What Went Wrong?:
The Puerto Rican Debt Crisis and the "Treasury Put"

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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? Given gloomy macroeconomic fundamentals and relatively low risk premia, investors were either stunningly myopic or Puerto Rican debt was implicitly insured by the U.S. Treasury. The rational investor model rules out the former hypothesis.

This project 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, especially the prior bailout of the city of New York. Evaluating the Treasury Put hypothesis with a minimal set of assumptions is possible given two fortuitous features – a unique characteristic of Puerto Rican bonds and a "seismic shock." 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 features allow us to compute accurately the risk premia on Puerto Rican bonds. The second feature was the non-bailout of the city of Detroit in 2013 that effectively extinguished the Treasury Put. Preliminary calculations indicate that Puerto Rican risk premia were stable before the Detroit bankruptcy and bracketed by the risk premia on Corporate Aaa and Baa bonds, but widened dramatically thereafter, thus supporting the existence of a Treasury Put and a substantial misallocation of capital to Puerto Rico.

Keywords: Puerto Rican Debt Crisis; Government Guarantees, Capital Misallocation, Bond Interest Rates

JEL Codes: H81 (Loan Guarantees), H74 (State and Local Borrowing), G18 (Government Policy), G01 (Financial Crises), G12 Asset Pricing (Bond Interest Rates)

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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] economic and financial 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? 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).[1] Not surprisingly given these developments, real GDP began to contract severely (Figure 3). Between 2005 and 2013 (the last year of available data), real GDP declined by 15%. In 2006, a very favorable tax credit for U.S. corporations operating in Puerto Rico was finally eliminated.[2] In its July 2012 report on the Puerto Rican economy, the Federal

[1] Interestingly, this pattern for Puerto Rico follows very closely the pattern for the United States, suggesting some common cause perhaps linked to demographics. In any event, the sharp drop in this employment ratio impaired the ability of Puerto Rico to meet its debt obligations.

[2] 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

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." Per the above quotation, the outcome was "inevitable." On January 4, 2016, Puerto Rico began to default on some of its bond commitments; bankruptcy was effectively declared on June 30, 2016.[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 GDP has grown dramatically over the past 15 years. 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 7.0% is 70% larger than 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, including not being on an accrual basis and omitting capital expenditures and the deficit-creating activities of several government agencies. When some of these concerns are addressed, the 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, we remove the expenditures associated with debt service. This downward adjustment nearly cancels the upward adjustments to the deficit on a budgetary basis. Thus, at least for the latter years, the Figure 4 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

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completely eliminated. The extent to which this elimination contributed to the slowdown 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 domestic price level was approximately constant between 1995 and 2005.

[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).

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, the median age in 2015 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, Puerto Rico will have an older population than the Caribbean region, the United States, and the average ages for the more developed and less developed sets of countries. With falling 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 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, the Puerto Rican risk premium was greater than that on Corporate Aaa bonds by 41 basis points and less than that on Corporate Baa bonds by 85 basis points. A Baa bond is quite creditworthy; “Obligations rated Baa are subject to moderate credit risk; they are considered medium-grade and as such may possess speculative characteristics” (see Appendix C for further information on Moody’s ratings). Puerto Rican risk premia were much lower than those for non-investment grade (“junk”) bonds, though this comparison should be done with caution due to the substantial liquidity premium for junk bonds. The offering 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, the risk premia for Puerto Rican bonds is surprisingly low in the face of overwhelming 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 or Puerto Rican debt was implicitly insured by the U.S. Treasury. Whiles some myopia and misjudgments are surely possible, the 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 important features allow us to identify and measure the implicit guarantee from the U.S. Treasury as perceived by investors:

1. The dire fiscal and economic situations of Puerto Rico,
2. The simultaneous issuance of insured and uninsured bonds that allows us to estimate 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.

With the estimated increase in borrowing costs following the elimination of the Treasury Put, we can measure the extent of resource misallocation associated with the implicit government guarantee.

Our quantitative evaluation of the Treasury Put hypothesis proceeds as follows. Section 1 documents the Treasury Put. Starting with the 1975 bailout of New York City, a long list of government assistance of distressed borrowers led investors to the expectation of a bailout in the event of a Puerto Rican default.

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 features 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 risk premia: 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. Misallocation costs due to the Treasury Put are also computed and compared to recent estimates.

Section 5 summarizes our results and relates them to ongoing discussions about the role of government guarantees in financial markets.

1. The "Treasury Put"

The "Treasury Put" is the implicit guarantee by the federal government to provide support in the event of financial distress by the issuer of Puerto Rican bonds as perceived by investors.[4] In the event of a default by Puerto Rico, investors would, in effect, "place" their debt with the federal government that would return the securities at near face value to investors through some form of bailout to Puerto Rico. 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, the New York City was on the verge of bankruptcy.[5] Initially, the federal government explicitly refused to offer any financial assistance. Republican president Gerald Ford stated 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 headline in the *New York Daily News* (October 30, 1975): "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. What is particularly noteworthy about that bailout is that New York City was led by a liberal Democratic mayor, while the administration of President Ford was Republican and fiscally conservative.

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

1. Lockheed, 1971: federal guarantee of $0.25 billion of Lockheed debt (*New York Times*, 1979). [Figures in brackets are the nominal figure adjusted to 2013 dollars by the inflation in the GDP price deflator or the growth rate in nominal GDP, respectively.; to be added later]

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

[4] As a technical matter, contractual obligations for bond payments reside with the "obliger," who is frequently but not always the issuer.

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

3. Savings and Loan Crisis, 1986 to 1995: resolution costs to taxpayers of $124 billion (Curry and Shibut, 2000, Table 4).

4. Brady Bonds, 1989 to the present: federal guarantee that facilitated the swapping of impaired U.S. bank loans to Latin American firms and countries for tradable bonds guaranteed by the U.S. Treasury (Investopedia, 2018). No dollar figure is available.

5. 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, BIS, Canada, and several Latin American countries (Lustig, 1995, p. 20).

6. Troubled Asset Relief Program (TARP), 2007-2008: authorization for the U.S. Treasury to spend $700 billion to support institutions and individuals affected by the Financial Crisis, though only $466 billion was dispersed: $245 billion to banks, $80 billion to General Motors and, again, Chrysler, $68 billion to AIG, $46 billion to foreclosure prevention programs, and $27 billion to programs to increase credit availability (Investopedia, 2018).

Mervyn King, former head of the Bank of England, has 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" (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 outstanding Puerto Rican debt obligations.

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 (<u>emphasis added</u>),

> But there is another message I want to tell you. Within our mandate, the ECB is ready to do <u>whatever it takes</u> 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, British financial interests aggressively lobbied for intervention by the U.S. federal government (Jencks, 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 but 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, thus "extinguish[ing] mercantile debts to foreign creditors running into millions of pounds" (Jencks, 1938, p. 106; Federal Judicial Center, n.d.). In effect, the federal government bailed-out the states indirectly by "changing the rules of the game." That bailout was temporary, and the 1841 Act was repealed two years later. This pattern of legislation with parallels to a "tax holiday" allowed the federal government to balance the interests of insolvent states -- those in a precarious financial situation who needed to be relieved of part or all of their debts – and illiquid states -- those in temporary difficulty but with the financial wherewithal and need to return to the international capital markets in the near term.[6] Burdensome state debts were thus either discharged or

[6] In his Nobel Prize lecture and in the popular press, Sargent (2012a, Section VI and 2012b, respectively) interprets the events of the 1840's as suggesting that the federal government had stood firm against bailing-out the states. However, his account does not recognize the Bankruptcy Act of 1841 as an effective bailout mechanism forcing creditors to absorb losses from delinquent state debt. He further interprets the adoption by many states of balance-budget amendments to their constitutions during this

reorganized at no direct cost to taxpayers, and creditor rights enhanced by the repeal in 1843 of the Bankruptcy Act. Somewhat over half the 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.[7]

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 be reflected in low risk premium. Puerto Rican bond investors held a Treasury Put.

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period as strengthening fiscal discipline. Such an interpretation underestimates the creativity of accountants and the cunning of politicians and is inconsistent with the huge borrowings that have been undertaken regularly by "balanced budget" states.

[7] 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).

2. Estimating The Risk Premium

This section presents the model for estimating 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 minor importance). 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).[8] 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,

[8] Longstaff (2011) document that the liquidity premium is quantitatively important in the municipal market, and can be as large as xx basis points for short-term municipals.

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

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 (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,

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

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

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

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 ($r^{T,20}$),

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

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,

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

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. Importantly, any bias that exists will result in a upward bias in τ because our procedure is based on the highest possible marginal income tax rate, and using a lower tax rate lowers σ. 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, though this issue remains unsettled (Longstaff, 2011, fn. 1). If the "true" tax rate is less than the one 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 be due to 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 pre-refunding (so called defeased bonds). Our results will not be 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. μ^m and μ^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), $(\ell^{uni} - \ell^{ins})$. 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 relative to macroeconomic fundamentals.

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 largely due to an expansion of their insurance activities into derivative securities. If the solvency of companies insuring bonds is seriously questioned, then equation (6) underestimates the true insurers' risk premium and, per equation (7), this underestimate will lead to a downward bias in the estimate of σ. Such a potential bias would not seem of concern here. As will be discussed in more detail in the next section, the insured bonds in our sample were backed by five insurers. As of January 2007, all five insurers had AAA ratings from S&P. All of the bonds in our sample issued since October 2004 (with one exception) have been insured by only two of these companies. They have maintained their AAA ratings through September 2010. The next month, their ratings were lowered a notch to AA+. 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.[9] The default risk of insurers

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

appears to be adequately captured by equation (6). Consistent with the safety afforded by the insurers of the bonds studied here, as of May 2018, scheduled payments for defaulted bonds have been covered in full.

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 anticipated changes in statutory income tax rates and the stance of monetary policy. These important drivers of municipal yields are accounted for in our estimate of σ by the shock variable, s, which is eliminated in our procedure through differencing.

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.

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, the very low default rates with municipal bonds makes it quite difficult to implement in the current context.

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 the 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 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. For example, 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 insufficient liquidity in the 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 "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. AAEW find that, from 2008 to 2017, approximately one-half the movement in the bank valuations (as measured by market to book equity) can be accounted for by variations in the value of government guarantees.

Neither approach dominates in estimating the value of government guarantees. Rather, these four approaches depict the fundamental tradeoff between simple, non-parametric models (such as the one used in the current study) that are relatively robust but inefficient and more complicated estimators relying on an explicit theory and parameterization that are more efficient but fragile in the face of possible model misspecification.[10]

[10] 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.

3. Data

Our estimate of the risk premium 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 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 without sufficient information to compute the yield or determine the issue date or maturity are excluded. Pre-refunded bonds are also excluded. A tedious examination of the remaining GO bonds (reading the Official Statements, for each bond offering, 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 Table 2. (Specific comments on data collection are in Appendix D.) 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). Call 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. note 6, Table 2 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. (The FRED database also provides data on the Corporate Baa yield used below for comparative purposes.) Data for the Treasury yield curve does not always match 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 (a match that 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.[11] 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 fifth series is the marginal income tax rate for the marginal municipal bond investor (τ). Recall that income from Puerto Rican bonds is triple-tax free and that, to facilitate comparisons between tax-free Puerto Rican and taxable bonds, the latter is grossed-up for income taxes. See Appendix E for details. Several steps are involved. Most importantly, we have to make a distinction between regular and alternative 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 $250,000).[12] The following discussion is keyed to the entries in Table E1 in Appendix E 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 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

[11] 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, per equation (3), the exact (m = n) or near-exact (m close to n) maturity matches for most pairs of uninsured/insured bonds.

[12] Note that we focus on "high," not the "highest" income. In the latter case for very wealthy individuals, several of the phase-outs discussed below will have been exhausted, and the marginal tax rate for very wealthy individuals 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 full economics professors (filing jointly) will be higher than the marginal income tax rate for Bill Gates.

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 is the summation of these four effective marginal tax rates, items [7].

The AMT regime imposes a different set of marginal income tax rates, and one marginal income tax rate 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 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.[13] This 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 2017.

[13] 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 presence of the bias in both the numerator and denominator of the ratio suggest that this omission will not result in a large error.

4. Results

This section contains our empirical results divided into three sections: before the Detroit bankruptcy of July 2013, 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, and we examine the 13 bond issue dates comprising 45 GO bonds that occurred between January 1, 2000 and the bankruptcy. We examine Puerto Rican bonds at the initial offering price on or near the issue date. This is the period when bonds are most liquid, and hence prices should be most accurate. The risk premia for Puerto Rican bonds is presented in column 12 of Table 2 for all 45 issues.

The results are summarized in Table 3, which aggregates the 45 risk premia into their 13 issue dates and compares them to the risk premia on Corporate Aaa and Baa bonds. The risk premia on Puerto Rican bonds (column 2) generally lies between the risk premia for Corporate Aaa and Baa bonds (columns 1 and 3, respectively). The one exception is in May 2008 during the financial crisis, a period in which financial markets were severely disrupted. Averaged over all 45 GO bonds issued since 2000, the risk premia on Puerto Rican GO bonds has exceeded the comparable risk premia on Corporate Aaa bonds by 63 basis points. Relative to Corporate Baa bonds, Puerto Rican are less risky, 36 basis points lower than the comparable risk premia for Corporate Baa bonds. Table 3 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. Treasury.

B. After Detroit

However, this expectation was upended by a seismic shock to the municipal bond market. On July 18, 2013, Detroit filed for bankruptcy with debt of $18 to $20 billion; no federal assistance was forthcoming. 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 is between $13 to $16 billion (using the GDP price deflator or current dollar GDP per capita as the scaling variables, respectively).

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 assistance (ABC, 2013). When asked "no federal bailout?", Mayor Bing responded "not yet." *Rollcall* reported that "Soon 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 New York City loan package enacted in 1975" (Ota, 2013, p. 2) The Obama Administration's reluctance was echoed in Congress concerning pension obligations. Eight days after Detroit filed for bankruptcy, Senator Lindsay Graham introduced an amendment to a bill with the following provisions (Graham, 2013):

> • 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 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). The 2013 Detroit bankruptcy and the federal government's truancy regarding a rescue package for bond holders was a watershed event extinguishing the Treasury Put.

The Detroit bankruptcy is a major event that allows us to identify and quantify the Treasury Put. The effective termination of the Treasury Put should 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, so we cannot repeat the above analysis assessing returns 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 on a monthly basis. Using the above formulas to compute the risk premia for matched Puerto Rican bonds, we examine whether the Detroit bankruptcy led to a substantial increase in the risk premium.

[The post-Detroit yield-to-maturity calculations have not yet been performed. They will be provided in the next draft.]

Based on the bond information collected to date, the behavior of bond prices (loosely comparable to the yield to maturity) can be examined. After the Detroit bankruptcy, the differential in prices widened dramatically, as shown in the right ("fat") section of Figure 3. This increase in the spread of bond prices corresponds to roughly a 300 basis point in increase in the risk premium.

C. Misallocation Costs

The fundamental problem with the Treasury Put is that it shifts-out the demand curve for capital, lowering finance costs and directing capital to inefficient uses. Given our estimate of the Treasury Put and estimates of the slope of the supply curve for municipal bonds, the extent of this misallocation can be estimated. The 300 basis point increase in the risk premium leads to approximately a 40% increase in the cost of capital. 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 flow of capital is approximately $15 billion, about 15% of the current outstanding Puerto Rican debt.

[In the next draft, this estimate of misallocation will be compared other studies, including the value of the "Greenspan Put" estimated by Miller, Weller, and Zhang (2002) for the stock market (130 basis points) and the dollar value of "Paulson's Gift," a cash infusion and a three-year guarantee on unsecured debt to banks in October 2008 estimated by Veronesi and Zingales (2010) to be worth about $130 billion]

5. Summary And Conclusions

To answer the question posed in the title of this paper, "What Went Wrong?" The fault lies in financial markets, which systematically failed to control the flow of capital to Puerto Rico. That failure was tied to an implicit guarantee of the debt, the "Treasury Put." Evaluating the Treasury Put hypothesis is made possible in the case of Puerto Rico given two fortuitous features – pairs of uninsured and insured bonds issued on the same day with the same maturity and other characteristics and the "seismic shock" of the Detroit bankruptcy and the unexpected absence of federal support. Our identification of the Treasury Put is based on five pillars:

1. Macroeconomic fundamentals were dismal (Introductory Section, Figures 1-5, and Table 1).
2. The Treasury Put existed (Section 1)
3. Default risk was too low (Section 4.A and Table 3).
4. The Treasury Put was extinguished (Section 4.B)
5. Default risk rose (Section 4.B and Figure 6).

This conclusion about What Went Wrong stands in contrast to that offered by the GAO (2018). This well-researched document concludes that the misallocation of capital was due largely to an information failure. Which view is correct has important implications for the appropriate policy. Under the Information Failure hypothesis, capital flows can be improved by requiring better and more timely information, as recommended by GAO.

By contrast, the Treasury Put hypothesis raises the question how does the Treasury extinguish its implicit guarantee?[14] There is a sizeable literature studying the problem of how governments can make binding, credible commitments while providing a safety net. Karaken and Wallace (1978) was one of the earlier contributions in the context of deposit insurance. They concluded that regulation of the insured financial intermediaries assets and liabilities is essential. More recently, Kehoe and Chari (2016) analyze government bailouts as an inefficient but unavoidable intervention into otherwise efficient markets. They also conclude that regulation is important; in their case, they advocate controlling leverage and taxing size to

[14] 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.

achieve a second best outcome. A contrasting view is offered by Bornstein and Lorenzoni, forthcoming) who show that forebearance can lead to an aggregate demand externality. Discretionary intervention eliminates the latter and may lead to a better outcome, even in the face of moral hazard concerns. An alternative solution is “exemplary non-intervention,” as has been pursued in the cases of Detroit and Puerto Rico. Whether this stance can be maintained in the future is debatable, but the passage of laws restricting governments would be an important step in controlling the misallocations associated with the Treasury Put.

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

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). (The latter is sometimes labeled gross national income.) GDP measures the value of economic activity within the borders of a sovereign state regardless if it is conducted 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. 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. The debt/GDP data reported in Figure 4 (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 (%)
	(1)	(2)	(3)	(4)
2000	63.2	0.671	42.4	70.2
2005	71.2	0.649	46.2	76.5
2010	90.9	0.658	59.8	99.0
2015	100.2	0.658	65.9	109.1

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, February 20, 2018. No data are available for 2015; the 2015 value equals the 2010 value.

Column 3: The product of columns 1 and 2.

Column 4: Transformation: Column 3 multiplied by 1.655, per this discussion below.

The debt figures in columns 1, 2, and 3 of Table A1 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 xx is approximately 11% lower than the implied debt figure in column 3, interpolated linearly between the 2010 and 2015 data (62.3%). We believe that the Krueger, Teja, and Wolfe are more accurate. To attenuate measurement error, we thus use the ratio of unfunded pension liabilities to debt in the Barron's data is 0.637 (= 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 since the article mentions that the estimate of unfunded pension liabilities is slightly below 50. We average these two ratios (0.655) and assume that this estimate can be applied to the debt figures in the above appendix table. These computations are presented in column 4.

Appendix B. Puerto Rican Government Deficits

This appendix provides details underlying Figure 5. The figures in columns 1 to 4 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 (nominal)	Budgetary (Cash) Basis	Budgetary (Cash) Basis	Accrual Basis	Operating Basis
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
2002	1				71.62	1.40			
2003	1				74.83	1.34			
2004	2				80.32	2.49			
2005	3				83.91	3.58			
2006	3				87.28	3.44			
2007	4				89.52	4.47			
2008	5				93.64	5.34			
2009	7	2.86	3.52	2.68	96.39	7.26	2.97	3.65	2.78
2010	7	2.72	4.35	1.81	98.38	7.12	2.77	4.42	1.84
2011	7	1.80	3.79	1.09	100.35	6.98	1.79	3.77	1.09
2012	7	2.38	5.22	2.75	101.56	6.89	2.34	5.14	2.71
2013	7	1.31	3.61	2.55	102.45	6.83	1.28	3.52	2.49
2014	8				102.45	7.81			
		.							
Average, 2009 to 2013							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; FOIA request to the GAO pending). These data are based on a careful analysis of government financial statements by the GAO.

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: FRED.

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. 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 (yyyy) Rating Scale and Definitions; https://www.moodys.com/sites/products/ProductAttachments/AP075378_1_1408_KI.pdf

Appendix D. 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 States (OS) are available on the first author's website.

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 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 EMMA, 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.

Appendix E. Computing The Marginal Income Tax Rate For The Marginal Municipal Bond Investor

Table E1 lists the tax rates and other variables needed to compute the marginal income tax rate for the marginal municipal bond investor. Investors in Puerto Rican bonds are not assessed these taxes. The data are provided in Table E2.

Table E1 -- 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 this 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 is contained in the EXCEL file "Computing the REG Weight."

12. Same as 11.

13. Transformation.

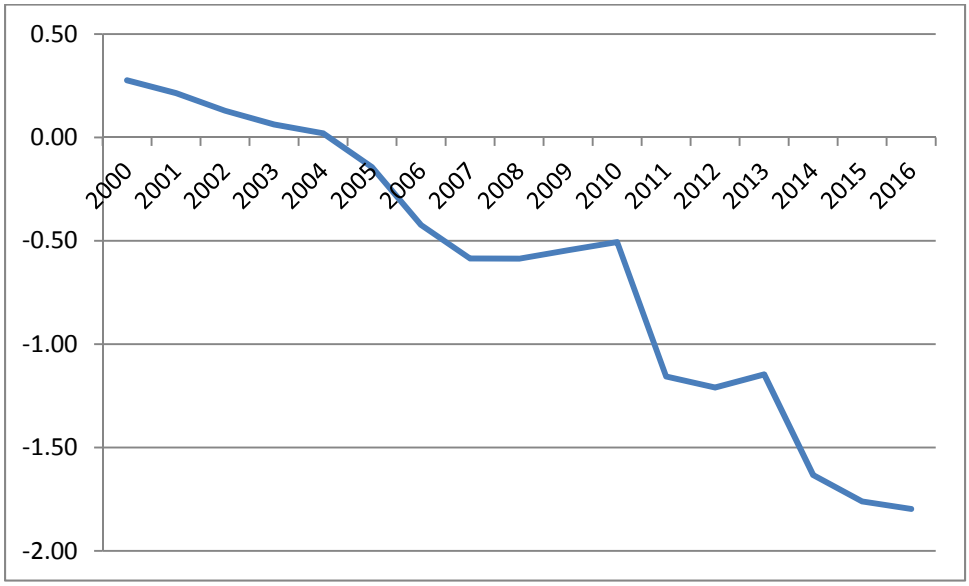
14. Transformation.

Table E2 -- 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

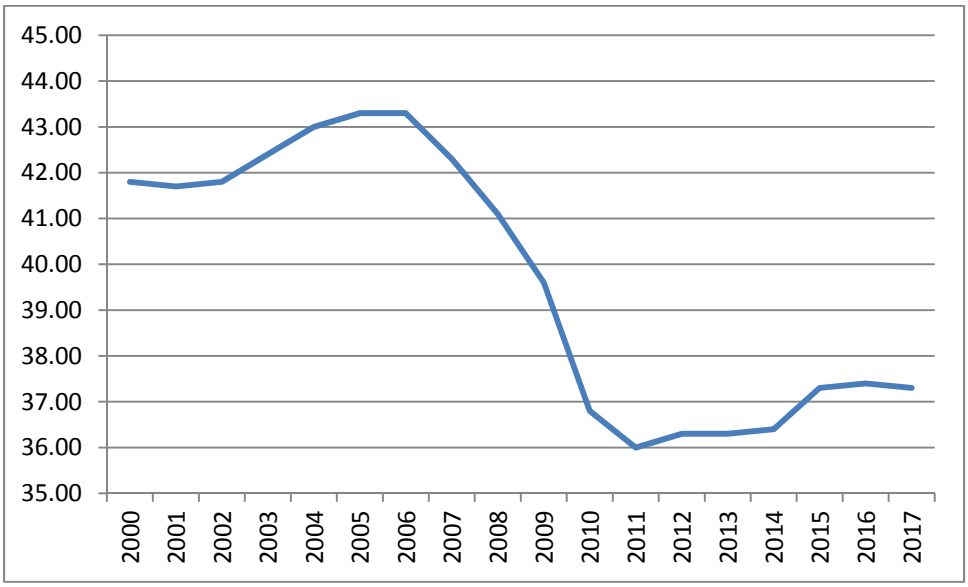
Notes and Sources:
See Notes and Sources to Table E1.

Figure 1. Population Growth, 2000-2016



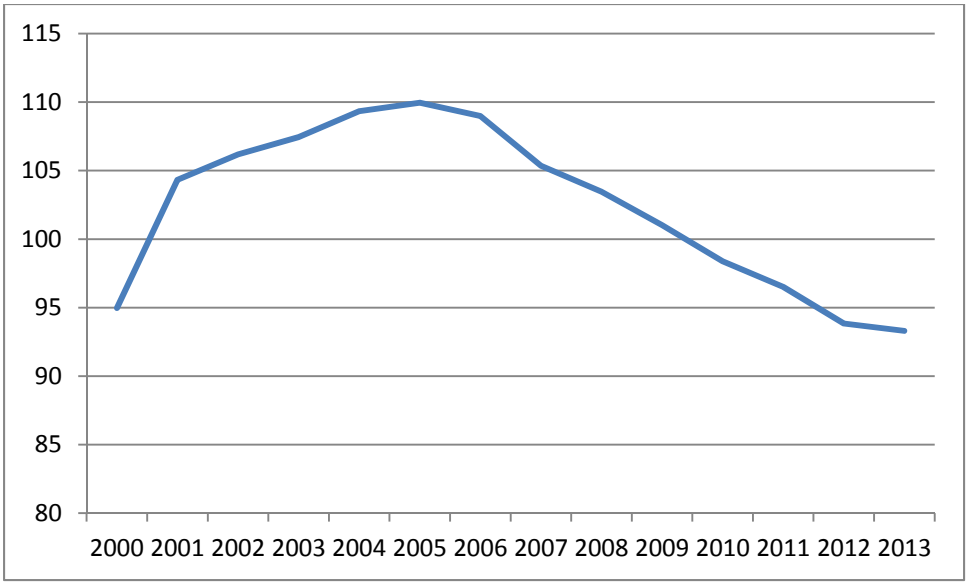
Notes: Annual population growth rate for year t is the exponential rate of growth of midyear population from year t-1 to t, expressed as a percentage. Population is based on the de facto definition of population, which counts all residents regardless of legal status or citizenship--except for refugees 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, February 19, 2018.

Figure 2. Employment To Population Ratio, 2000-2017



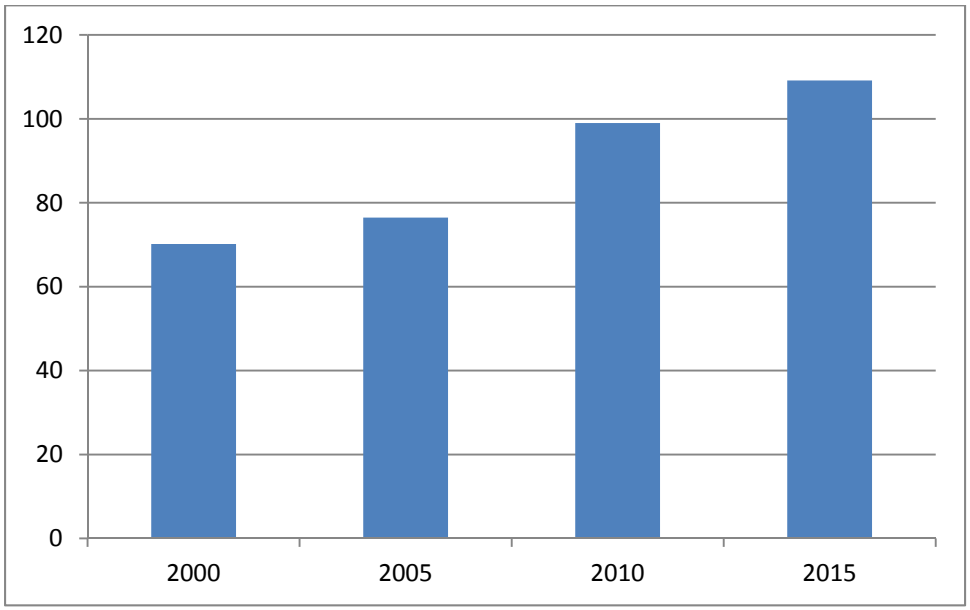
Notes: Employment to population ratio is the proportion of a country's population that is employed. Ages 15 and older are generally considered the working-age population (modeled ILO estimate). Source: World Bank, Employment to Population Ratio for Puerto Rico [SLEMPTOTLSPZSPRI], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/SLEMPTOTLSPZSPRI, February 19, 2018

Figure 3. Gross Domestic Product (constant 2010 US$), 2000-2013



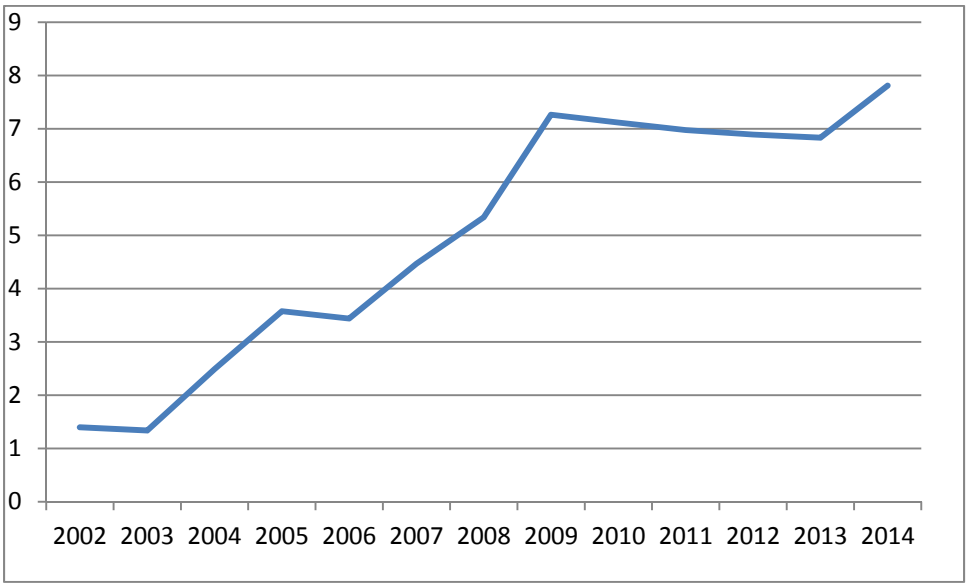
Notes: Source: World Bank, World Development Indicators, retrieved from https://data.worldbank.org/indicator/NY.GDP.MKTP.KD February 21, 2018.

Figure 4. Public Liabilities, As A Ratio To GDP



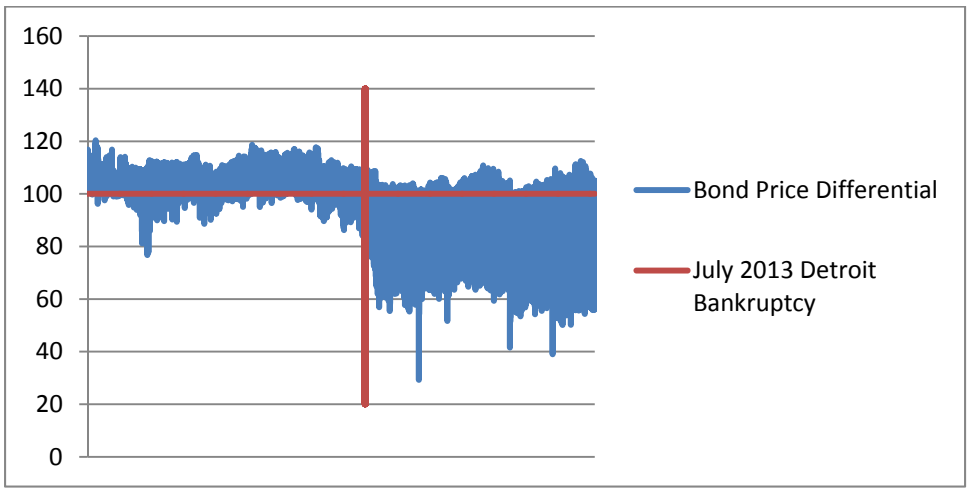
Notes: The numerator is the sum of debt and unfunded pension liabilities for the public sector. See Appendix A for details about the construction of the numbers in this Figure: 70.2, 76.5, 99.0, and 109.1 for 2000 to 2015, respectively. Some studies scale by GNP, which substantially increases the ratios. 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$



Notes: Sources: Deficit data (GAO, 2018, Figure 2, p. 9; data provided by a FOIA request to the GAO). Nominal GDP data (FRED).

Figure 6. Average of The Differential in the Prices of Traded Matched Bonds
January 2008 to December 2016
The July 2013 Detroit Bankruptcy Indicated by the Vertical Red Line



Notes: Average of The Differential in the Prices of Traded Matched Bonds.

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 -- Summary Information For 45 Matched Uninsured/Insured Bonds

Number	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 (Red/ Blue)[1]	Quality Of The Matu-rity Match	Bias For σ From Matu-rity Match[6]	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	1.69
2	539	745145YN6	745145YR7	10-25-2001	MBIA	1.000	N[3]/N	16/16	Exact		2.13
3	540	745145YP1	745145YR7	10-25-2001	MBIA	1.000	N/N	16/16	Exact		2.13
4	546	745145YX4	745145YY2	10-25-2001	Ambac	6.770	N/N	19/19	Exact		2.18
5	546	745145YX4	745145ZA3	10-25-2001	Ambac	18.190	N/N	19/19	Exact		2.18
6	548	745145YZ9	745145YY2	10-25-2001	Ambac	6.770	N/N	19/19	Exact		2.18
7	548	745145YZ9	745145ZA3	10-25-2001	Ambac	18.190	N/N	19/19	Exact		2.18
8	665	745145VT6	745145VU3	4-4-2002	FGIC	21.190	N/N	05/05	Exact		1.24
9	784	745145R61	745145R53 745145R79	8-8-2002	FGIC	130.290/ 19.260	12/12	27/ 32&22	Not Exact	Up-ward	1.66
10	1305	7451458M7	7451458N5	5-18-2004	FSA	29.165	[4/]	30/31	Not Exact	Down-ward	1.20

11	1305	7451458M7	7451458P0	5-18-2004	MBIA	40.000	[4/]	30/31	Not Exact	Down-ward	1.20
12	1305	7451458M7	7451458Q8	5-18-2004	FGIC	22.315	[4/]	30/31	Not Exact	Down-ward	1.20
~~13~~	~~1414~~	~~74514LCR6~~	~~74514LCS4~~	~~10-7-2004~~	~~FSA~~	~~8.560~~	~~12/N~~	~~14/14~~	~~Exact~~		~~2.35~~
14	1420	74514LCX3	74514LCW5	10-7-2004	FSA	14.985	14/14	19/18	Not Exact	Up-ward	1.17
15	2261	74514LNB9	74514LNA1	10-16-2007	AG	24.940	N/N	17/17	Exact		1.39
16	2262	74514LNC7	74514LNA1	10-16-2007	AG & MBIA	53.215& 24.940	N/N	18/17&19	Not Exact	Up-ward	1.42
17	2416	74514LSN8	74514LTE7	5-7-2008	AG	36.110	N/N	14/14	Exact		2.61
18	2416	74514LSN8	74514LTF4	5-7-2008	AG	27.360	N/N	14/14	Exact		2.61
19	2417	74514LSP3	74514LTG2	5-7-2008	AG	50.220	N/N	15/15	Exact		2.61
20	2417	74514LSP3	74514LTH0	5-7-2008	AG	15.995	N/N	15/15	Exact		2.61
21	2426	74514LSQ1	74514LTJ6	5-7-2008	AG	53.955	N/N	16/16	Exact		2.88
22	2426	74514LSQ1	74514LTL1	5-7-2008	AG	16.605	N/N	16/16	Exact		2.88
23	2793	74514LVV6	74514LVT1	9-17-2009	FSA	42.790	14/20	31/30	Not Exact	Up-ward	1.90
24	2793	74514LVV6	74514LVU8	9-17-2009	FSA	51.045	14/20	31/31	Exact		1.90
25	3154	74514LWK9	74514LWP8	2-17-2011	FSA/AGM	35.420	21/21	28/27	Not Exact	Up-ward	1.30
26	3156	74514LWM5	74514LWL7	2-17-2011	FSA/AGM	42.025	16/16	33/33	Exact		1.23
27	3157	74514LWQ6	74514LWT0	2-17-2011	FSA/AGM	15.000	21/21	34/34	Exact		1.22
28	3183	74514LXA0	74514LXF9	3-17-2011	FSA/AGM	20.000	16/16	32/32	Exact		1.30

29	3184	74514LXB8	74514LXF9	3-17-2011	FSA/AGM	20.000	16/16	32/32	Exact		1.30
30	3185	74514LWZ6	74514LXC6	3-17-2011	FSA/AGM	40.000	16/16	35/36	Not Exact	Down-ward	1.25
31	3187	74514LXH5	74514LXC6	3-17-2011	FSA/AGM	40.000	35/16	36/36	Exact		1.30
32	3189	74514LWX1	74514LXG7	3-17-2011	FSA/AGM	105.000	N/16	40/37	Not Exact	Up-ward	1.40
33	3276	74514LZF7	74514LZD2	7-12-2011	FSA/AGM	5.900	16/16	19/19	Exact		1.63
34	3277	74514LZH3	74514LZD2	7-12-2011	FSA/AGM	5.900	16/16	19/19	Exact		2.03
35	3279	74514LZG5	74514LZE0	7-12-2011	FSA/AGM	4.500	16/16	20/20	Exact		1.61
36	3280	74514LZJ9	74514LZE0	7-12-2011	FSA/AGM	4.500	16/16	20/20	Exact		1.94
37	3482	74514LA56	74514LD46	4-3-2012	FSA/AGM	20.000	N/N	22/22	Exact		1.46
38	3484	74514LC70	74514LD53	4-3-2012	FSA/AGM	5.000	22/22	23/23	Exact		1.54
39	3486	74514LC88	74514LD61	4-3-2012	FSA/AGM	5.000	22/22	24/24	Exact		1.46
40	3487	74514LA72	74514LD61	4-3-2012	FSA/AGM	5.000	22/22	24/24	Exact		1.59
41	3489	74514LA80	74514LD79	4-3-2012	FSA/AGM	5.000	22/22	25/25	Exact		1.43
42	3493	74514LB22	74514LD87	4-3-2012	FSA/AGM	11.520	22/22	27/27	Exact		1.77
43	3499 & 3500	74514LC39 74514LB63	74514LD20	4-3-2012	FSA/AGM	322.925	22/22	33&37/35	Not Exact	Down-ward	1.30
44	3503	74514LC62	74514LD46	4-3-2012	FSA/AGM	20.000	22/22	22/22	Exact		1.46
45	3504	74514LC70	74514LD53	4-3-2012	FSA/AGM	5.000	22/22	23/23	Exact		1.46

Notes:

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

[2] Insurance companies: Ambac, AG, CIFG, FGIC, FSA, MBIA, Radian, Syncora. FSA was acquired by AG in July 2009 and renamed Assured Guaranty Municipal Corporation (AGM). AG and FSA/AGM were rated Axx throughout the entire sample period.

[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] See Appendix D for some details concerning the collection of the Puerto Rican data.

[6] 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 insured pair. This positive differential leads to an upward bias in our estimate of the risk premium, σ.

Table 3 -- Risk Premia Across And Issue Dates

Issue Date	Corporate Aaa	Puerto Rican	Corporate Baa	Non-Investment Grade ("Junk")
	(1)	(2)	(3)	(4)
March 15, 2000	1.350	1.690	2.050	TO
October 25, 2001	1.680	2.165	2.560	BE
April 4, 2002	0.900	1.245	2.210	PROVIDED
August 8, 2002	1.150	1.662	2.390	IN
May 18, 2004	0.590	1.204	1.300	THE
October 7, 2004	0.590	1.170	1.350	NEXT
October 16, 2007	0.860	1.402	1.690	DRAFT
May 7, 2008	0.990	2.878	2.310	
September 17, 2009	0.960	1.928	2.170	
February 17, 2011	0.810	1.249	1.700	
March 17, 2011	0.890	1.141	1.800	
July 12, 2011	1.000	1.804	1.820	
April 3, 2012	1.050	1.497	2.310	
Average	0.986	1.618	1.974	
Differential With Column 2	-0.632	0.000	+0.356	

Notes: Details underlying the estimation of these risk premia are presented in Sections 2 and 3.