: a population decline since 1950, deficits in the operating budget since 2008, and increasingly burdensome health care and pension costs, among other problems. In April 2012, the Michigan Governor and the City agreed to a consent decree that involved financial reforms and the creation of an advisory board to oversee most fiscal affairs. On February 19, 2013, the *New York Times* (2013) reported that "[a] review team appointed by the State of Michigan has concluded that Detroit is mired in serious financial problems, a step that draws the city ever closer to emergency oversight by a state-assigned financial manager." Michigan effectively took over Detroit's finances with the appointment of an Emergency Manager on March 14, 2013.

(using growth in current dollar GDP per capita or the GDP price deflator or as the scaling variable).

That a bailout was expected was clear. Detroit Mayor Dave Bing, speaking on ABC's *This Week*, seemed to leave the door open for federal assistance, saying that he has engaged in talks with the Obama administration for help (ABC, 2013) and noting the Chrysler and GM had received federal aid when in financial distress. When asked "no federal bailout?," Mayor Bing responded "not yet." *Rollcall* reported that "[s]oon after Detroit filed for protection under Chapter 9 of the bankruptcy code, the Obama Administration made it clear it would not seek a bailout similar to the $2.5 billion [sic] New York City loan package enacted in 1975" (Ota, 2013, p. 2). Eight days after Detroit filed for bankruptcy, Senator Lindsay Graham (2013) introduced an amendment to a bill with the following provisions concerning federal bailouts:

> • No federal funds may be used to purchase or guarantee any asset or obligation of any municipal, local, or county government if that locality has defaulted, is at risk of defaulting, or likely to default absent such federal assistance.
>
> • In addition, the federal government would also be prohibited from issuing lines of credit or providing direct or indirect financial aid to prevent bankruptcy.

The amendment barely failed by a 14 to 16 vote. Other legislation was introduced in July 2013 to specifically exempt the federal government from any liability for state and local pension obligations (Ota, 2013, p. 2). This no-bailout sentiment was echoed by Morningstar (2013, p. 13): "[g]iven the current political climate in Washington, D.C., we also think it is unlikely that the federal government will offer any sort of financial bailout for Puerto Rico." The 2013 Detroit bankruptcy and the federal government's truancy regarding a rescue package for debtors or creditors was a watershed event extinguishing the Treasury Put.

The Detroit bankruptcy allows us to identify and quantify the Treasury Put. The effective termination of the Treasury Put will be reflected in a marked increase in the risk premium on Puerto Rican bonds on and shortly after July 2013. No new bonds were issued after this date, so we cannot repeat the analysis in Section 4.A measuring risk premium on the issue date. Instead, to assess the impact of the removal of the Treasury Put, we track the trading of matched bonds and compute the yield-to-maturity for uninsured and insured bonds on a monthly basis (see the notes to Table 3 for details about the computation). The focus on monthly intervals is

necessitated by the thinness of the Puerto Rican bond market. Using equation (7) to compute the risk premium for matched bonds, we examine whether the Detroit bankruptcy led to a substantial increase in the risk premium.

The results are presented in Tables 3 and 4. The Detroit bankruptcy filing occurred on July 18, 2013, and we divide risk premia into the Before interval (January 1 to July 17, 2013) and an After interval (July 18 to December 31, 2013). Row 1 reports our baseline result that the risk premia rose from 258 to 556 basis points. Row 2 trims the data for four outliers: matches 15 (low) and 17, 18, and 33 (high). The differential for the remaining bonds falls slightly to 278 basis points with a much lower standard error. Row 3 focuses on a subset of traded bonds with a very close match -- traded on the same or adjacent days -- between uninsured and insured bonds. (Thus, these results are conceptually closer to those in Table 2.) The differential in risk premia Before and After Detroit is 400 basis points. Table 3 documents the substantial rise in the risk premium on Puerto Rican bonds after the Detroit bankruptcy.

As noted above, the comparison of risk premia before and after Detroit can be understood as a classic difference-in-difference model. Under this interpretation, the underlying data are the adjusted returns for uninsured and insured bonds and the Detroit bankruptcy of July 18, 2013 is the treatment. In our case, the formal evaluation is equivalent to a simple difference-in-means test, which generates t-statistics of 4.38, 6.04, and 5.13 for rows 1, 2, and 3, respectively.

An alternative explanation of our results is that the purported rise in the risk premium merely reflects a rise in the liquidity premium on uninsured bonds (Passadore and Xu, 2018), as investors largely withdrew from the uninsured bond market after the Detroit shock. Trading volume of uninsured bonds fell by 21% between the Before and After intervals. However, the trading volume of insured bonds fell by 22%. Thus, any increases in liquidity premia in the Puerto Rican bond cancel in our calculations (cf. equations (1) to (3)) and cannot be driving the results in Table 3.

Table 4 reports two robustness checks. Panel A recognizes that investors in a somewhat illiquid bond market investors may not react quickly to the extinguishing of the Treasury Put on July 18, 2013. We thus redefine the After interval to begin on the first day of the subsequent months; that is, 14 and 45 days after July 18 (exact dates are provided in the braced items in the table). There is some evidence of a delayed response, as the differentials rise by 32 to 88 basis points relative to the baseline result in row 1 of Table 3.

Panel B explores the effects of anticipation effects. Detroit's fiscal woes were well known and the Obama Administration's non-rescue may have been "in the wind," so the seismic shock may not have been totally unexpected. Forward-looking investors might have begun trading based on expectations prior to the actual date of the Detroit bankruptcy. We examine this possibility by shifting back the endpoint of the Before interval from July 17 to the last day of the four preceding months ad seriatim and maintaining a six month window. Relative to our baseline result, the differential premia rise, suggesting the existence of an anticipation effect.

Taken together, the evidence in Tables 3 and 4 suggest that the Treasury Put was at least 300 basis points and likely higher.

C. Misallocation Costs

The Treasury Put misallocates capital. Figure 6 contains an analysis of the market for Puerto Rican bonds. The Treasury Put lowers finance costs, shifts-out the demand curve for capital, and thus directs capital to inefficient uses. The removal of the Treasury Put is effectively an inward shift of the demand curve. The vertical distance between the two demand curves is our estimate of the Treasury Put. Given this estimate and an estimate of the slope of the supply curve for municipal bonds, the extent of this misallocation can be calculated. The 300 basis point increase in the risk premium leads to approximately a 38% increase in the cost of capital.[20] When multiplied by an estimate of the slope of the supply curve for municipal capital of 0.365 (Joulfaian and Matheson, 2009), the implied decrease in the stock of capital is 14%, approximately $14 billion.

While sizeable, this misallocation of capital was not responsible for Puerto Rico's financial woes. The Treasury Put induces two opposing effects: a higher level of debt but lower finance costs per unit of debt. The net effect is financially detrimental only if the elasticity of the supply curve for Puerto Rican debt exceeds unity, which is well above the estimate noted above.[21] The ultimate causes of the Puerto Rico's default may be more deeply rooted in internal political failures and external relations with the U.S. mainland.

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[20] The average yield on uninsured Puerto Rican bonds before Detroit for the period January 2000 to April 2012 (the last issue before the Detroit bankruptcy) is 7.862. This yield is the cost of capital influencing the flow of debt to Puerto Rico. The removal of the Treasury Put, estimated here to be 3.000, would have increased this yield to 10.862, a 38% increase.

[21] The crucial role of the supply elasticity in determining the potentially deleterious impact of the Treasury Put can be seen in the following inequality for interest payments: (R+TP)*B[R+TP] > R*B[R],

The Treasury Put may continue to misallocate capital if it again becomes "live" and the financial situations of beleaguered states continue to deteriorate and thus the Treasury Put becomes relevant. The five most troubled states – Illinois, New Jersey, Massachusetts, Connecticut, and Kentucky – have outstanding liabilities of $745 billion. The scope for misallocating capital is very large.

5. Summary, Conclusion, And The Policy Dilemma

To answer the questions posed at the beginning of this paper – What went wrong? Why were risk premia so low? Where was market discipline? -- the fundamental cause of these failures was an implicit guarantee of Puerto Rican liabilities, the "Treasury Put." Evaluating the Treasury Put hypothesis is made possible in the case of Puerto Rico given three fortuitous features of the empirical environment – 1) the dire fiscal and economic conditions of Puerto Rico, 2) pairs of uninsured and insured bonds issued on the same day with the same maturity and other characteristics and 3) the "seismic shock" of the Detroit bankruptcy and the unexpected absence of federal support. Identification of the Treasury Put is based on five pillars [supporting evidence listed in brackets]:

1. Macroeconomic fundamentals were dismal [Introduction, Figures 1-5, Table 1],
2. The Treasury Put existed [Section 1],
3. Default risk was too low [Section 4.A, Table 2],
4. The Treasury Put was extinguished [Section 4.B],
5. Default risk rose [Section 4.B, Tables 3 and 4].

Our analysis documents the existence of a sizeable Treasury Put of at least 300 basis points and a significant misallocation of capital to Puerto Rico of $14 billion.[22]

The conclusion of this study differs from that offered by the GAO (2018). This well-researched document concludes that the misallocation of capital was due largely to information failures. Which view is correct has important implications for the appropriate policy. Under the Information Failure hypothesis, capital flows can be improved by requiring higher quality and

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where R is the non-distorted market interest rate, $TP = -\Delta R < 0$ the distortion created by the Treasury Put, and B[.] bond supply negatively related to its argument (cf. Figure 6). Manipulating this inequality and interpreting the TP as the change in the interest rate leads to the following inequality for the price elasticity of the bond supply schedule: $((B[R-\Delta R]-B[R])/B[R-\Delta R]) / (\Delta R/R) > 1.0$.

[22] The existence of a quantitatively important Treasury Put also raises questions about the proper specification of bond pricing formula, which usually ignore the important role for implicit government guarantees documented in this paper.

more timely information, as recommended by the GAO. However, the radical increase in yields post-Detroit and the recognition that many Puerto Rican bond investors are sophisticated – being either professional money managers or high-income households who hire professional money managers -- militate against the GAO hypothesis.

By contrast, the Treasury Put hypothesis raises the question how can the implicit guarantee – which effectively is a form of regulatory forbearance -- can be extinguished on a permanent basis? There is a sizeable literature studying the problem of how governments can make binding, credible commitments while providing a safety net.[23] Karaken and Wallace (1978) was one of the earlier contributions in the context of deposit insurance. They conclude that regulation of the assets and liabilities of insured financial intermediaries is essential. More recently, Chari and Kehoe (2016) analyze government bailouts as an inefficient but unavoidable intervention into otherwise efficient markets. They focus on "sustainably efficient" policies and also conclude that regulation – in the form of controlling leverage and taxing size -- is important to achieve a second best outcome. A third approach is "exemplary non-intervention," as has been pursued with the Detroit and Puerto Rican defaults. Doubts exist as to whether these policies can be sustained in the face of future crises.

Ending government bailouts has been considered in a working group composed of scholars with diverse backgrounds, and the resulting essays have been published in a 2010 volume edited by Kenneth Scott (law), George Shultz (policymaking), and John Taylor (economics). Shultz (Chapter 1) focuses much of the discussion at the conference on "making failure tolerable," and he concludes the volume by noting "…that we have to *define and measure systemic risk operationally* if we are going to make any progress. Without an operational definition the bailout mentality will continue" (p. 286, italics in original). As demonstrated by the Taylor essay in the same volume (Chapter 4), defining and quantifying an operational measure of systemic risk is a daunting and unresolved task.

Restrictions on borrowings codified in legislation, such as balanced budget amendments, may be another solution that eliminates the need for government guarantees and bailouts. Of course, legislation that is passed can be revoked, but extant legislation creates friction in the

[23] See Herold (2018) for an extended discussion of insolvency frameworks for sub-national governments. Bornstein and Lorenzoni (forthcoming) question the wisdom of a commitment strategy. They argue that a firm commitment to non-intervention can lead to an aggregate demand externality. Discretionary interventions eliminate the latter and may lead to better outcomes, even in the face of moral hazard.

system that may temper borrowing and make intervention unnecessary. State balanced budget amendments arose in the 1840's after several states defaulted on their debts (Heins, 1963, pp. 8-12). In his Nobel Prize lecture and in the popular press, Sargent (2012a, Section VI and 2012b, respectively) and others interpret the adoption by many states of balanced budget restrictions during this period as strengthening fiscal discipline. While the constraints may have been binding in the short-term, such an interpretation underestimates the creativity of accountants, the tenacity of lawyers, and the cunning of politicians and is inconsistent with the huge borrowings that have been undertaken regularly by the 49 "balanced budget" states.[24]

These accumulated state debts are not unexpected. In 1852, the balanced budget restriction in New York's state constitution was challenged in terms of the Special Fund Doctrine, which refers to debt serviced by a specific revenue source. That challenge was rejected, and no further cases were brought for approximately the next 40 years, a period during which there was little borrowing by states save for the exigencies brought about by the Civil War.[25] In 1889, a challenge by Colorado was successful, the Special Fund Doctrine was sustained, and state debt began to grow. The key legal issue is the meaning of "debt." Legal precedents have tended to conclude that debt not explicitly guaranteed by the full faith and credit of a state can be accumulated in states with balanced budget restrictions.[26] "Nonguaranteed borrowing methods can be classified into four broad categories: (1) revenue bonds of state agencies (the special-fund doctrine); (2) public corporations, authorities, and commissions; (3) lease-purchase agreements; and (4) delegation of state functions to political subdivisions" (Heins, 1963, pp. 13-14). Unfunded pension liabilities are another form of debt (qua financial liability) that may be added to this list for some states. Balanced budget restrictions are easy to

[24] As of 2018, Vermont is the only state without a statutory balanced budget restriction.

[25] The court's reasoning was prescient and anticipated the unfortunate ramifications of sustaining the Special Fund Doctrine in future cases: "It believed that if a debt could be created 'in regard to one source of revenue, we see no reason why the same thing may not be done in regard to every other source of revenue of the state, including not only all revenue which may arise from property, but also all which may be realized by the exercise of the power of taxation' " (Ratchford, 1941, p. 447).

[26] Ratchford (1941, pp. 464-465) offers a deeply critical view of legal developments: "In the development and application of the special fund doctrine,…[t]he courts have taken a term from the field of finance and around it have developed an attenuated legal doctrine which bears little resemblance to the original meaning of the term."

circumvent. They have not been successful in constraining deficit financing and hence the possible need for government bailouts.[27]

A second approach to constraining state debt relies on an index of economic growth that lowers interest payments when the state economy weakens. These "growth indexed bonds" (GIB) effectively reduce the upper tail of the debt/GDP ratio, and hence assist states in financial distress. However, as noted by Blanchard, Mauro, and Acalin (2016), this benefit must be balanced against the cost with GIB's from increase in premia due to liquidity and novelty (at least initially) and growth risk. Simulations (Acalin, 2018) suggest that the reduction in the upper tail would be modest for representative parameter values and simple indexing formulas, thus explaining why GBI's have not been introduced widely. Moreover, GIB's would tempt governments to manipulate the indexes (e.g., GDP, unemployment) to lower debt costs.

A third approach uses ex-post legislative restrictions to preclude bailouts and hopefully constrain borrowing. As noted in Section 4.B, such legislation aimed at states and municipalities was proposed shortly after the Detroit bankruptcy, but was not adopted.

More recent events offer a similarly bleak prognosis. The Dodd-Frank legislation passed in the United States after the 2007-2008 Global Financial Crisis involved a number of stringent regulations. However, over time, they have been relaxed by actions of the Executive and Judicial branches. Korea adopted a no-bailout policy after the 1997 financial crisis. This policy was explicitly stated by the Korean government, resonated with the political position of the incoming president, and was confirmed in a Letter of Intent to the IMF (Gormley, Johnson, and Rhee, 2015, pp. 492-493). These authors conclude that the no-bailout policy was not enforced, as the largest Korean firms received an exceptional amount of aid during the Global Financial crisis. The history of government policy during the Euro Crisis paints an equally uninviting picture. The no-bailout clause in the Maastrict Treaty creating the European Monetary Union, coupled with explicit statements of support of this clause by German Chancellor Kohl, were insufficient to prevent massive bailouts during the Euro crisis by the European Union and the ECB (Sinn, 2014, pp. 19-22). In the end, a Gordian Knot may well describe the unresolved

[27] A more sanguine view of the efficacy of fiscal rules is supported by the empirical work of Poterba and Rueben (1999) and Fatás and Mihov (2006). Avoiding balanced budget restrictions may deter borrowings indirectly because the composition of debt is shifted from low-risk/low-cost debt backed by the full faith and credit of the government and its taxing capacity to higher-risk/higher-cost debt backed by an uncertain revenue stream (Heins, 1963, Chapter 4).

tension between restrictive policies that are beneficial and political influences that are pervasive (Rajan and Zingales, 2003; Morck, Wolfenzon, and Yeung, 2005). How to extinguish the Treasury Put on an ongoing basis in a democratic society remains an open question.

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Table 1 – Median Age Of the Population

Country	**2015**	**2040**	**Annualized Growth Rate (%)**
	(1)	(2)	(3)
Puerto Rico	**36.4**	**45.8**	**0.923**
Caribbean Region	30.3	37.7	0.878
United States	37.6	41.2	0.366
More Developed Countries	41.1	45.5	0.408
Less Developed Countries	27.8	33.1	0.700

Notes: Source: United Nations (2018).

Table 2 -- Risk Premia Across Issue Dates

Issue Date	Corporate Aaa	Puerto Rican	Corporate Baa	Non-Investment Grade ("Junk")
A. Baseline: Highest τ	(1)	(2)	(3)	(4)
1. March 15, 2000	1.35	1.69	2.05	5.47
2. October 25, 2001	1.68	2.17	2.56	8.27
3. April 4, 2002	0.90	1.25	2.21	6.04
4. August 8, 2002	1.15	1.66	2.39	8.16
5. May 18, 2004	0.59	1.20	1.30	3.02
6. October 7, 2004	0.59	1.76	1.35	2.48
7. October 16, 2007	0.86	1.40	1.69	3.51
8. May 7, 2008	0.99	2.76	2.31	5.43
9. September 17, 2009	0.96	1.93	2.17	6.22
10. February 17, 2011	0.81	1.25	1.70	2.53
11. March 17, 2011	0.89	1.31	1.80	3.03
12. July 12, 2011	1.00	1.80	1.82	3.48
13. April 3, 2012	1.05	1.50	2.31	4.28
Average	**0.99**	**1.67**	**1.97**	**4.76**
B. Corporate τ = MEAN[τ]				
Average	**0.99**	**1.69**	**1.97**	**4.76**
C. τ / 2				
Average	**0.99**	**1.50**	**1.97**	**4.76**
D. High-Quality Insurers Highest τ				
Average	**0.89**	**1.71**	**1.89**	**3.87**

Notes: Details concerning data sources and the estimation of the risk premia are discussed in Sections 2 and 3. For Corporate Aaa, Corporate Baa, and Non-Investment grade bonds (ICE BofAML U.S. High Yield Master II Index tracking below investment grade corporate debt) the risk premia are the yield on this asset class less the 20-year Treasury yield; these data were retrieved from FRED, Federal Reserve Bank of St. Louis, https://fred.stlouisfed.org/series/DAAA, https://fred.stlouisfed.org/series/DBAA, https://fred.stlouisfed.org/series/BAMLH0A0HYM2EY, and https://fred.stlouisfed.org/series/DGS20, respectively. The results presented in Panel A to C are based on different tax rates: in Panel A, the highest marginal tax rate for the marginal municipal bond investor -- household, as discussed in Section 3 and Appendix F; in Panel B, the corporate marginal income tax rate defined as the sum of the federal corporate rate (35.0%) and an average of state corporate rates (6.5%, Chirinko and Wilson, 2017, Figure 2, which happens to equal the unweighted average (2000 to 2016) of the tax rate used in Panel A; in Panel C, the baseline tax rate used in Panel A halved. The results in panel D exclude bond issues numbers 1 to 5 as listed in Table 2 (or, equivalently, bonds 1 to 12 listed in Appendix C); the insurers for these bonds had lower credit quality than the insurers for bond issues number 6 to 13.

Table 3 -- Risk Premia Before And After Detroit Bankruptcy Benchmark Results (Percent)

	Before Detroit	After Detroit	Differential (σ)
	(1)	(2)	(3)
Monthly	2.58 (0.28) {1.1.13 to 7.17.13}	5.56 (0.61) {7.18.13 to 12.31.13}	2.98 (0.68)
Monthly Trimmed	2.31 (0.21) {1.1.13 to 7.17.13}	5.09 (0.40) {7.18.13 to 12.31.13}	2.78 (0.46)
Daily Matched	2.56 (0.34) {1.1.13 to 7.17.13}	6.56 (0.66) {7.18.13 to 12.31.13}	4.00 (0.78)

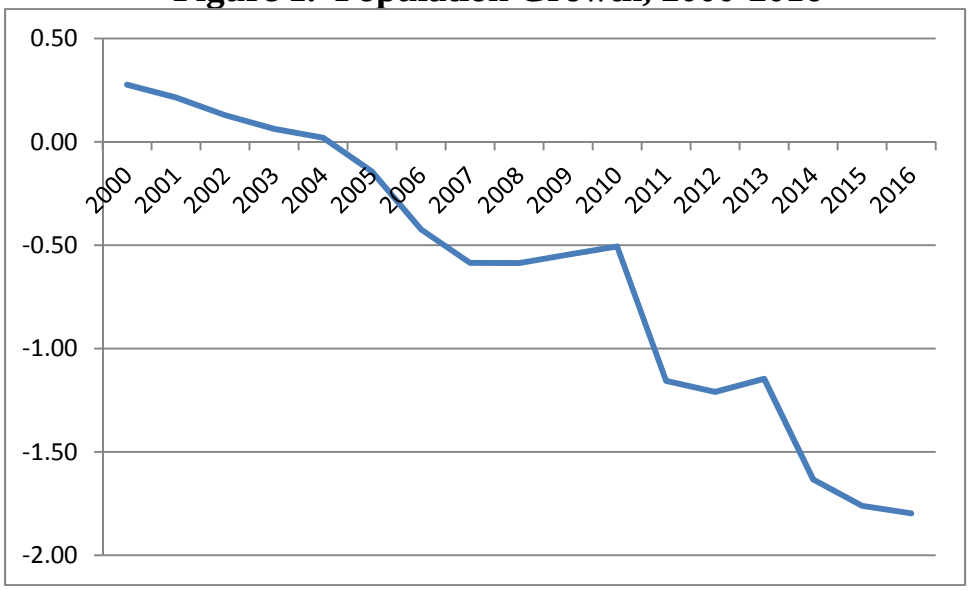
Notes: The first two figures in a cell represent the risk premium estimated Before Detroit, After Detroit, and the Differential between these two risk premia in columns 1, 2, and 3, respectively. The risk premia are stated as percents; for example, 2.98 is equivalent to 298 basis points. Column 3 is the Difference-in-Difference estimate of the Treasury Put. Figures in parentheses are standard errors. The dates defining the intervals are given in braces. Entries in the first row are for all σ's in the sample computed on a monthly basis. Entries in row 2 have been trimmed, with four outliers removed: the lowest (#15) and three highest σ's (#17, #18, #33). Computations for the entries in the first two rows proceed as follows. For a given bond, we compute the yields for those days in which a trade(s) occurred. For a given sub-interval (either a month or part of a month), we average yields for the traded uninsured and insured Puerto Rican bonds and, in those sub-intervals in which there are yields for both bonds, we compute the risk premium according to equation (7) (along with data for the Corporate Aaa yield, the 20-year Treasury yield, and the marginal tax rate, which are available for all trading days). (For programming reasons, we do not include the adjustment for maturities with Treasury data; this omission is of no quantitative importance since the maturity differences are small or non-existent.) These computations yield a matrix, 45 matched bonds by the number of sub-intervals. We then average across matched bonds in a sub-interval and then, based on the definition of an interval in braces, average across sub-intervals to generate the figures reported in the rows 1 and 2. Entries in the third row are σ's computed for matched bonds both traded on the same or an adjacent day.

Table 4 -- Risk Premia Before And After Detroit Bankruptcy Robustness Results (Percent)

	Before Detroit	After Detroit	Differential
	(1)	(2)	(3)
A. Delayed Response			
14 Days	2.58 (0.28) {1.1.13 to 7.17.13}	5.88 (0.61) {8.1.13 to 12.31.13}	3.30 (0.68)
45 Days	2.58 (0.28) {1.1.13 to 7.17.13}	6.44 (0.68) {9.1.13 to 12.31.13}	3.86 (0.75)
B. Anticipation Effects			
17 Days	2.56 (0.29) {1.1.13 to 6.30.13}	5.56 (0.61) {7.18.13 to 12.31.13}	3.00 (0.68)
47 Days	2.17 (0.17) {12.1.12 to 5.31.13}	5.56 (0.61) {7.18.13 to 12.31.13}	3.39 (0.64)
78 Days	2.12 (0.17) {11.1.12 to 4.30.13}	5.56 (0.61) {7.18.13 to 12.31.13}	3.44 (0.64)
108 Days	1.96 (0.15) {10.1.12 to 3.31.13}	5.56 (0.61) {7.18.13 to 12.31.13}	3.60 (0.62)

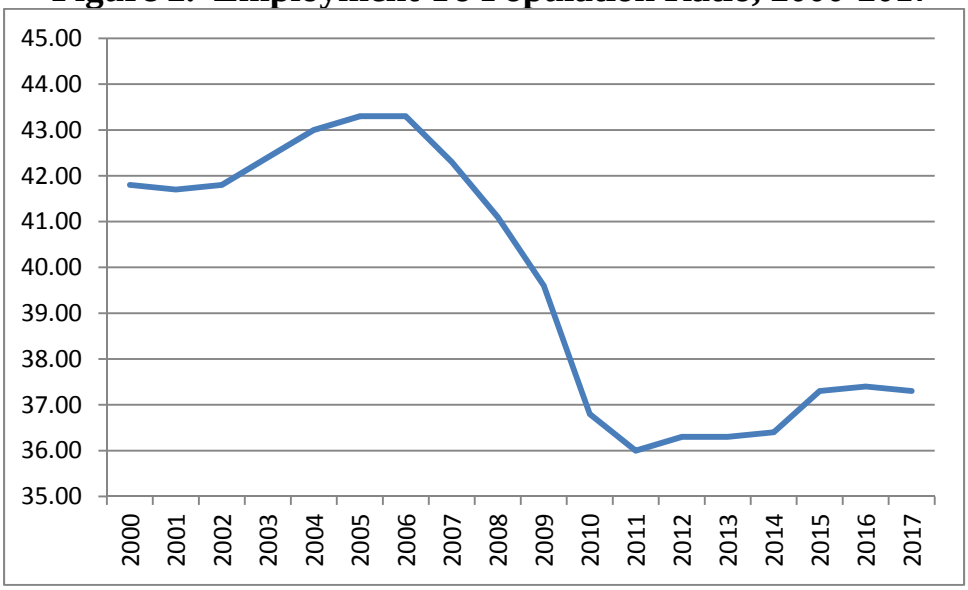
Notes: The first figure in a cell represent the risk premium estimated Before Detroit, After Detroit, and the Differential between these two risk premia in columns 1, 2, and 3, respectively. The risk premia are stated as percents; for example, 3.30 is equivalent to 330 basis points. Column 3 is the Difference-in-Difference estimate of the Treasury Put. Standard errors are in parentheses. Dates defining the intervals are in braces. The entries in Panel A allow for a delayed response to the extinguishing of the Treasury Put by defining the After Detroit interval 14 and 45 days after July 17, 2013. The entries in Panel B allow for anticipation effects for the extinguishing of the Treasury Put by defining the Before Detroit interval 17, 47, 78, and 108 days before July 18, 2013 and maintaining a six month window. See the notes to Table 3 for further details.

Figure 1. Population Growth, 2000-2016



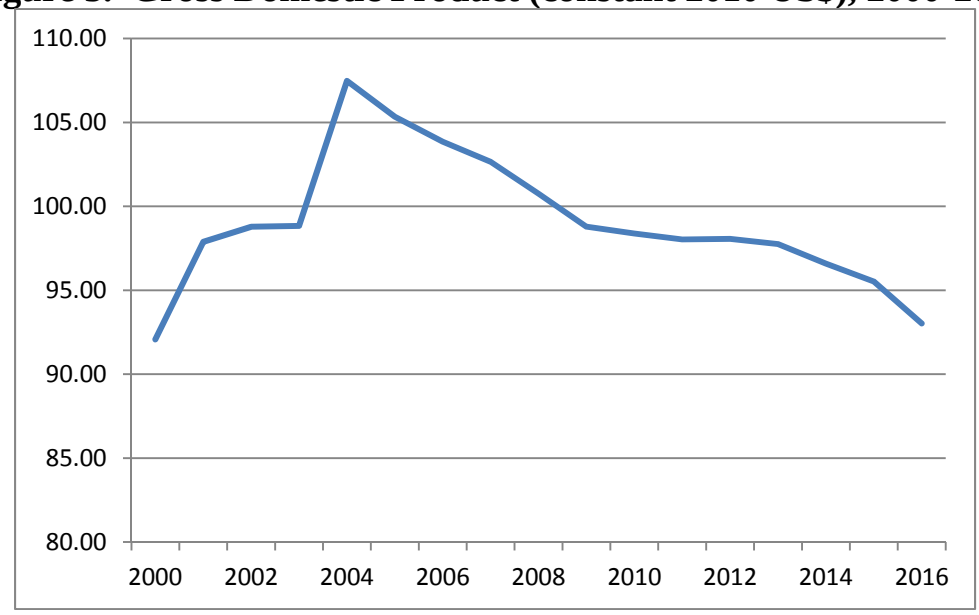
Notes: Annual population growth rate for year t is the exponential rate of growth of midyear population from year t-1 to t, expressed as a percentage. Population is based on the de facto definition of population, which counts all residents regardless of legal status or citizenship--except for refugees not permanently settled in the country of asylum, who are generally considered part of the population of the country of origin. Source: World Bank, Population Growth for Puerto Rico [SPPOPGROWPRI]; retrieved from FRED, Federal Reserve Bank of St. Louis, https://fred.stlouisfed.org/series/SPPOPGROWPRI.

Figure 2. Employment To Population Ratio, 2000-2017



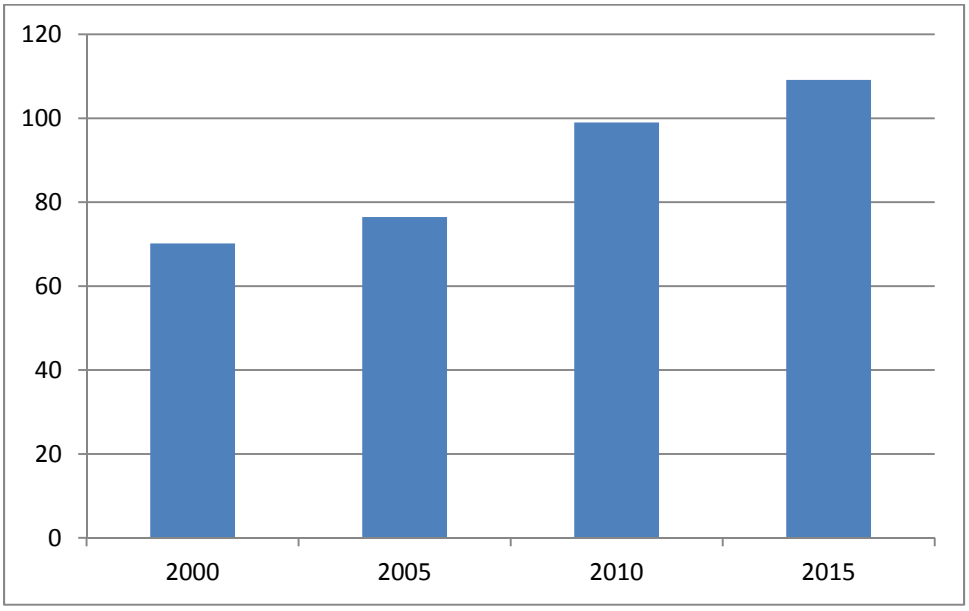
Notes: Employment to population ratio is the proportion of a country's working-age population that is employed. Ages 15 and older are generally considered the working-age population (modeled ILO estimate). Source: World Bank, Employment to Population Ratio for Puerto Rico [SLEMPTOTLSPZSPRI]; retrieved from FRED, Federal Reserve Bank of St. Louis, https://fred.stlouisfed.org/series/SLEMPTOTLSPZSPRI.

Figure 3. Gross Domestic Product (constant 2010 US$), 2000-2016



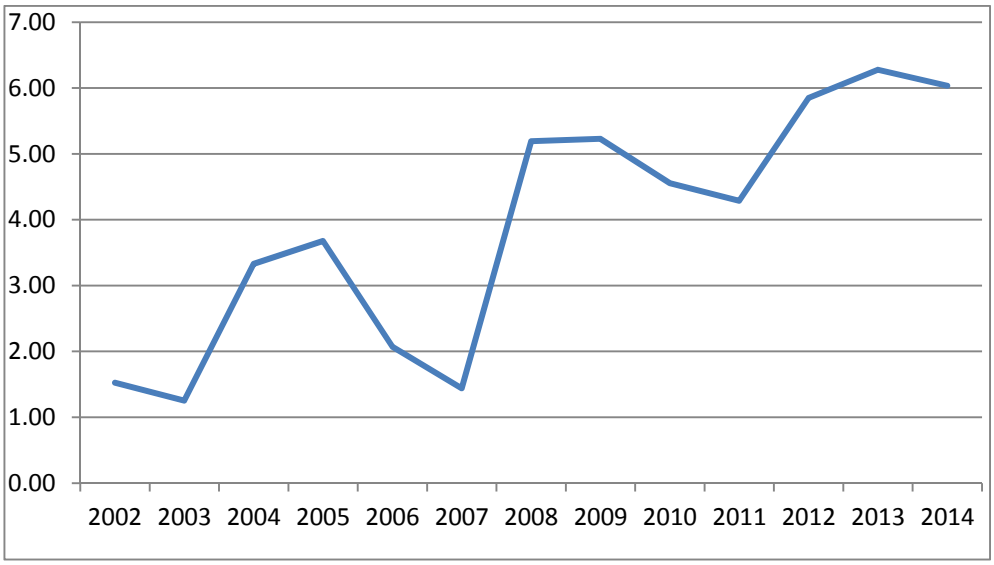
Notes: Source: World Bank, World Development Indicators; retrieved from https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.

Figure 4. Public Liabilities, As A Ratio To Nominal GDP, Various Years



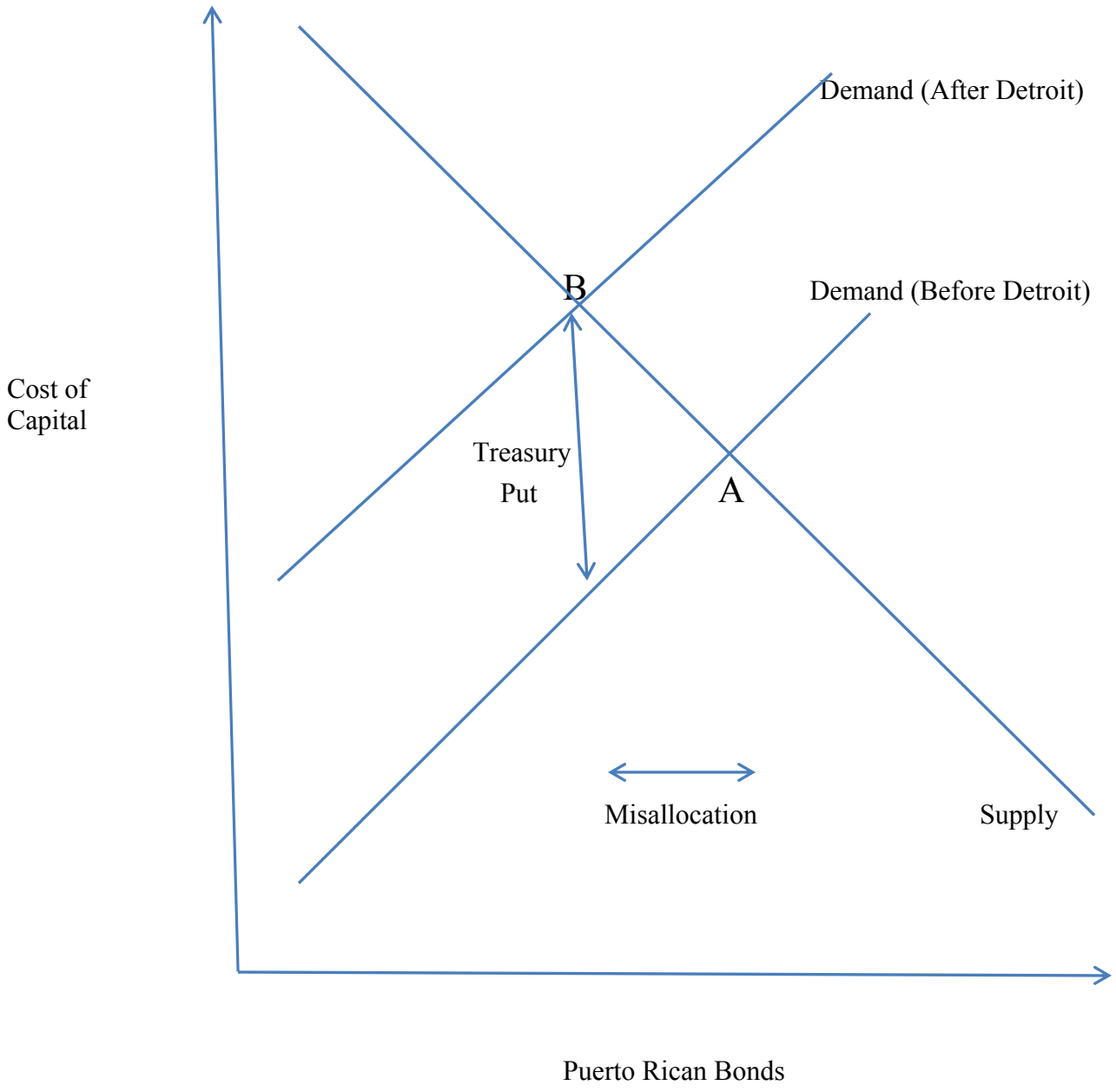
Notes: The numerator is the sum of debt and unfunded pension liabilities for the public sector; the denominator is nominal GDP. See Appendix A for details about the construction of the numbers in this Figure: 70.2, 76.5, 99.0, and 109.1 for 2000 to 2015, respectively. Some studies scale by GNP, which substantially increases the ratio. See Appendix A for a discussion of differences between using GDP and GNP as the scaling variable.

Figure 5. Government Deficits, As A Percentage Of GDP, 2002-2014



Notes: Sources: Deficit data (GAO, 2018, Figure 2, p. 9; data provided via a FOIA request to the GAO; these data are compiled from Puerto Rico's publicly available, audited financial statements. GDP data, World Bank [NYGDPMKTPCDPRI]; retrieved from FRED, Federal Reserve Bank of St. Louis, https://fred.stlouisfed.org/series/NYGDPMKTPCDPRI.

Figure 6. The Market For Puerto Rican Bonds And The Treasury Put



Appendix A. Computing The Debt/GDP And Unfunded Pension Liabilities/GDP Ratios

This appendix provides details for the date presented in Figure 4.

The fiscal situation of a sovereign state –a nation, a sub-national unit (e.g., a U.S. state or city), or a territory (e.g., the Commonwealth of Puerto Rico) -- is often evaluated by the ratio of outstanding liabilities to some measure of economic activity. The two most frequently used measures of economic activity are gross domestic product (GDP) and gross national product (GNP). (Unless otherwise stated, GDP and GNP are in nominal terms.) GDP measures the value of economic activity within the borders of a sovereign state regardless if it is undertaken by citizens (both persons and businesses) or foreigners. GNP equals GDP plus the economic activity of its citizens working abroad less the economic activity of foreigners working within its borders. (GNP is sometimes labeled gross national income.) For most countries, the two measures are quite close. But when there is a large foreign presence, GDP will exceed GNP. Such a situation holds, for example for Ireland, Luxembourg, and Puerto Rico. Since the measure of economic activity is meant to capture the ability of a sovereign state to repay its debts, GDP is the more appropriate concept because the activities it measures can be taxed.

A sovereign state's liabilities are the sum of outstanding debt plus unfunded pension liabilities. Data on the outstanding debt of Puerto Rico has been collected by Krueger, Teja, and Wolfe (2015) but it was stated relative to GNP. In Table A1, the debt/GDP data (column 3) are computed as the product of debt/GNP (column 1) multiplied by the GNP/GDP ratio (column 2) in Table A1,

Table A1 -- Computing The Debt/GDP And Total Liabilities/GDP Ratios

Year	Debt/GNP (%)	GNP/GDP	Debt/GDP (%)	Total Liabilities/GDP (%)	GDP (Nominal, billions $)
	(1)	(2)	(3)	(4)	(5)
2000	63.2	0.671	42.4	70.2	61.7
2005	71.2	0.649	46.2	76.5	83.9
2010	90.9	0.658	59.8	99.0	98.4
2015	100.2	0.658	65.9	109.1	103.1

Notes And Sources:
Column 1: Krueger, Teja, and Wolfe (2015, p. 9); unfunded pension obligations are excluded.

Column 2: University of Pennsylvania, Ratio of GNP to GDP for Puerto Rico [GNPGDPPRA156NUPN]; retrieved from FRED, Federal Reserve Bank of St. Louis, https://fred.stlouisfed.org/series/GNPGDPPRA156NUPN. No data are available for 2015; the 2015 value equals the 2010 value.

Column 3: Transformation: the product of columns 1 and 2.

Column 4: Transformation: column 3 multiplied by 1.654, per the discussion below in this appendix.

Column 5: GDP data, World Bank [NYGDPMKTPCDPRI]; retrieved from FRED, Federal Reserve Bank of St. Louis, https://fred.stlouisfed.org/series/NYGDPMKTPCDPRI.

The debt figures in columns 1, 2, and 3 of Table B1 exclude unfunded pension liabilities. We use two different data sources to estimate unfunded pension liabilities. *Barron's* (2012) contains data for 2012 on unfunded pension liabilities, as well as outstanding debt. However, their debt figure of $51.9 is approximately 17% lower than the implied debt figure in column 3, the latter interpolated linearly between the 2010 and 2015 data (62.3%). We believe that the Krueger, Teja, and Wolfe data are more accurate. To attenuate measurement error, we thus use the ratio of unfunded pension liabilities to debt in the Barron's data, 0.638 (= 33.1 / 51.9). The second data source is from *Pensions & Investments* (2017), which reports a ratio of unfunded pension liabilities to debt of 0.670 (= 50.0 / 74.0); we round down slightly since the article mentions that the estimate of unfunded pension liabilities is slightly below 50. We average these

two ratios (0.654) and assume that this estimate can be used to adjust the debt figures in the above appendix table. The results of these computations are presented in column 4.

These figures may represent a lower bound. Morningstar (2013) reports that debt and unfunded liabilities are $88.6 (p. 5) and $37.0 (p. 4), respectively, in 2013, resulting in a Total Liabilities / GDP ratio of 1.23. This ratio is 17% higher than the comparable ratio in Table A1 (based on a linear interpolation between 2010 and 2015.

Appendix B. Puerto Rican Government Deficits

This appendix provides details for the date presented in Figure 5. The figures in columns 1 to 5 are in billions of U.S. dollars. The figures in columns 6 to 9 are stated as percentages.

Year	**Deficit**					**Deficit As A Percentage Of GDP**			
	Budgetary (Cash) Basis	Budgetary (Cash) Basis	Accrual Basis	Operating Basis	GDP	Budgetary (Cash) Basis	Budgetary (Cash) Basis	Accrual Basis	Operating Basis
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
2002	1.09				71.62	1.52			
2003	0.94				74.83	1.25			
2004	2.68				80.32	3.33			
2005	3.09				83.91	3.68			
2006	1.81				87.28	2.07			
2007	1.29				89.52	1.44			
2008	4.86				93.64	5.19			
2009	5.04	2.86	3.52	2.68	96.39	5.23	2.97	3.65	2.78
2010	4.48	2.72	4.35	1.81	98.38	4.56	2.77	4.42	1.84
2011	4.30	1.80	3.79	1.09	100.35	4.29	1.79	3.77	1.09
2012	5.94	2.38	5.22	2.75	101.56	5.85	2.34	5.14	2.71
2013	6.43	1.31	3.61	2.55	102.45	6.28	1.28	3.52	2.49
2014	6.18				102.45	6.03			
		.							
Average, 2009 to 2013						5.24	2.23	4.10	2.18
Ratio To The Average in Column 7							1.00	1.84	0.98

Notes And Sources:

Column 1: GAO (2018, Figure 2, p. 9. Data provided via a FOIA request to the GAO. These data are based on a careful analysis of government financial statements by the GAO, and they are compiled from Puerto Rico's publicly available, audited financial statements.

Column 2: Commonwealth of Puerto Rico (2015, p. 64).

Column 3: Commonwealth of Puerto Rico (2015, p. 66, Total Government).

Column 4: Commonwealth of Puerto Rico (2015, p. 66, Total Government less Debt Service less COFINA Debt Service less principal payments (per fn. (1)).

Column 5: World Bank [NYGDPMKTPCDPRI]; retrieved from FRED, Federal Reserve Bank of St. Louis, https://fred.stlouisfed.org/series/NYGDPMKTPCDPRI.

Column 6: Transformation, column 1 divided by column 5, times 100.

Column 7: Transformation, column 2 divided by column 5, times 100.

Column 8: Transformation, column 3 divided by column 5, times 100.

Column 9: Transformation, column 4 divided by column 5, times 100.

Appendix C. Summary Information For 45 Matched Uninsured/Insured Bonds

Match #	Spread-sheet Line Number Also Search for "##"	CUSIP Uninsured Bond (Red)[1]	CUSIP Insured Bond (Blue)[1]	Calendar Date Of Uninsured and Insured Matched Bonds	Company Backing The Insured Bond[2]	Amount Of Issue Of Insured Bond (millions $, Blue)[1]	Call Year (R/B)[1]	MATURITY DATE (Red/ Blue)[1]	Quality Of The Matu-rity Match	Bias For σ From Matu-rity Match[5]	σ
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1	74	745145QC9	745145QB1	3-15-2000	MBIA	110.935	05/10	29/26	Not Exact	Up-ward	1.690
2	539	745145YN6	745145YR7	10-25-2001	MBIA	1.000	N[3]/N	16/16	Exact		2.131
3	540	745145YP1	745145YR7	10-25-2001	MBIA	1.000	N/N	16/16	Exact		2.131
4	546	745145YX4	745145YY2	10-25-2001	Ambac	6.770	N/N	19/19	Exact		2.182
5	546	745145YX4	745145ZA3	10-25-2001	Ambac	18.190	N/N	19/19	Exact		2.182
6	548	745145YZ9	745145YY2	10-25-2001	Ambac	6.770	N/N	19/19	Exact		2.183
7	548	745145YZ9	745145ZA3	10-25-2001	Ambac	18.190	N/N	19/19	Exact		2.183
8	665	745145VT6	745145VU3	4-4-2002	FGIC	21.190	N/N	05/05	Exact		1.245
9	784	745145R61	745145R53 745145R79	8-8-2002	FGIC	130.290/ 19.260	12/12	27/ 32&22	Not Exact	Up-ward	1.662
10	1305	7451458M7	7451458N5	5-18-2004	FSA	29.165	[4]	30/31	Not Exact	Down-ward	1.205

Match #	Spread-sheet Line Number Also Search for "##"	CUSIP Uninsured Bond (Red)[1]	CUSIP Insured Bond (Blue)[1]	Calendar Date Of Uninsured and Insured Matched Bonds	Company Backing The Insured Bond[2]	Amount Of Issue Of Insured Bond (millions $, Blue)[1]	Call Year (R/B)[1]	MATURITY DATE (Red/ Blue)[1]	Quality Of The Matu-rity Match	Bias For σ From Matu-rity Match[6]	σ
11	1305	7451458M7	7451458P0	5-18-2004	MBIA	40.000	[4/]	30/31	Not Exact	Down-ward	1.205
12	1305	7451458M7	7451458Q8	5-18-2004	FGIC	22.315	[4/]	30/31	Not Exact	Down-ward	1.202
13	1414	74514LCR6	74514LCS4	10-7-2004	FSA	8.560	12/ N	14/14	Exact		2.345
14	1420	74514LCX3	74514LCW5	10-7-2004	FSA	14.985	14/ 14	19/18	Not Exact	Up-ward	1.170
15	2261	74514LNB9	74514LNA1	10-16-2007	AGC	24.940	N/ N	17/17	Exact		1.388
16	2262	74514LNC7	74514LNA1	10-16-2007	AGC & MBIA	53.215& 24.940	N/ N	18/ 17&19	Not Exact	Up-ward	1.416
17	2416	74514LSN8	74514LTE7	5-7-2008	AGC	36.110	N/ N	14/14	Exact		2.615
18	2416	74514LSN8	74514LTF4	5-7-2008	AGC	27.360	N/ N	14/14	Exact		2.615
19	2417	74514LSP3	74514LTG2	5-7-2008	AGC	50.220	N/ N	15/15	Exact		2.779
20	2417	74514LSP3	74514LTH0	5-7-2008	AGC	15.995	N/ N	15/15	Exact		2.779
21	2426	74514LSQ1	74514LTJ6	5-7-2008	AGC	53.955	N/ N	16/16	Exact		2.878
22	2426	74514LSQ1	74514LTL1	5-7-2008	AGC	16.605	N/ N	16/16	Exact		2.878

Match #	Spread-sheet Line Number Also Search for "##"	CUSIP Uninsured Bond (Red)[1]	CUSIP Insured Bond (Blue)[1]	Calendar Date Of Uninsured and Insured Matched Bonds	Company Backing The Insured Bond[2]	Amount Of Issue Of Insured Bond (millions $, Blue)[1]	Call Year (R/B)[1]	MATURITY DATE (Red/ Blue)[1]	Quality Of The Matu-rity Match	Bias For σ From Matu-rity Match[6]	σ
23	2793	74514LVV6	74514LVT1	9-17-2009	FSA	42.790	14/20	31/30	Not Exact	Up-ward	1.960
24	2793	74514LVV6	74514LVU8	9-17-2009	FSA	51.045	14/20	31/31	Exact		1.896
25	3154	74514LWK9	74514LWP8	2-17-2011	FSA/AGM	35.420	21/21	28/27	Not Exact	Up-ward	1.297
26	3156	74514LWM5	74514LWL7	2-17-2011	FSA/AGM	42.025	16/16	33/33	Exact		1.229
27	3157	74514LWQ6	74514LWT0	2-17-2011	FSA/AGM	15.000	21/21	34/34	Exact		1.220
28	3183	74514LXA0	74514LXF9	3-17-2011	FSA/AGM	20.000	16/16	32/32	Exact		1.300
29	3184	74514LXB8	74514LXF9	3-17-2011	FSA/AGM	20.000	16/16	32/32	Exact		1.298
30	3185	74514LWZ6	74514LXC6	3-17-2011	FSA/AGM	40.000	16/16	35/36	Not Exact	Down-ward	1.246
31	3187	74514LXH5	74514LXC6	3-17-2011	FSA/AGM	40.000	35/16	36/36	Exact		1.301
32	3189	74514LWX1	74514LXG7	3-17-2011	FSA/AGM	105.000	N/16	40/37	Not Exact	Up-ward	1.396
33	3276	74514LZF7	74514LZD2	7-12-2011	FSA/AGM	5.900	16/16	19/19	Exact		1.631
34	3277	74514LZH3	74514LZD2	7-12-2011	FSA/AGM	5.900	16/16	19/19	Exact		2.033

Match #	Spread-sheet Line Number Also Search for "##"	CUSIP Uninsured Bond (Red)[1]	CUSIP Insured Bond (Blue)[1]	Calendar Date Of Uninsured and Insured Matched Bonds	Company Backing The Insured Bond[2]	Amount Of Issue Of Insured Bond (millions $, Blue)[1]	Call Year (R/B)[1]	MATURITY DATE (Red/ Blue)[1]	Quality Of The Matu-rity Match	Bias For σ From Matu-rity Match[6]	σ
35	3279	74514LZG5	74514LZE0	7-12-2011	FSA/ AGM	4.500	16/ 16	20/20	Exact		1.615
36	3280	74514LZJ9	74514LZE0	7-12-2011	FSA/ AGM	4.500	16/ 16	20/20	Exact		1.936
37	3482	74514LA56	74514LD46	4-3-2012	FSA/ AGM	20.000	N/ N	22/22	Exact		1.460
38	3484	74514LC70	74514LD53	4-3-2012	FSA/ AGM	5.000	22/ 22	23/23	Exact		1.541
39	3486	74514LC88	74514LD61	4-3-2012	FSA/ AGM	5.000	22/ 22	24/24	Exact		1.460
40	3487	74514LA72	74514LD61	4-3-2012	FSA/ AGM	5.000	22/ 22	24/24	Exact		1.591
41	3489	74514LA80	74514LD79	4-3-2012	FSA/ AGM	5.000	22/ 22	25/25	Exact		1.427
42	3493	74514LB22	74514LD87	4-3-2012	FSA/ AGM	11.520	22/ 22	27/27	Exact		1.771
43	3499 & 3500	74514LC39 74514LB63	74514LD20	4-3-2012	FSA/ AGM	322.925	22/ 22	33&37/ 35	Not Exact	Down-ward	1.305
44	3503	74514LC62	74514LD46	4-3-2012	FSA/ AGM	20.000	22/ 22	22/22	Exact		1.460
45	3504	74514LC70	74514LD53	4-3-2012	FSA/ AGM	5.000	22/ 22	23/23	Exact		1.460

Notes:

The Official Statements (OS) are available from the first author upon request.

[1] "Red" and "Blue" identify uninsured and insured bonds, respectively.

[2] Insurance companies: Ambac, AGC, FGIC, FSA, MBIA. FSA was acquired by AGC in July 2009 and renamed Assured Guaranty Municipal Corporation (AGM). AGC and FSA/AGM were rated Aaa during most of the sample period and no lower than A3 (as of January 2013); see Section 2.B for further discussion of their credit ratings.

[3] "N" indicates not callable.

[4] Both the uninsured and insured bonds are callable at the discretion of and on any Mandatory Tender Date set by the Secretary of the Treasury of the Commonwealth of Puerto Rico.

[5] Bias is based on the assumption that the term structure is upward sloping. Thus, a longer maturity bond, ceteris paribus, will have a higher yield. For example, in row 1, the slightly greater maturity for the uninsured bond results in a higher yield than would have occurred if the uninsured bond had the exact same maturity as its matched insured bond. This positive differential leads to an upward bias in our estimate of the risk premium, σ.

Appendix D. Moody's Rating Scale – Long-Term Debt

Rating	Description
Investment Grade	
Aaa	Obligations rated Aaa are judged to be of the highest quality, with minimal risk.
Aa1	Obligations rated Aa are judged to be of high quality and are subject to very low credit risk.
Aa2	
Aa3	
A1	Obligations rated A are considered upper-medium-grade and are subject to low credit risk.
A2	
A3	
Baa1	Obligations rated Baa are subject to moderate credit risk. They are considered medium-grade and as such may possess speculative characteristics.
Baa2	
Baa3	
Non-Investment Grade	
Ba1	Obligations rated Ba are judged to have speculative elements and are subject to substantial credit risk.
Ba2	
Ba3	
B1	Obligations rated B are considered speculative and are subject to high credit risk.
B2	
B3	
Caa1	Obligations rated Caa are judged to be of poor standing and are subject to very high credit risk.
Caa2	
Caa3	
Ca	Obligations rated Ca are highly speculative and are likely in, or very near, default, with some prospect of recovery in principal and interest.
C	Obligations rated C are the lowest-rated class of bonds and are typically in default, with little prospect for recovery of principal and interest.

Notes: Long-term debt has an original maturity of one year or greater. Source: Moody's (n.d.) Rating Scale and Definitions; https://www.moodys.com/sites/products/ProductAttachments/AP075378_1_1408_KI.pdf

Appendix E. Comments On Data Collection For Puerto Rican Bonds And Interest Rates

Puerto Rican Bonds

The following detailed comments concern various assumptions and procedures used in collecting the Puerto Rican bond data.

1. The Official Statements (OS) are available from the first author upon request.

2. If a bond has a very short maturity (usually less than one year) and is not insured, it is not included in our list of uninsured bonds for subsequent analysis.

3. Absence of an OS for a particular issue is important. We look for some documentation in an OS about that particular bond. If no information is found, even if data are available on EMMA, this bond in not included in our list (e.g. CUSIP 745145Y55).

4. However, if two or more bonds without an OS are the sum of a bond with an OS, we include these bonds. In some cases, the same bond has two or more CUSIP's. For example,

   - 74514LPY7 and 74514LQA8 refer to the same bond, which is also listed as 74514LKB2;

   - 74514LPZ4 and 74514LQB6 refer to the same bond, which is also listed as 74514LKC0.

   We include all bonds because the two or more CUSIP's refer to non-overlapping trading patterns. By including both bonds, we capture all trading activity.

5. For the five items below denoted by Pqr in the penultimate column, we include the issue amount for the comparable security listed above that entry. It appears that the Pqr bond and its preceding information refer to the same security with disjoint trading histories.

2007-10-04	74514LLX3	7/1/2020	5.00	13.700	105
2007-10-04	74514LMP9	7/1/2020	5.00	Pqr	105
2007-10-04	74514LLY1	7/1/2021	5.00	14.400	104.762
2007-10-04	74514LMQ7	7/1/2021	5.00	Pqr	104.762
2007-10-04	74514LLZ8	7/1/2022	5.00	15.100	104.459
2007-10-04	74514LMR5	7/1/2022	5.00	Pqr	104.459
2007-10-04	74514LMA2	7/1/2023	5.00	15.850	104.21
2007-10-04	74514LNH6	7/1/2023	5.00	Pqr	104.21
2007-10-04	74514LMB0	7/1/2024	5.00	16.650	103.561
2007-10-04	74514LMG9	7/1/2025	5.00	17.500	103.21
2007-10-04	74514LMD6	7/1/2026	5.00	18.350	103.324
2007-10-04	74514LNJ2	7/1/2026	5.00	Pqr	103.324

6. For 10.16.07, the data for 74514LNA1 and74514LNB9 are not consistent in EMMA when compared to the OS. We assume the data in the OS is the correct data. In effect, the data for 74514LNA1 and74514LNB9 need to be swapped with each other to be consistent with the information in the OS.

7. If EMMA indicates a lower amount at issuance relative to the OS, we use the data for EMMA.

8. If a bond is listed in the OS but does not appear in EMMA, then
   a) if we have a CUSIP from the OS, we include the bond or
   b) if we do not have a CUSIP from the OS, we exclude the bond.

9. For the bonds placed on May 18, 2004, the yield figures (0.0383 for all three bonds) reported in the OS have been converted to the equivalent bond prices to ensure reporting uniformity with respect to the other bonds in the table. The bond prices have been computed with a precision of two.

Interest Rates

10. Three Aaa and Baa datapoints were interpolated: 12.31.65, 12.31.71, 11.11.16.

11. Two Municipal 20 datapoints were interpolated: 1.1.71, 9.14.01.

12. Three Treasury datapoints were estimated. Yields for 30-year Treasuries are missing from 2.19.02 to 2.8.06. However, yields for 20-year Treasuries are available for this period. We compute the difference between the 30-year and 20-year Treasuries for the two years before and after this interval; the average difference is -0.1517. This figure is added to the 20-year Treasury yield for three dated dates falling in the interval: 10.16.03, 11.25.03, 10.07.04. Only the latter dated date has a matched bond that enters the analysis in Tables 2 and 3.

13. A fourth Treasury datapoint, 11.11.10, was linearly interpolated.

Appendix F. Computing The Marginal Income Tax Rate For The Marginal Municipal Bond Investor -- Household

Table F1 lists the tax rates and other variables needed to compute the marginal income tax rate for the marginal municipal bond investor assumed to be a household. Investors in Puerto Rican bonds are not assessed these taxes. The data are provided in Table F2.

Table F1 -- Taxation Of Income From Treasury And Puerto Rican Bonds Regular And Alternative Minimum Tax (AMT) Regimes Data Sources

	Tax Regime:	**Regular**			**AMT**	
	Issuer:	**U.S. Treasury**	**Puerto Rico**		**U.S. Treasury**	**Puerto Rico**
	Tax Rates	(1)	(2)		(3)	(4)
1	Federal tax rate $[\tau^{F}]$	Yes	No		No	No
2	State tax rate $[\tau^{S}]$	Yes	No		Yes	No
3	Net federal and state tax rate $[\tau^{FS} \equiv \tau^{F} + \tau^{S} - \tau^{F} * \tau^{S}]$	Yes	No		No	No
4	3.8% (net investment income tax (NII, "Medicare Tax")) $[\tau^{NII} \equiv 0.038]$	Yes	No		Yes	No
5	2.0% (phase-out of personal exemptions (PPE)) $[\tau^{PPE} \equiv (0.02/2{,}500) * \tau^{FS}]$	Yes	No		No	No
6	3.0% (phase-out of itemized deductions (PID, Pease Limitation)) $[\tau^{PID} \equiv 0.03 * \tau^{FS}]$	Yes	No		No	No
7	Regular marginal tax rate on interest income $[\tau^{REG} \equiv \tau^{FS} + \tau^{NII} + \tau^{PPE} + \tau^{PID}]$	Yes	No		No	No

8	AMT federal tax rate $[\tau^{A}]$	No	No		Yes	No
9	25.0%*AMT tax rate (phase-out of AMT exemption) $[0.25*\tau^{A}]$	No	No		Yes	No
10	AMT marginal tax rate on interest income $[\tau^{AMT} \equiv \tau^{A}*1.25+\tau^{S}+\tau^{NII}]$	No	No		Yes	No
11	Number of total returns filed with AGI $\geq$ \$200,000 $[N^{TOTAL}]$	-------	-------		-------	-------
12	Number of AMT returns filed with AGI $\geq$ \$200,000 $[N^{AMT}]$	-------	-------		-------	-------
13	Percent of returns filed under regular tax status $[\omega^{REG} = (N^{TOTAL} - N^{AMT}) / N^{TOTAL}]$	-------	-------		-------	-------
14	Marginal tax rate on interest income $[\tau \equiv \omega^{REG}*\tau^{REG} + (1-\omega^{REG})*\tau^{AMT}]$	-------	-------		-------	-------

Notes And Sources (presented by row number)
Several of the sources below are to the website of the Internal Revenue Service (IRS, https://www.irs.gov).

1. Source: IRS (*Statistics of Income* (SOI), Table 23).

2. Source: Daniel Wilson (Federal Reserve Bank of San Francisco). Weighted-average of the individual state tax rates, where the individual state data are from the NBER TAXSIM model for the period 1999 to 2011 and the weights are state personal income. For the period 2012 to 2016, values for the weighted-average are assumed equal to the 2011 value. State tax data from the SOI Public Use Files suggests that there is little variation in the average state tax rates for the period 2011 to 2016 (http://users.nber.org/~taxsim/marginal-tax-rates/as.html). See Moretti and Wilson (2017) for more details about the source data.

3. Transformation: State taxes are assumed deductible against federal taxes.

4. Source: IRS. This tax began in 2013.

5. Source: IRS. Phase-outs are in effect from 1999 to 2000, eliminated from 2001 to 2012 under the 2001 Bush tax cuts (the *Economic Growth and Tax Relief Reconciliation Act of 2001*), and reinstated from 2013 to the present. In 2015, phase-out increments are determined discretely in terms of $2,500 "steps." The computation linearizes the step function. The same pattern is assumed for all years in which phase-outs were in effect.

6. Source: IRS. Phase-outs are in effect as follows: 1999-2005, 3%; 2006-2007, 2%, 2008-2009, 1%; 2010-2012, 0%; 2013-present, 3% (*American Taxpayer Relief Act*, 2012). For 2015, the computation is based on the assumption that adjusted gross income (AGI) is too high to permit the deduction of medical/dental and casualty/theft expenses, that there are no gambling losses, and that investment funds are not borrowed.

7. Transformation.

8. Source: IRS. This figure is for the highest marginal income tax rate under AMT.

9. Source: IRS.

10. Transformation.

11. Source: IRS. For 2004 to 2014, data obtained from *SOI Tax Stats – Historic Table 2* (https://www.irs.gov/uac/soi-tax-stats-historic-table-2). For 1999 to 2003, only data for total returns are available from *SOI Tax Stats – Individual Income Tax Returns Publication 1304 (Complete Report)* (https://www.irs.gov/uac/soi-tax-stats-individual-income-tax-returns-publication-1304-complete-report#_tbla). For the 1999 to 2003 period, the ratio ω^{REG} in row 13 is estimated directly as the total returns ratio (REG / (REG + AMT) in year t divided by the total returns ratio in 2004, all multiplied by the high income ratio (REG / (REG + AMT) for AGI $\geq$ $200,000) for 2004. A comparison of the total returns data from the two different data sources for 2004 and 2005 indicates a very close match. The data for these computations are contained in the EXCEL file "Computing the REG Weight."

12. Same as 11.

13. Transformation.

14. Transformation.

Table F2 -- Taxation Of Income From Treasury And Puerto Rican Bonds
Regular And Alternative Minimum Tax (AMT) Regimes
Data Series

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
1999	0.3960	0.0519	0.4274	0.0000	0.0000	0.0128	0.4402	0.2800	0.0700	0.4019	-------	-------	0.6481	**0.4267**
2000	0.3960	0.0519	0.4274	0.0000	0.0000	0.0128	0.4402	0.2800	0.0700	0.4019	-------	-------	0.6468	**0.4267**
2001	0.3910	0.0519	0.4226	0.0000	0.0000	0.0127	0.4353	0.2800	0.0700	0.4019	-------	-------	0.6477	**0.4235**
2002	0.3860	0.0518	0.4178	0.0000	0.0000	0.0125	0.4303	0.2800	0.0700	0.4018	-------	-------	0.6439	**0.4201**
2003	0.3500	0.0518	0.3836	0.0000	0.0000	0.0115	0.3952	0.2800	0.0700	0.4018	-------	-------	0.6417	**0.3975**
2004	0.3500	0.0517	0.3836	0.0000	0.0000	0.0115	0.3951	0.2800	0.0700	0.4017	3.062	1.735	0.6382	**0.3975**
2005	0.3500	0.0514	0.3834	0.0000	0.0000	0.0115	0.3949	0.2800	0.0700	0.4014	3.589	2.202	0.6198	**0.3973**
2006	0.3500	0.0502	0.3826	0.0000	0.0000	0.0077	0.3903	0.2800	0.0700	0.4002	4.076	2.632	0.6076	**0.3942**
2007	0.3500	0.0499	0.3825	0.0000	0.0000	0.0076	0.3901	0.2800	0.0700	0.3999	4.572	2.923	0.6101	**0.3939**
2008	0.3500	0.0496	0.3823	0.0000	0.0000	0.0038	0.3861	0.2800	0.0700	0.3996	4.371	2.847	0.6056	**0.3914**
2009	0.3500	0.0500	0.3825	0.0000	0.0000	0.0038	0.3863	0.2800	0.0700	0.4000	3.930	2.725	0.5905	**0.3919**
2010	0.3500	0.0499	0.3824	0.0000	0.0000	0.0000	0.3824	0.2800	0.0700	0.3999	4.299	3.031	0.5865	**0.3896**
2011	0.3500	0.0502	0.3827	0.0000	0.0000	0.0000	0.3827	0.2800	0.0700	0.4002	4.710	3.285	0.5891	**0.3899**
2012	0.3500	0.0502	0.3827	0.0000	0.0000	0.0000	0.3827	0.2800	0.0700	0.4002	5.274	3.454	0.6043	**0.3896**
2013	0.3960	0.0502	0.4263	0.0380	0.0000	0.0128	0.4771	0.2800	0.0700	0.4382	5.597	3.214	0.6352	**0.4629**
2014	0.3960	0.0502	0.4263	0.0380	0.0000	0.0128	0.4771	0.2800	0.0700	0.4382	6.235	3.487	0.6413	**0.4632**
2015	0.3960	0.0502	0.4263	0.0380	0.0000	0.0128	0.4771	0.2800	0.0700	0.4382	-------	-------	0.6413	**0.4632**
2016	0.3960	0.0502	0.4263	0.0380	0.0000	0.0128	0.4771	0.2800	0.0700	0.4382	-------	-------	0.6413	**0.4632**
Avg. 2000 2016	0.3681	0.0507	0.4001	0.0089	0.0000	0.0086	0.4177	0.2800	0.0700	0.4096	-------	-------	0.6230	0.4150

Notes and Sources:
See Notes and Sources to Table F1.