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The Price of Safety: The Evolution of Municipal Bond Insurance Value

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ABSTRACT

We examine the benefits of bond insurance to taxpayers using comprehensive data and selection models to control for fundamentals and the endogenous choice to insure. Prior to 2008, insurance provided Aaa coverage and saved issuers 9 bps on average. Insurers were then downgraded in 2008–2009 and municipalities upgraded due to Moody's scale recalibration in 2010, shrinking the difference in credit ratings between the underlying issuers and the insurers from both sides and lowering the value of available credit enhancement. Overall, insurance provides gross value when insurers have higher ratings than the issuers they cover. Only relatively low-rated issuers benefit, subsidized by higher-rated municipalities who over-insure. Cross-sectional results indicate that agency problems and conflicts of interest play a role in issuers' decisions to over-insure.

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1. Introduction

The purpose of this paper is to test whether bond insurance provides value to issuers of municipal bonds (munis). This question is important because the cost of insurance is borne by taxpayers.[1] This question remains unanswered by a literature providing mixed evidence based on relatively small samples of munis issued in particular states (e.g., Texas, California, New York) or in limited time periods.

In theory, insurance should reduce the cost of municipal borrowing by reducing expected default costs, providing due diligence, and improving price stability and market liquidity. Indeed, these are claims made by insurers.[2] From the literature, Thakor (1982) models a signaling benefit, Nanda and Singh (2004) indicate a tax benefit, and Gore et al. (2004) find that insurers reduce asymmetric information costs. It is further intuitive that bond insurers provide more reliable certification than the credit rating agencies (CRAs), given that insurers potentially incur losses in the event of issuer default; see Bergstresser et al. (2015). Statistically, the joint probability of default (PD) is lower than the individual PD given imperfect correlation between issuer and insurer. Still, prior empirical studies document a yield inversion in the secondary market, where insured bonds have higher yields than comparably-rated uninsured bonds during the 2008 financial crisis, suggesting that insurance has no value precisely when needed most; see Bergstresser et al. (2010), Lai and Zhang (2013), and Chun et al. (2018).

We bring a more comprehensive dataset to the question of insurance value than prior studies and tackle the selection effects associated with the endogenous choice to insure. We examine the direct and indirect value of bond insurance with a sample of over 700,000 general obligation (GO) bonds issued over the last 30 years with data on issuers, insurers, issue characteristics including the time series of changes in underlying credit quality, and secondary market activities.

We first provide insights into the previously documented yield inversion in the secondary market during the 2008–2009 financial crisis. We find that this yield inversion is driven primarily by insured munis with credit ratings at or above the ratings of their insurers, many of whom experienced serious financial distress and downgrades during the crisis. After losing their Aaa ratings, these insurers were rated the same or below most munis' underlying credit ratings. In contrast, in all time periods, including the crisis, lower-rated bonds with insurance face lower yields than their uninsured counterparts. We conclude that insurance is valuable to investors, provided the insurance company is of higher credit quality than the issuers.

We then focus on the primary market and measure the benefit of insurance to issuers as a reduction in offering yields at issuance. Using comprehensive data from 1985–2016, we find that issuers accrue a total benefit of $459 million over the entire 31-year period, roughly equivalent to the premiums collected

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1. Annual muni insurance premiums peaked at approximately $1.5 billion in 2007 (see Joffe, 2017). Although the industry contracted following the financial crisis of 2008, the fraction of newly issued bonds with insurance has rebounded since 2012. See Section 2.1 for details.

2. The largest public provider of municipal bond insurance sponsors articles promoting the value of their products at www.municipalbonds.com. See, for example, "Top 5 Reasons You Should Choose Insured Muni Bonds Over Uninsured" available here: http://www.municipalbonds.com/bond-insurance/top-5-reasons-should-choose-insured-muni-bonds-over-uninsured/.

by one insurer (MBIA) in just one year (2004). In the pre-crisis period (1985–2007), when bond insurers provided Aaa-rated coverage, we find that on average, insurance lowers offer yields and issuance costs on a dollar-weighted basis. However, in the period since 2008, we find no evidence that insurance lowers the average municipal issuers' borrowing costs, even in gross terms. Only relatively low-rated issuers obtain any direct benefit of insurance.

Consistent with the secondary market results, our primary market analysis indicates that this lack of insurance value stems from the relative quality of insurers vis-a-vis insured issuers. Because the monolines were downgraded in 2008–2009 and because general obligation bonds upgraded due to Moody's scale recalibration in 2010, the difference in credit ratings of issuers and available insurance shrinks from both sides. Given that the gross value of insurance is only positive among relatively low-rated issuers, we conclude that highly-rated issuers.[3]

To ensure the robustness of our conclusion, we employ multiple empirical modeling approaches, including OLS regressions and selection models. In all models, we thoroughly control for observable bond and issuer characteristics as well as macroeconomic variables. Given our comprehensive set of publicly and commercially available data, we believe that any risk factor omitted from our models would be difficult for muni bond investors (primarily retail investors) to observe and price.[4]

We take seriously the endogenous choice by issuers whether or not to insure their bonds and the potential for such selection to influence our empirical results. Because credit ratings are coarse measures of credit risk (see Goel and Thakor, 2015), there exists variation in credit quality within each rating category. The most transparent highly-rated issuers, observable as high-quality to market participants, have less need for insurance to signal their quality. If insurance is purchased only by relatively opaque and lower-quality issuers within each rating category, then primary market yield inversion does not necessarily imply a lack of insurance value. To account for the selection into insurance, we employ two state-of-the-art selection adjusted models. The first is a propensity score matching model used to calculate average treatment effects. The second is a "doubly-robust" inverse-probability weighted regression adjustment model adapted from Cattaneo (2010) that controls for the endogenous choice to insure yet remains robust to potential misspecification. These selection-adjusted models reduce the magnitude of the yield inversion obtained in the OLS regressions, but cannot reverse it; average yield inversion remains a statistically significant 4 bps. Our conclusions remain robust after controlling for the endogenous choice to insure.

Although it is puzzling that highly-rated issuers pay for relatively low-rated insurance without commensurate economic benefits, the evidence is consistent with prior literature documenting an "over-

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3. Based on data from MBIA and AMBAC annual reports, we estimate that municipalities paid over $17 billion dollars directly to insurers from 1995–2008. In 2017, we estimate that the two remaining bond insurers (Assured Guaranty and subsidiaries and the much smaller Build America Mutual) collected approximately $250 million in premiums. See Internet Appendix Figure A.1.

4. In addition to underlying and insured credit ratings, we control for each bond the choice to insure, the prior use of insurance by the issuer, the size of the specific bond as well as the size of the full issue, call features, bond maturity and squared maturity to account for its non-linear effects, an indicator for underwriter, a discrete count of the number of underwriters and advisors for the issue, an indicator for whether the bond is bank qualified, an indicator for whether the issue is negotiated or competitively offered, state fixed effects, specified use of proceeds (general purposes, water and sewer, K-12 education, higher education, or other uses), year fixed effects, and other macro-economic factors including contemporaneous Baa–Aaa credit spread, the slope of the yield curve (10Y–1Y Treasury yields), the 10Y Treasury constant maturity yield, and the inflation rate.

insurance" phenomenon. For example, Shapira and Venezia (2008) document the irrational consumer preference of full-coverage (zero-dollar deductible) automobile liability, medical insurance, and consumer product policies (e.g., fabric stain coverage sold in furniture stores and TV and appliance warranties sold by major retailers). Different from these covered losses, where premiums are paid by the policies' direct beneficiaries, we find evidence of an over-insurance phenomenon when premiums are paid by one party (taxpayers) and any insurance payout goes to another party (investors).

Auxiliary analysis provides some insight into the factors leading some issuers to over insure. First, we hypothesize that heterogeneity in sophistication, risk aversion, and potential corruption among public officials play a role. Conversation with a public official responsible for over 2,500 issues indicates that officials expend "all available resources to ensure that nothing goes wrong" given that their personal reputations are at stake. Lacking data on cross-sectional variation in issuer risk aversion, we test whether cross-sectional variation in official corruption correlates with the documented over-insurance and find that jurisdictions with higher corruption (relatively higher conviction rates among public officials) despite lower deterrence (relatively lower prosecution rates) leave the most money on the table.[5]

We further hypothesize that influential underwriters and advisors play a role in some issuers' decision to over-insure. The conflicts of interest among underwriters are clear; underwriters take the opposing side of a zero-sum transaction and have no fiduciary duty to issuers. To the extent that underwriters hold inventory over any period, they benefit from the intrinsic value of the insurance paid for by the issuer. Conflicts of interest among influential municipal advisors are derivative. Prior to 2014, which is most of our 1985–2016 sample period, underwriters routinely performed a dual role advising the issuers to whom they had no fiduciary duty. After 2014, new regulations prohibit agents from serving as official advisors on deals they underwrite and impose fiduciary duties on municipal advisors, restrictions on pay to-play and gifts/gratuities, and new standards for professional qualifications. However, the SEC (2017) and Bergstresser and Luby (2018) report troubling non-compliance with these new regulations. We find that municipalities hiring large, influential advisors or underwriters leave the most money on the table, consistent with our hypothesis. These cross-sectional results are relevant to the current policy debate over municipal advisor incentives and commend enforcement of the new regulatory standards. Our more granular measure of money left on the table by poorly-advised municipalities compliments the prior work from Ang et al. (2017) and should prove useful to future research on municipal issuer behavior.

Finally, we consider improved liquidity as a potential indirect benefit of insurance to issuers who engage in advanced-refunding over our sample period.[6] We measure muni liquidity using transaction costs estimated following Harris and Piwowar (2006). We find little difference in the transaction costs of insured versus uninsured bonds of similar credit quality, either before or since the crisis, thereby ruling out liquidity value as an economic justification for the documented over-insurance. We also document an important side contribution to the literature: in the period following improved disclosure of trade prices via the Electronic Municipal Market Access (EMMA) database, the transaction cost (half-spread) on a $5,000 trade fell from roughly 135 basis points (bps) to roughly 85 bps. This improvement in transaction

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5. Our results complement those from Butler et al. (2009). They find that issuers in more corrupt locations are more likely to insure their bonds. We find that among issuers insuring their bonds, those in more corrupt locations are more likely to do so with less benefit.

6. The Tax Cuts and Jobs Act makes previously tax-exempt interest on advanced refunding bonds taxable, essentially eliminating the advantages and appeal of such bonds after December 31, 2017.

costs paid by investors, especially retail investors, commends regulatory efforts toward improved transparency. The novel evidence of over-insurance in this paper indicates a need for similar regulatory efforts to better inform issuers and enforce new advisor standards.

Our paper proceeds as follows. We briefly describe the municipal bond insurance market and related literature in Section 2 and provide a detailed description of our data in Section 3 including details on our bond transaction cost function estimation. We examine the value of insurance in the secondary and primary markets in Section 4. In Section 5, we explore alternative explanations for the decision to purchase insurance, including potential conflict of interest of agents involved and potential liquidity value. Finally, Section 6 concludes.

2. Background and related literature

2.1 Evolution of municipal bond insurance

In 1971, the American Municipal Bond Assurance Corporation (AMBAC) began to guarantee timely payment of principal and interest in the event of municipal default. Shortly thereafter, the Municipal Bond Insurance Association (MBIA) formed as a joint entity by major property and casualty insurers (Aetna, Travelers, Cigna, Fireman's Fund, and Continental). The financial distress of New York City and default by Washington Power Supply (in 1983) increased demand for muni insurance, and Financial Guaranty Insurance Company (FGIC) and Financial Security Assurance (FSA) entered the market in 1983 and 1985, respectively. The subsequent default by Orange County, CA (in 1994) further increased demand and the so-called "Big Four" were joined in the early 2000s by Assured Guaranty Corporation (AGC), Radian Guaranty, XL Capital Assurance (XLCA), and CDC IXIS Financial Guaranty (CIFG). However, the market remained concentrated with the Big Four insurers controlling nearly $2 trillion of the $2.3 trillion insured par outstanding in 2006.

We present graphically the ascent in the popularity of bond insurance in the GO bond market and its subsequent crash during the financial crisis (see Internet Appendix Figure A.2). In the pre-crisis period, a high of over 60% of GO bonds are insured. By 2010, the percentage was closer to 10%. Since the depth of the crisis and the demise of the largest monolines,[7] the remaining market was ceded to Assured Guaranty who wrote virtually all muni insurance from 2009 to 2012.[8] Beginning in 2013, Build America Municipal (BAM), a mutually incorporated insurer, emerges as a serious competitor in the post-crisis market. By 2016, the percentage of GO bonds with insurance rebounds to about 20% representing approximately 7% of issuance volume.

2.2 Contribution to prior literature

Prior empirical research documents several puzzles in the muni market. The first such puzzle examined extensively is the evidence that long-term tax-exempt muni yields are too high relative to after-tax yields

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7. Bond insurers are referred to as "monolines" because they are prohibited by insurance regulators from providing other types of coverage such as property & casualty or life & health insurance.

8. Assured Guaranty operates in this market with two subsidiaries, AGC and Assured Guaranty Municipal (AGM). For details on the demise of the monoline insurance industry, see Moldogaziev (2013) and Cornaggia et al. (2018b).

on taxable bonds.[9] Related papers appeal to the tax-sensitivity of muni investors to explain other puzzling phenomena; see Starks et al. (2006) and Landoni (2018) regarding the "January effect" and the original issue premium, respectively. Finally, Ang et al. (2017) document the puzzling evidence that the widespread advanced refunding by municipal issuers is exercised prematurely and at a net present value loss.

Disclosure of trade prices from EMMA and issuer fundamentals made available by the Municipal Securities Rulemaking Board (MSRB) helped expand the literature to analyze market efficiency (as in Downing and Zhang, 2004, Harris and Piwowar, 2006, Green et al., 2007, and Schultz, 2012), real economic effects of muni rating changes (as in Adelino et al., 2017 and Cornaggia et al., 2018a), the relative importance of default, liquidity, and tax components in muni credit spreads (e.g., Wang et al., 2008, Ang et al., 2014, and Schwert, 2017), market segmentation (e.g., Pirinsky and Wang, 2011, Schultz, 2012, and Babina et al., 2017), muni market information environment (Gao et al., 2018a and Cornaggia et al., 2018b), and the effects of state bankruptcy policies (Gao et al., 2018b).

To this growing literature, we analyze the value of credit enhancement provided by the monoline insurers, specifically to municipal issuers in the form of reduced interest costs at issuance. Prior empirical analysis of insurance value (discussed below) focuses primarily on secondary market value (to investors) and/or employs relatively small samples from individual states or in specific time periods. We believe that the question of insurance value is even more important in the primary markets (i.e., to the taxpayers paying the premiums) and we bring the question to the entire market (760,084 GO bonds) over a 30-year period. We focus specifically on unlimited GO bonds because of their homogeneous recourse to tax revenues, because taxpayers bear their cost of insurance, and for consistency with prior literature, e.g., Kidwell et al. (1987); Bergstresser et al. (2010); and Bergstresser et al. (2015). We find evidence that, in the absence of Aaa-rated municipal insurers, only low-rated issuers derive (gross) economic benefits from purchasing insurance.

2.3 Prior evidence of insurance value

Early evidence from Cole and Officer (1981) indicates a significant negative difference between the true interest cost with and without insurance suggesting that insurance provides at least a gross benefit. Adding data on premiums for 333 MBIA-insured bonds, Kidwell et al. (1987) estimate an average net benefit of 22 bps, increasing in issuer credit risk. Wilkoff (2013) finds that insurance lowers yields by 8 bps, on average, in a more recent sample.

However, more recent studies suggest less benefit over time. Analyzing a sample of bonds issued in California and New York, Bronshtein (2015) finds that the value of insurance has fallen from over 3% of deal value prior to the financial crisis to below 1% of deal value thereafter. Kriz and Joffe (2017) also analyze bonds issued in California and find no significant insurance value after including comprehensive issuance costs.

Based on a sample of munis issued in 2015, Landoni (2017) finds that the tax-arbitrage value of insurance suggested by Nanda and Singh (2004) is negligible; even negative under a realistic calibration. Cornaggia et al. (2018b) find that insured bonds of various credit quality price identically to true Aaa uninsured bonds (indicating that insurance is valuable) prior to the crisis, but then returns on insured

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9. For examples, see Trzcinka (1982), Kidwell and Trzcinka (1982), Skelton (1983), Buser and Hess (1986), Kochin and Parks (1988), Green (1993), Green and Oedegaard (1997), Chalmers (1998), Chalmers (2006), and Longstaff (2011).

bonds diverge from true Aaa returns after the financial crisis. Other studies of secondary markets document a negative benefit of municipal bond insurance over time and during the crisis period in particular; see Bergstresser et al. (2010), Lai and Zhang (2013), and Chun et al. (2018).

In contrast to the apparent decline in insurance benefit, evidence from Ely (2012) suggests that the cost of coverage is increasing. We aim to resolve the apparent puzzle that issuers are paying more for a less valuable product over time with models that control for selection bias. However, even after controlling for underlying credit quality and the endogenous choice to insure, we find that insurance only lowers borrowing costs among relatively low-rated issuers.

3. Data

3.1 Primary market data

We construct our sample from a variety of sources to comprehensively describe the municipal bond universe up to June 16, 2016, the cutoff date for our access to the Mergent Municipal Bond Securities (Mergent) database. We start with 3,555,964 bonds issued by 53,045 municipal issuers across different levels of government. We then limit our sample to only tax-exempt, semi-annual fixed-rate coupon bonds that are unlimited tax GO bonds issued since 1985, have a positive offering amount and coupon rate, and represent new borrowing.[10] We also exclude all bonds that are offered via unconventional channels (e.g. limited offerings, private placements, and remarketing), and a small number of bonds that are issued by U.S. territories other than Puerto Rico.

Our primary market analysis requires rating and insurer's ID at issuance. Cornaggia et al. (2018b) document key limitations of the Mergent data, including over-written bond ratings and insurance providers; that is, Mergent overwrites these values as they change over time. In addition, for insured bonds, Mergent only records the rating of the insurer and not the rating of the underlying credit. Because the majority of municipal bonds have changes in insurer (mainly due to the restructurings in the monoline insurance industry after the crisis), credit rating, or both over our sample window, relying exclusively on Mergent data would result in erroneous inferences. We therefore employ the reconstructed time series of original and subsequent insurers of each bond available from Cornaggia et al. (2018b) and supplement the credit ratings with a comprehensive history of S&P and Moody' ratings for municipal bonds obtained directly from these rating agencies' websites.[11] We convert character ratings into numeric ratings with 21 corresponding to the highest credit quality and 1 the lowest. Many bonds are rated by more than one credit rating agency; in this case, we employ the harshest as our measure of underlying credit quality. We report the distribution of underlying rating categories of sample bonds in Internet Appendix

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10. We exclude a small number of CUSIPs that are the pre-refunded portion of an original new borrowing. When a bond gets pre-refunded, the pre-refunded portion and the remaining balance become two separate CUSIPs in the Mergent database but retain all issuance characteristics of the original bond. For analysis related to the primary market, we exclude both CUSIPs to avoid double counting. For analysis related to the secondary market, we exclude only the pre-refunded CUSIPs, given that trading activity in the original bond switches to that of the remaining-balance CUSIP after the pre-refunding date.

11. We are grateful to Ryan Israelsen for providing us these data up to and including 2012, originally collected for analysis in Cornaggia et al. (2018a), and Marc Joffe for providing post-2012 ratings history from Rule 17g-7(b) data at http://www.ratingshistory.info.

Table A.1. Note that all insured GO bonds with Aaa underlying rating were issued prior to the loss of Aaa insurance. We find no evidence that Aaa-rated issuers purchase lower-rated insurance.

From Moody's press releases and news updates available on their website, we obtain the credit rating history of the insurers. We obtain data on corporate restructuring dates from a wide variety of sources, including Moldogaziev (2013) and insurers' websites.

3.2 Secondary market data

We obtain trade data for the bonds in our sample from the MSRB (available on WRDS) from January 2005 to December 31, 2018. We then filter the trade data by removing primary market transactions (i.e., when-issued trades, offering takedown trades, and trades within two weeks of issuance), trades that occur less than one year prior to maturity, a handful of trades with size of less than $1,000, and price outliers (bonds with prices less than 50 or higher than 150, following Schwert, 2017).

We use these trade data for two purposes. One is to analyze trading activities and the yields at which munis trade in the secondary market. Because we care about prices paid or received by investors, we examine only customer trades. Our sample after cleaning has 8,582,171 customer trades in 307,126 bonds. The second use of the trade data is to estimate transaction costs as our measure of bond liquidity, following the methodology developed by Harris and Piwowar (2006) (explained in detail in the Internet Appendix). We estimate transaction costs for the full trade sample period, as well as separately for the three sub-sample periods: pre-crisis (2005–6/2007), crisis (7/2007–6/2009), and post-crisis (7/2009–end). We plot the transaction cost estimates for the full sample in Internet Appendix Figure A.3. Here, we observe that in the period following improved disclosure of trade prices via EMMA, the transaction cost (half-spread) on a $5,000 trade fell from roughly 135 basis points (bps) to roughly 85 bps.[12]

4. The value of insurance

4.1 Value of insurance in the secondary market

Figure 1 provides ex post anecdotal evidence of the insurance value following a municipal default. However, municipal defaults are rare and the documented price impact of insurance varies, apparently providing a (puzzling) negative value during financial crisis when it is needed most. We hypothesize that this yield inversion documented previously in secondary markets is a consequence of the turmoil in the insurance industry during the crisis period, coupled with the facts that (1) muni investors rely heavily on insurer credit rating and (2) rating agencies were slow to update insurer ratings; see Cornaggia et al. (2018b).

In order to test our hypothesis, we first establish a baseline estimate of insurance value following Bergstresser et al. (2010). Specifically, we run the following regression on the cross-section of bond-trade observations separately for each month and each underlying credit category, controlling for bond characteristics and trade characteristics:

$$\begin{aligned} y_{i,j} = {} & I_{buy,i,j}(\beta_1 + \beta_2 \text{LnTradeSize}_{i,j}) + I_{sell,i,j}(\beta_3 + \beta_4 \text{LnTradeSize}_{i,j}) \\ & + \beta_5 \text{Mat}_i + \beta_6 \text{Mat}_i^2 + \beta_7 \text{LnIssueSize}_i + \beta_8 \text{LnBondSize}_i + \beta_9 I_{insured,i} + \epsilon_{i,j}, \end{aligned} \tag{1}$$

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12. The results from our transaction cost functions complement the event study from Chalmers et al. (2017).

where $y_{i,j}$ is the trade yield on bond *i* and trade *j*. *Mat* is the maturity of the bond, and Mat^2 is included in the regression to account for non-linear effects of maturity on trade yield. *LnBondSize* is the logged size of the bond and *LnIssueSize* is the logged size of the issue that includes the bond. *LnTradeSize* is the logged size of the trade, with I_{buy} or I_{sell} indicating whether the trade is a customer buy or customer sell. The value of insurance is reflected in β_9, the coefficient on the insurance dummy Iinsured that captures the difference in trade yields between insured and uninsured bonds, holding all else constant. If insurance is valuable, we should observe negative β_9 indicating that insurance lowers the trade yield (or equivalently, increases the value of the bond).

Table 1 shows the estimated value of insurance based on the specification in Equation (1) for each underlying rating category. Panel A reports the time-series average of β_9 based on 36 monthly regressions for the pre-crisis period from 2005 through 2007. Panel B reports β_9 based on 132 monthly regressions for the period from 2008 through 2018. Alongside the estimates, we report the t-statistics (*t-stat*) and the average number of bond-trade observations (*Nobs*) in the monthly regressions for the given underlying rating category. We compute t-statistics for the average estimates using the corresponding time-series standard errors.

Despite our longer sample period and more complete credit rating histories, we find largely similar results to those in Bergstresser et al. (2010) in Table 1: (1) the pre-crisis insurance coefficients are invariably negative in Panel A, confirming that trade yields on insured bonds are lower than those of uninsured bonds across all underlying rating categories; (2) Panel B shows yield inversion (i.e., positive estimates) in the 2008–2018 period on insured bonds with high underlying credit quality (A and above ratings) or without ratings. However, different from Bergstresser et al. (2010), we find that insurance is still valuable to relatively low-quality bonds (Baa rating).[13] The trade yields on these bonds are about 66 bps lower than those on their uninsured counterparts. The results here suggest that the deterioration of insurance quality through the crisis (resulting in the lost opportunity to purchase Aaa certification) helps explain why the value of insurance inverts only on higher quality bonds.

The analysis in Bergstresser et al. (2010) assumes that all insurers provide the same insurance value. This is likely reasonable in the pre-crisis period when virtually all major insurers are Aaa-rated. However, as discussed in Cornaggia et al. (2018b) and references therein, the monoline insurers were downgraded in 2008 and 2009 and went through bankruptcies or restructuring activities. MBIA and AMBAC lost their Aaa certification in June 2008. After the newly established Berkshire Hathaway Assurance Corp lost its Aaa rating in April 2009, there are no remaining Aaa-rated monolines. Insurers' ratings are at best Aa, others A or Baa. If the secondary market prices insured bonds at the insurance rating rather than the underlying rating as suggested by the results from Cornaggia et al. (2018b), then such bonds could exhibit yield inversion following the insurer's downgrade.

To test the role of contemporaneous insurer rating, we augment the regression model specified in Equation (1) with indicators to differentiate insurers' credit quality:

$$\begin{aligned} y_{i,j} = {} & I_{buy,i,j}(\beta_1 + \beta_2 \text{LnTradeSize}_{i,j}) + I_{sell,i,j}(\beta_3 + \beta_4 \text{LnTradeSize}_{i,j}) + \beta_5 \text{Mat}_i \\ & + \beta_6 \text{Mat}_i^2 + \beta_7 \text{LnIssueSize}_i + \beta_8 \text{LnBondSize}_i + \beta_{Aaa} I_{Aaa} \\ & + \beta_{Aa} I_{Aa} + \beta_A I_A + \beta_{Baa} I_{Baa} + \epsilon_{i,j} \qquad (2) \end{aligned}$$

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13. We exclude from our analysis a handful of non-investment grade bonds.

where I_{Aaa}, I_{Aa}, I_A, and I_{Baa} indicate whether the contemporaneous insurer's rating is Aaa, Aa, A, or Baa. Because Moody's provides a more comprehensive coverage of the monoline industry, we use Moody's for insurers' rating histories. The exception is the new entrant BAM which is rated only by S&P during our sample period. Based on this history, we assign the prevailing insurer's credit quality for each bond at the time of each trade.

The value of insurance for each insurance rating category is captured by β_{Aaa}, β_{Aa}, β_A, *and* β_{Baa} respectively. As before, we run the regressions separately for each month and each underlying rating category. We report the time-series average of insurance value estimates over the period since the crisis in Table 2.[14] In the trade data for this period, the percent of insured bond-trade observations with Aaa-rated insurance falls to about 9.5% from 96% in the pre-2008 period; Aa-, A-, and Baa-rated insurance increases to about 26%, 22%, and 27% respectively (with the remaining portion below investment grade or unrated). In addition to each insurance value estimate and its corresponding t-statistic, we also report the number of monthly regressions (*Nregs*) for which such value is estimable (requiring observations with such insurance rating in monthly cross-sections). Here, several important results emerge.

First, Aaa-rated insurance continues to be valuable in the post-crisis period. All estimates are significantly negative and the value is higher for lower underlying quality. There is no yield inversion if the insurance is of the highest quality (Aaa), although such Aaa insurance exists for only a few months into the crisis period. Second, we observe yield inversion only when the contemporaneous insurance rating is at or below the underlying rating, and not when insurance rating is above the underlying rating. For example, the Aa-rated insurance wrap is valuable to A- and Baa-rated bonds but not valuable to bonds whose underlying credit quality is already Aa. Likewise, A-rated insurance is valuable to Baa-rated bonds, but not Aa- and A- rated bonds.

Still, the finding that insurance has negative value for high quality bonds is puzzling. One possible explanation is that these bonds originally carry Aaa-rated insurance. When that insurance value subsequently falls due to downgrades of the monolines, investors who demand Aaa-certification sell (or are forced to sell) these bonds. To test this hypothesis, we split our sample into two sub-samples: 1) the "lost Aaa" sub-sample, consisting of bonds issued prior to 2008 and insured by the four major pre-crisis Aaa-rated insurers (MBIA, AMBAC, FGIC, and FSA), together with the "control" bonds being uninsured bonds issued prior to 2008, and 2) the "never Aaa" sub-sample, consisting of bonds issued after 2008 during which only Aa-or-below insurance wrap is available, together with the "control" bonds being uninsured bonds issued after 2008. We then rerun our regression model specified in Equation (2) on these sub-samples. To save space, we tabulate these results in Internet Appendix Table A.2 in Panels A and B respectively.

Contrary to expectations, we observe in Panel A no yield inversion among bonds that previously carried Aaa insurance, and thus cannot attribute secondary market yield inversion to portfolio rebalancing following the monoline downgrades. Panel B indicates that the yield inversion occurs among high quality bonds issued after the crisis when Aaa insurance is no longer available. Only lower-quality bonds exhibit lower yields associated with insurance. This result leads us to conclude that the yield inversion phenomenon documented since the crisis is likely due at least in part to the disappearance of Aaa insurance wrap in the market place and the new lower (and more diverse) insurance quality era. Without Aaa certification, insurance does not provide clear benefit to investors in highly-rated munis.

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14. In untabulated results for the pre-crisis period, we find almost identical findings to those in Table 1.

4.2 Value of insurance in the primary market

Although a small number of bonds are insured directly by investors in a secondary market, insurance is typically paid for by municipal issuers at the time of issuance.[15] The primary contribution of this paper is an assessment of the direct benefits of this insurance to the taxpayers paying the premiums, addressing the endogenous choice to insure. We measure these direct benefits as the reduction in offering yield attributable to the insurance coverage, controlling for other factors. We start with the unconditional differences between insured and uninsured bonds to develop a sense for the determinants of insurance. We then control for publicly- and commercially-available issuer and time-period specific characteristics using OLS regressions. Finallly, we control for the endogenous choice by issuers to insure their bonds with semi-parametric and robust selection-adjusted models.

4.2.1 Unconditional values of insurance

Table 3 shows the unconditional differences in offer yields and other characteristics between insured and uninsured bonds over time. Positive differences reflect higher values for insured bonds compared to uninsured bonds. Over the entire sample period, insured bonds' offering yields are 48 bps higher than uninsured bonds on average. However, as the subperiod analysis reveals, this positive difference is driven by the 2008–2016 period, during which insured bonds reflect lower-rated insurance purchased mostly by relatively low-rated issuers. In contrast, insured bonds issued in the pre-crisis period exhibit higher-rated insurance, higher-rated issuers, on average, and thus exhibit lower average yields. In addition to differences in ratings and yields, we observe that insured bonds are smaller in issue size and have longer maturities, providing preliminary guidance on the selection effect we address in subsequent sections.

The distributions of insured and uninsured offering yields, plotted in Panels A and B of Figure 2, demonstrate that the change between the pre- and post-crisis period is not only in the central tendency, but a shift in the entire distribution. The distribution of insured yields is lower than that of uninsured yields prior to the crisis, but shifts higher during and following the crisis. We investigate this distributional shift by rating category and find that the yield inversion in Panel B exists for bonds rated Aa or A (the majority of bonds as per Table A.1). For bonds rated Baa and below, we find no yield inversion in the post-crisis period, as shown in Panel C of Figure 2.

We further test whether the yield inversion in Panel B is driven by 2008 specifically and the flight-to-quality during the crisis. We plot (but do not display) the density separately by year and find that the yield inversion exists in each year since 2008, which rules out any particular vintage effect. Similarly, we replicate the density shown in Panel C separately by year and find that the insured bond yield distributions are lower than uninsured bond yield distributions for these lower-rated issuers in each year.[16]

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15. Our insurance dummy reflects the insurance status at issuance. We discard a small number of bonds where investors pay for secondary market insurance.

16. Figures by year and by each rating category are available from the authors.

4.2.2 OLS estimates of insurance value

Using an expanded version of the model employed by Kidwell et al. (1987) and a modified version of their methods, we extend their (1975–1980) analysis to the 1985–2016 period. We first estimate a pooled multivariate regression model including an insurance dummy as an explanatory variable. We then re-estimate the model only for uninsured bonds, and use the parameter estimates to predict the offering yields on insured bonds with equivalent characteristics ("fitted yield"). The direct benefit of insurance is then the difference between the actual yield and the fitted yield. Negative values indicate a gain to the issuer because the insured bond is issued with a lower yield than an observationally equivalent uninsured bond. Based on mandatory insurance premium disclosures in CA and TX, we note that insurance premium is paid as a separate fee and not part of the offering yields.

We model offering yields in a fashion similar to specifications standard in the literature, but expand the set of explanatory and control variables to incorporate publicly- and commercially-available data on the issuer, issue, and the state of the economy at the time of issuance:

$$
\begin{aligned}
\text{OffYield}_{it} = {} & \alpha + \beta_1\text{Insured}_i + \beta_2\text{LnBondSize}_i + \beta_3\text{LnIssueSize}_i + \beta_4\text{Maturity}_i \\
& + \beta_5\text{Maturity}_i^2 + \beta_6\text{CallDummy}_i + \beta_7\text{I.Rating}_i + \beta_8\text{I.UnderwriterDec}_i \\
& + \beta_9\text{NumOfAgents}_i + \beta_{10}\text{BankQlf}_i + \beta_{11}\text{Comp}_i + \beta_{12}\text{Neg}_i + \gamma_1\text{MacroVar}_t \\
& + \gamma_2\text{BiggerState}_i + \gamma_3\text{UseOfProceeds}_i + \gamma_4\text{PrevInsurance}_i + \epsilon_{it}, \qquad (3)
\end{aligned}
$$

where $OffYield_{it}$ is the offering yield of bond i issued in month t. The indicator variable *Insured* captures the difference in offering yields between insured and uninsured bonds, holding all else constant. If insurance is valuable, we should observe negative β_1 indicating that insurance lowers the offering yield. An ideal specification would include issuer or even issue fixed effects (FE) as well as year FE to most cleanly estimate the price effect of insurance, holding all else constant. However, the occurrence of partial insurance (some cusips insured and other cusips uninsured within the same issue) is extremely rare. In fact, partially insured issues account for less than 2% of our Mergent universe (760,084 GO bonds across 55,408 issues).[17] Therefore, issue FE would force identification from this tiny subsample which may not be representative. Moreover, most issuers who issue multiple times in the data do so across years. Because we control for year FE, the inclusion of issuer FE would force identification from a tiny subsample of frequent issuers, which tend to be of the highest credit quality. Given that issues are generally 100% insured or 100% uninsured across the term structure, we include year FE and control for observable characteristics in our model.

We include the following explanatory variables. *LnBondSize* is the logged size of the bond and *LnIssueSize* is the logged size of the issue that includes the bond. *Maturity* is the maturity of the bond, and $Maturity^2$ is included in the regression to account for potential non-linear effects. *CallDummy* indicates whether the bond is callable. We include indicators for each rating category, using unrated bonds as the omitted category. Since it is likely that underwriters and advisors influence the choice to buy insurance, we include $I.UnderwriterDec_i$ which are dummy variables representing whether the bond issue

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17. From the 55,408 GO bond issues in our Mergent data, 34,222 (61.76%) are completely uninsured, 20,105 (36.29%) are fully insured, and 1,081 (1.95%) have partial insurance. In these rare cases, the insured and uninsured cusips exhibit variation in duration (both maturity and coupon rates) which should result in different offer yields irrespective of the insurance value.

was underwritten by an underwriter in the 1st, 2nd, 3rd, etc. decile of insured/uninsured issuance in the year the bond was issued and $NumOfAgents_i$ for the total number of advisors and underwriters associated with the bond issue. We include an indicator for whether the bond is bank qualified (*BankQlf*) and dummy variables for whether the issue is negotiated (*Neg*) or competitively offered (*Comp*); a substantial fraction of issues have no information which we include as a base category. *MacroVar* is a vector of macro-economic factors including contemporaneous Baa–Aaa credit spread, the slope of the yield curve (10Y–1Y Treasury yields), the 10Y Treasury constant maturity yield, and the inflation rate. The vector *BiggerState* includes fixed effects for the 10 largest issuing states (plus NJ, which we include as a high state/local tax jurisdiction) to control for variation in offer yields based on variation in state tax rates or other home biases.[18]

We add a vector of dummy variables in *UseOfProceeds* for the issues' primary purpose, creating categories for General Purposes, Water and Sewer, K-12 Education, Higher Education, and All Other Uses. Lastly, since the choice to purchase insurance may persist over time, we include *PrevInsurance* indicating whether the issuer insured nearly all, none, or a mixed amount of their issues in the previous period (pre–2000, 2000–2007, and 2008–2016). In summary, we believe we control for publicly- and commercially-available information expected to influence municipal bond prices. We report the results from Equation 3 in Table 4 by time period and observe explanatory power greater than 90%.

Next, we estimate fitted yields for insured bonds by re-estimating the model in Equation (3) using only uninsured bonds, by year, and use those parameter estimates to predict the offering yields on insured bonds with equivalent characteristics. The direct benefit of insurance is then the difference between the actual yield and the fitted yield, which we plot year-by-year in Panel (a) of Figure 3. Negative values indicate a gain to the issuer because the insured bond is issued with a lower yield than an observationally equivalent uninsured bond. Because insurance tends to be purchased by smaller issuers, we plot in red bars the size-weighted difference in yield (which more accurately captures the economic effects of the yield differences) as well as equally-weighted differences (in black bars). The numbers underlying Figure 3 are tabulated in Internet Appendix Table A.3. Based on size-weighted differences, the yield benefit of insurance is roughly 3.3 bps for the entire sample (7.5 bps based on equal weighting); by either measure, the benefits dissipate after 2011.

Assuming taxpayers paying the issuance costs care more about dollars than basis points, we translate the difference in yields to dollar gains and losses. We plot these results in Panel (b) of Figure 3 and provide the underlying estimates in Table A.3. However, translating mean differences in offering yields into dollar costs is not simple multiplication; multiplying the mean difference in yield for any given year by the total issuance amount in that year produces biased estimates of economic impact due to heterogeneity (insured bonds tend to be longer maturity and smaller size). To estimate the total economic cost/benefit of insurance to issuers in dollar terms, we first multiply the difference in offering yield at the bond level by bond size. We then treat this amount as an annuity paid each year until the bond's maturity and calculate the present value using the 1-year US Treasury rate at issuance before aggregating across bonds. We report this aggregate number as the "Dollar Loss" in millions in Table A.3 and then convert into percentage terms by dividing by the aggregate amount of insured debt that year.[19] From Table A.3

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18. Excluding these state dummies does not materially affect our estimates.

19. We discount at the riskfree rate here for two reasons. First, it is consistent with the present valuing of insurance promised and not yet paid in the financial statements of the insurers, which is done at the riskfree rate. Second, we attempt to not introduce

and Figure 3 Panel (b), we see that not only is the post-crisis period marked by losses, but also several pre-crisis years starting as early as 1997.

As prior results indicate that insurance value is a function of the underlying credit rating of the bond, relative to the credit rating of the insurer, we report next the yield differences and dollar gains (losses) by rating category in Table 5. Here, we observe that the highest-rated purchasers subsidize lower-rated purchasers of insurance over the entire 30-year period. In terms of size-weighted yield differences, we observe yield inversion in bonds rated Aaa, Aa1 and Aa3. However, in dollar terms, we observe losses on average to issuers rated Aaa, Aa1, Aa3, and A1 with gains accruing on average to issuers rated A2 and below. Because Table 5 estimates the gross value of insurance, premiums erode the net gains substantially. From column (6) in Table 5, we see that the aggregate dollar gain from insurance is approximately $496 million. For context, this aggregate gain over 30 sample years is comparable to the $458 million in domestic premiums collected by a single insurer (MBIA) in one year (2004).

Together, results from Figure 3, Table A.5, and Table 5 indicate that insurance provides gross value on average in the pre-crisis period (when insurance provided Aaa-certification) but not the post-crisis period, and that the over-insurance phenomenon is greatest among highly rated issuers who appear to subsidize relatively low-rated issuers. Next, we estimate selection adjusted models to further address the possibility that within each group with common characteristics (e.g., credit ratings) only the poorest quality issuers purchase insurance.

4.2.3 Selection-adjusted models of insurance value

Although the choice to insure may reflect unobservable factors, such as risk aversion among public officials, bond prices (offering yields modeled above) reflect factors observable to underwriters and investors. Our OLS model (Equation 3) controls for observable characteristics and macroeconomic variables that are publicly and commercially available. We further control for selection bias here in two ways.

First, we use a classic propensity scoring model to estimate the probability of insurance usage using a probit model of selection. Because prior literature provides little theoretical guidance regarding municipalities' choice to insure, we use a "kitchen-sink" approach employing all the covariates in Equation (3), replacing offering yield with the insurance dummy as the dependent variable. We then match each treated (insured) bond to its 3 nearest (uninsured) neighbors based on this score and calculate the yield differences. We calculate standard errors as in Abadie and Imbens (2016) to account for the fact that the scores themselves are estimates. Table 6 presents the marginal effects from the probit equation. We observe that longer maturity and larger bonds are more likely to be insured, as are lower-rated bonds. However, there is no apparent relationship between callability and the choice to purchase insurance. Water bonds are significantly more likely to be insured than those for general purposes. State effects are not tabulated to save space, but we observe that issuers in PA, NJ, and CA are more likely to insure their bonds than issuers in TX, MD, or MN, controlling for credit quality.

We also find that insurance choices are very persistent, with heavy purchasers of insurance in previous periods much more likely to purchase insurance in the current one. This result provides one possible explanation for the over-insurance phenomenon in the post-crisis period. Psychologists attribute

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another potentially correlated source of heterogeneity by discounting at the offering yield. Discounting at the offering yield leads to a slightly smaller loss than we report; not discounting at all leads to a slightly larger one.

other instances of self-defeating behavior, such as institutional and personal under-reaction to climate change, in part to "behavioral momentum" or habit.[20] In short, some public officials may choose to insure their bonds in the post-crisis period simply because they have historically done so.

We present the result from the propensity-scoring method in Panel A of Table 7. Control ling for the decision to insure, insurance saves issuers approximately 2.7 bps in yield over the entire period. This gross saving is similar to the average premiums charged by insurers (documented by Liu, 2012 and Ely, 2012), but this average obscures significant variation across periods. Prior to the crisis, gross insurance value is consistent with estimates by Kidwell et al. (1987). After the crisis, lower rated insurance does not lower yields. This pooled-by-period model, controlling for the time variation in macroeconomic variables, facilitates the best matches and Panel A results indicate that the results in Figure 3 and Table 5 are not entirely attributable to a selection effect.

Second, we use an inverse-probability weighted regression adjustment (IPWRA) model to overcome any remaining concern over selection model misspecification. The IPWRA method, originally proposed by Cattaneo (2010), controls for selection effects by augmenting the regression for the outcome variable (offering yields) with probability weights derived from a probit model for the selection variable (the insurance choice). The key advantage is that estimates are consistent if either the outcome model or the selection model is correct. In our case, this approach allows us to leverage our confidence in the model for the outcome variable: high explanatory power and informed by a rich literature on the determinants of offering yields while controlling parametrically for the choice of insurance. We specify the outcome and selection equations as follows:

$$\begin{aligned}\text{OffYield}_{it} = {} & \alpha + \beta_1\text{LnIssueSize}_i + \beta_2\text{Maturity}_i + \beta_3\text{Maturity}_i^2 + \beta_4\text{I.Rating}_i \\ & +\beta_5\text{CallDummy}_i + \beta_6\text{BankQlf}_i + \beta_7\text{Comp}_i + \beta_8\text{Neg}_i \\ & +\gamma_1\text{MacroVar}_t + \gamma_2\text{BiggerState}_i + \gamma_3\text{UseOfProceeds}_i + \epsilon_{it}, \qquad (4)\end{aligned}$$

$$\begin{aligned}\text{Insured}_i = {} & \alpha + \beta_1\text{LnIssueSize}_i + \beta_2\text{Maturity}_i + \beta_3\text{Maturity}_i^2 + \beta_4\text{I.Rating}_i \\ & +\beta_5\text{I.UnderwriterDec}_i + \beta_6\text{NumOfAgents}_i + \beta_7\text{BankQlf}_i + \beta_8\text{Comp}_i \\ & +\beta_9\text{Neg}_i + \beta_{10}\text{CallDummy}_i + \gamma_1\text{BiggerState}_i + \gamma_2\text{UseOfProceeds}_i \\ & +\gamma_3\text{PrevInsurance}_i + \epsilon_i. \qquad (5)\end{aligned}$$

Note that β_4 and β_5 in Equation (5) are vectors of coefficients for ratings and underwriter decile dummies. State fixed effects control for variation in demand for insurance based on variation in state and local income tax rates or other jurisdictional differences.

We present the results from the IPWRA analysis in Panel B of Table 7 for the full period and subperiods. In the full period, insured yields are 5.4 bps lower than uninsured yields. This gross value of insurance is driven primarily by the pre-crisis period (when insurance provided Aaa-certification) and appears economically small relative to the premiums reported by the public insurers over that period. In the earliest subperiod (1985–1999), the average gross benefit of insurance to issuers is approximately 9 bps. In the "heyday" of bond insurance (2000–2007), when more than half the market was insured, the

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20. See, e.g., "Psychology and Global Climate Change: Addressing a Multi-faceted Phenomenon and Set of Challenges: A Report by the American Psychological Association's Task Force on the Interface Between Psychology and Global Climate Change", page 129, available online at the APA website at http://www.apa.org/science/about/publications/climate-change.aspx

average gross benefit is 8.6 bps. This gross benefit reverses after 2008, with insured bonds facing 3.9 bps higher yields on average than uninsured bonds after controlling for characteristics and selection in a doubly-robust empirical model. Put differently, the unconditional difference of 63 bps in offering yields in the post-crisis period observed in Table 3 is narrowed to 3.9 bps by controlling for endogeneity and characteristics, but in no model is it completely erased.

We further test the robustness of our results to the inclusion of only the four big largest state (CA, NY, IL, TX) dummies in both regressions; big four state dummies in the outcome equation and all state dummies in the selection equation; raw and quadratic maturity effects in both equations; and interactions of issue amount and rating in the selection equation. All of these specifications (available from the authors) produce similar results for the mean offering yield by insurance status.

Overall, insurance provides gross value, on average, only when insurance provides Aaa certification. In the post-crisis period, when insurance companies are no longer rated Aaa, insurance provides gross value only to the lowest-rated issuers. Over time, the substantial premiums paid by highly-rated issuers represent negative value to those taxpayers and subsidization of the lower-rated issuers. Many issuers appear to be leaving substantial money on the table. We explore next the cross-sectional variation in this over-insurance phenomenon.

5. Alternative explanations

We hypothesize the choice of some issuers to over-insure their bonds reflects in part agency problems with respect to the public officials making decisions on behalf of taxpayers and conflicts of interest between issuers and underwriters, and perhaps issuers and their advisors. We explain these hypotheses and provide some empirical tests in Section 5.1. In Section 5.2, we explore bond liquidity as a potential alternative motivation for insuring bonds. In particular, many issuers in our sample participate in advanced refunding, which Ang et al. (2017) demonstrate is often done prematurely and at negative value. To the extent that issuers value secondary market liquidity toward this end, it is possible that they purchase insurance with the expectation that insuring their bonds improves bond liquidity. To assess bond liquidity as an explanation for over-insurance, we formally test the premise that insurance lowers secondary market transaction costs.

5.1 Agent incentives

In order to test cross-sectional differences in over-insurance, we first quantify the "money left on the table" for individual insured bonds in our sample. Using the difference in yield from the model in Equation 3, we calculate the dollar loss per bond as described in Section 4.2.2. We then scale the dollar loss by bond size and express the fraction in basis points. Our measure thus represents the fraction of total proceeds "left on the table" (and not a measure of yield). We then use this measure to examine the potential role of agency problems and conflicts of interest.

First, we consider potential agency problems between public officials and the taxpayers they represent. Because individual public officials (agents) bear the reputation costs of any problems associated with bond issuance (but bear only a small fraction of the costs associated with insurance expenditures) we expect agent risk-aversion to lead some public officials to over-insure their bonds. Such agency problems are potentially exacerbated by heterogeneity in issuer sophistication and corruption among public officials.[21] Evidence of behavioral momentum (habit) in Table 6 (whereby issuers who historically insured their bonds continue to do so in the post-crisis period, even though insurance no longer provides Aaa-certification) suggests that variation in issuer sophistication plays a role.

Butler et al. (2009) report that issuers in states with higher corruption, and indication of low government quality, face higher offer yields on their bonds. We conjecture that low-quality governments leave taxpayer money on the table for a variety of reasons including corruption and lack of due diligence. We test this conjecture with data drawn directly from administrative records of contemporaneous court filings compiled via FOIA requests by the Transactional Records Access Clearinghouse (TRAC).[22]

From these reports, we calculate the number of convictions and prosecutions per million persons for official corruption for each year and federal judicial district. Rather than aggregating these districts to the state level, we exploit the extra granularity provided and map each issuer to their geographic county and then map these counties to federal judicial districts.[23] Finally, following Butler et al. (2009), we compute dummy variables (High Convictions and High Prosecutions) if the bond issue is in a county within a federal judicial district that has population-adjusted conviction or prosecution rates above the 25th percentile of the cross-sectional distribution of rates in that year. The High Conviction variable proxies for the degree of corruption and the High Prosecution variable indicates the strictness of enforcement (corruption deterrent).

Table 8 Columns (1) and (2) present a regression of our measure of over-insurance ("money left on the table") on these variables and their interaction, controlling for bond characteristics, ratings dummies, year effects, and state dummies.[24] Higher corruption (as measured by conviction rates) is associated with more over-insurance whereas more aggressive prosecutions – serving as deterrence to official misconduct – are associated with less. Including the effects of the interaction of the two concepts conveys additional insight. High convictions and low prosecutions, most indicative of a corrupt environment, are associated with significantly higher economic losses (more money left on the table). In contrast, those municipalities with high prosecutions and high convictions (presumably those with the most effective deterrence) have significantly lower economic losses. Our results thus support the hypothesis that cross-sectional variation in over-insurance – an indicator of municipal underperformance in the bond issuance market – is linked to the quality of municipal governance.

We explore next the potential role of conflicts of interest among underwriters and municipal advisors. The conflicts of interest among influential underwriters are clear; underwriters take the opposing side of a zero-sum transaction and have no fiduciary duty to issuers. To the extent that underwriters hold inventory over any period, they benefit from the intrinsic value of the insurance paid for by the issuer. Conflicts of

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21. Rare defaults in GO bonds are commonly associated with corrupt public officials. Former Detroit Mayor Kwame Kilpatrick faces 28-year prison sentence for multiple corruption crimes including extortion, bribery, fraud and conspiracy (see, e.g., "Ex-Detroit mayor Kwame Kilpatrick lands in NJ prison with a camp," Detroit Free Press, June 6, 2018). Regarding official corruption leading to default in Jefferson County, AL, see e.g., "One year ago Jefferson County emerged from bankruptcy. Did Wall Street fleece the County Commission?" Birmingham Real-time news on AL.com, December 3, 2014.

22. Our data from TRAC (a nonpartisan data gathering, data research, and data distribution organization associated with Syracuse University) is not subject to the problems identified by Cordis and Milyo (2016).

23. We are grateful to Zihan Ye for providing us with the geographic mapping data.

24. We use as state dummies all states with more than one federal judicial district for these regressions.

interest among influential municipal advisors are derivative. Municipal advisors give advice on bond issuance, the investment of proceeds, escrow management, derivatives use and they solicit business for third parties. Prior to 2014, underwriters performed a dual role advising the issuers to whom they had no fiduciary duty. In the latter years of our 1985–2016 sample period, the MSRB imposes the following new regulations:

- In March 2015, the SEC approves amendments to MSRB Rules G-2, G-3, and D-13 establishing professional qualification requirements for municipal advisors, including the Series 50 examination.
- In November 2015, the SEC approves amendments to MSRB Rules G-20 imposing pay-to-play restrictions and restrictions on gifts and gratuities. Original restrictions in place since October 2005.[25]
- In December 2015, the SEC approves Amendments No 1 and No 2 to MSRB Rule G-42 establishing the first fiduciary duties (of care and loyalty) on municipal advisors.

However, SEC (2017) and Bergstresser and Luby (2018) report troubling non-compliance with these new regulations. Although the advising and underwriting functions for any particular bond issuance were statutorily separated in 2014, some advisors are affiliated with broker-dealers that also provide underwriting services.[26] In light of these potential conflicts of interest, we further hypothesize that advisor and underwriter influence increases with their market share, which we proxy by deal volume.[27]

To test whether influential advisors and underwriters are more associated with economic losses for issuers, we form dummy variables for Large Advisors or Large Underwriters indicating the advisor or underwriter is in the top decile of advisory business or underwriting by volume in that year. We then regress our measure of over-insurance on the Large Advisor and Large Underwriter dummies and report the results in Columns (3) and (4) of Table 8. We find some support for our conjecture that issuers leaving more money on the table are advised by influential advisors or working with influential underwriters. The effect is stronger when influential advisors are combined with small underwriters, or vice versa. When both advisors and underwriters are in the top decile – likely indicative of the most sophisticated issuers – we find no significant effect. Overall, the results in this section indicate that the over-insurance phenomenon is correlated with agency problems between public officials and the taxpayers they represent and with conflicts of interest among underwriters and advisors.

5.2 Liquidity value of insurance

The Tax Cuts and Jobs Act makes previously tax-exempt interest on advanced refunding bonds taxable, essentially eliminating the advantages and appeal of such bonds after December 31, 2017. However, advanced refunding was common during our 1985–2016 sample period (see, e.g., Ang et al., 2017). To the

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25. See http://www.msrb.org/Rules-and-Interpretations/Regulatory-Notices/2005/2005-52.aspx?n=1

26. Registration of Municipal Advisors; Temporary Stay of Final Rule, Release No. 34-71288 (January 13, 2014), 79 FR 2777 (January 16, 2014), available at http://www.sec.gov/rules/final/2014/34-71288.pdf

27. For an example of suboptimal advice by one of the largest municipal advisors (regarding the use of derivative contracts), see https://www.centredaily.com/news/article42817461.html

extent that issuers value secondary market liquidity in order to facilitate advanced refunding, it is possible that they purchase insurance with the expectation that insuring their bonds improves the bonds' liquidity. To assess bond liquidity as an explanation for over-insurance, we formally test the premise that insurance lowers secondary market transaction costs.

We plot the transaction cost curves for insured bonds and non-insured bonds in Figure 4. The figure indicates that on average, insured bonds are slightly more expensive to trade. However, this figure masks any additional heterogeneity among bonds. We thus estimate a weighted least squares regression of transaction cost on the insurance dummy $I_{insured}$, controlling for bond characteristics (bond size, issue size, maturity, coupon, bank-qualified status, whether the bond is issued at a discount or premium), dummy variables for issuer ratings (*I.Rating*), state fixed effects for the top 10 states (in terms of GO bond issuance volume), and macroeconomic variables at the time of bond issuance (*MacroVar*). Macroeconomic variables include the Baa–Aaa credit spread, the slope of the yield curve measured by the difference between the 10Y and 1Y Treasury yields, the 10Y Treasury constant maturity yield, and the inflation rate. Following Harris and Piwowar (2006), the weights used in the regression are the inverse of the estimated variance of the transaction cost estimate appearing on the left hand side of the regression model:

$$\begin{aligned}\text{TransCost}_i = \alpha + \beta_1 \text{I}_{insured,i} + \beta_2 \text{LnBondSize}_i + \beta_3 \text{LnIssueSize}_i + \beta_4 \text{LnMaturity}_i \\ +\beta_5 \text{Coupon}_i + \beta_6 \text{BankQlf}_i + \beta_7 \text{DiscountBond}_i + \beta_8 \text{PremiumBond}_i \\ +\gamma_1 \text{I.rating}_{it} + \gamma_2 \text{Top10State}_i + \gamma_3 \text{MacroVar}_i + \epsilon_i. \qquad (6)\end{aligned}$$

To save space, we report the results in Internet Appendix Table A.4. We run the regression for five trade sizes that reflect the most frequently occurring trade sizes at the retail and institutional levels. Once we properly account for the heterogeneity in the cross-section of insured bonds, it seems that insurance reduces transaction costs for larger trade sizes, but the magnitude of the reduction is economically small. The saving in transaction cost due to insurance is less than 2 bps, which is negligible when the (untabulated) average transaction cost is 85 bps for a $10,000 trade and 38 bps for a $200,000 trade.

To control for possible vintage effects not fully captured by macroeconomic variables prevailing at the time of bond issuance, we repeat the regression separately for three vintages of bond issue years: 1) bonds that are issued between 1985 and 1999, 2) bonds that are issued between 2000 and 2007, and 3) bonds that are issued between 2008 and 2016. We report the result of this vintage analysis in Internet Appendix Table A.4. Here, we report only the coefficient on the insurance dummy, our variable of interest, together with the adjusted R-squared from the regressions and the associated number of observations used. For bonds that are issued between 2000 and 2007, the golden era of the monoline industry with an almost universal Aaa insurance wrap, insurance delivers liquidity benefit, and the transaction cost savings occur for most trade sizes. For bonds that are issued from 2008 onward (when the industry goes through downgrades and restructurings and thus Aaa insurance is no longer available), there is no significant improvement in transaction costs for insured bonds, except for very small trade sizes ($20,000 and below). Overall, we conclude that the economic magnitude of the liquidity value of insurance, if any, is small.

Clearly, liquidity in markets changes through time and the financial crisis caused liquidity disruptions in many markets. To ensure that the crisis (or other time periods) is not causing our results, we repeat the transaction cost estimation procedure for 3 subperiods: 1) the pre-crisis sub-sample, which includes all trades between 2005 and June 2007, 2) the crisis sub-sample, which includes all trades between July 2007 and June 2009, and 3) the post-crisis sub-sample, which includes all trades between July 2009 and June 2016 (the end of our data sample). We find that the costs to trade small trade sizes steadily fall through all subperiods. For example, the cost to trade $5,000 in a muni bond is roughly 100 bps in the pre-crisis period, reduced to 96 bps in the crisis period and further to 83 bps in the post-crisis period.

We compare transaction costs of insured and uninsured bonds by subperiods in Internet Appendix Figure A.4. Contrary to insurers' claims, insured bonds in general have slightly higher transaction costs than uninsured bonds. Through the crisis and after the crisis, the transaction cost function of an average insured bonds increasingly converges to that of an average uninsured bond. To assess the statistical significance of the liquidity value of insurance after controlling for the cross-sectional variation in bond characteristics, we repeat the regression model in Equation (6) separately for the pre-crisis, crisis, and post crisis estimates of transaction costs, and report the coefficient on the insurance dummy in Internet Appendix Table A.5. Here, we see no difference in transaction costs of insured versus uninsured bonds during the crisis. Thus, liquidity is not likely to explain the yield inversion. After the crisis, insurance appears to save investors some transaction costs, but the magnitude of the saving (around 4 or 5 bps) is again economically small relative to the average transaction costs.

6. Conclusion

Our contributions to the literature are as follows. We provide an explanation (downgrade and bankruptcy of the monolines) for the municipal bond yield inversion previously documented in the secondary market during the financial crisis. We find that insurance remains valuable to investors, during the crisis and since, provided insurers maintain credit ratings higher than those of the underlying bonds they insure. Because most municipal bonds have ratings as high (or higher) than the bond insurers since 2008, the observed yield inversion obtains, on average, in the full cross-section of bonds. We also test whether insurance improves bond liquidity and find that the economic magnitude of this benefit is negligible. Overall, the secondary market evidence for insurance value to investors is limited in the post-crisis period.

We further examine the direct benefit of insurance to the issuers (taxpayers) paying the premiums. Here we find that insurance provides an average nine basis points of gross value across our broad sample of issuers in the pre-crisis period (1985–2007) when the monoline insurers were rated Aaa. However, in the post-crisis period when Aaa coverage is no longer available, we find that insurance provides no value for the overwhelming majority of issuers with credit ratings that are close to their insurers' ratings.

The post-crisis yield inversion we document in the primary market could result from some correlated risk variable omitted from our analysis. However, such an omitted variable would have to be (1) unimportant in the decades preceding the 2008 financial crisis, (2) suddenly significant in the post-crisis period, (3) known and observable to the (primarily retail) investors in these bonds, (4) known and observable to the municipal officials issuing and insuring bonds, (5) unknown or unobservable to the credit rating agencies, and (6) uncorrelated with macroeconomic variables for which we can obtain data. Given our comprehensive set of publicly and commercially available data, we believe it is unlikely that we omit important credit risk factors that are observable to the (primarily retail) investors in these markets.

Overall, we conclude that highly-rated issuers appear to be subsidizing the lower-quality issuers for whom insurance continues to provide positive gross value. We also conclude that the over-insurance phenomenon is influenced by agency problems between public officials and the taxpayers they represent and conflicts of interest among underwriters and municipal advisors. Our results commend additional regulatory efforts to enforce municipal advisor standards and better educate municipal issuers (heterogeneous in their sophistication) regarding the conflicts of interest inherent in underwriter incentives.

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TABLE 1: VALUE OF INSURANCE IN SECONDARY MARKET TRADING OF MUNICIPAL GO BONDS

The table shows the estimated value of insurance in the secondary market trading of municipal GO bonds, based on cross-sectional regressions of trade yields using the specification proposed in Bergstresser et al. (2010), i.e., $y_i = I_{buy}(\beta_1 + \beta_2 \text{LnTradeSize}) + I_{sell}(\beta_3 + \beta_4 \text{LnTradeSize}) + \beta_5 \text{MAT} + \beta_6 \text{MAT}^2 + \beta_7 \text{LnIssueSize} + \beta_8 \text{LnBondSize} + \beta_9 I_{insured}$. The regressions are run separately for each month and each category of underlying credit quality. β_9 captures the difference in trade yields between insured and uninsured bonds, holding all else constant, and reflects the value of insurance. Panel A reports the time-series average of β_9 estimates for the pre-crisis period, and Panel B reports that for the 2008–2018 period. t-statistics are computed as the time-series averages divided by the corresponding time-series standard errors. *Nobs* is the average number of bonds in a monthly regression for the given underlying rating category. Bond characteristics are from the Mergent Municipal FISD database, and trade data are from the MSRB. Rating data are collected from various sources as described in the text. The underlying credit rating is contemporaneous at the time of trade.

Panel A: Pre-crisis Period (2005–2007)

Underlying Rating	Estimate	t-stat	Nobs
Aa	-0.102	-23.03	18,383
A	-0.184	-32.10	16,032
Baa	-0.174	-26.94	2,689
Unrated	-0.197	-26.45	7,050
Number of monthly regressions: 36			

Panel B: Crisis and Post-Crisis Period (2008–2018)

Underlying Rating	Estimate	t-stat	Nobs
Aa	0.603	15.46	22,872
A	0.325	13.56	9,104
Baa	-0.660	-8.68	2,119
Unrated	0.347	13.77	9,871
Number of monthly regressions: 132			

TABLE 2: POST-CRISIS VALUE OF INSURANCE BY INSURANCE RATING

The table shows the estimated value of insurance for different insurance ratings in the secondary market trading of municipal GO bonds from the following regression model of the yield on trade *j* of bond *i*: $y_{i,j} = I_{buy}(\beta_1+\beta_2\text{LnTradeSize}_{i,j})+I_{sell}(\beta_3+\beta_4\text{LnTradeSize}_{i,j})+\beta_5\text{Mat}_i+\beta_6\text{Mat}_i^2 + \beta_7\text{LnIssueSize}_i+\beta_8\text{LnBondSize}_i+\beta_{Aaa}I_{Aaa}+\beta_{Aa}I_{Aa}+\beta_A I_A+\beta_{Baa}I_{Baa}+\epsilon_{i,j}$. The regressions are run separately for each month and each category of underlying creditquality. I_{Aaa}, I_{Aa}, I_A, and I_{baa} are dummies indicating whether the bond is insured by a *Aaa*-rated, *Aa*-rated, *A*-rated, and *Baa*-rated insurer at the time of trade, respectively. Reported in this table are the time-series average of β_{Aaa}, β_{Aa}, β_A, and β_{Baa} coefficients in the 2008–2018 period. t-statistics are computed as the time-series averages divided by the corresponding time-series standard errors. *Nregs* is the number of monthly regressions from which the value of insurance of the given rating class is estimable. Bond characteristics are from the Mergent Municipal FISD database, and trade data are from the MSRB. Rating data are collected from various sources as described in the text. Both the underlying and insurance credit rating are contemporaneous at the time of trade.

	Insurance Rating											
	Aaa			Aa			A			Baa		
Underlying Rating	Estimate	t-stat	Nregs	Estimate	t-stat	Nregs	Estimate	t-stat	Nregs	Estimate	t-stat	Nregs
Aa	-0.091	-8.74	11	0.177	9.15	127	0.798	17.34	82	0.261	9.34	132
A	-0.140	-4.53	16	-0.106	-5.88	131	0.157	6.64	84	0.299	7.71	132
Baa	-0.213	-8.95	11	-0.607	-13.28	132	-0.828	-6.88	86	-0.234	-3.92	132
Unrated	-0.200	-13.30	11	-0.100	-6.09	132	0.456	14.41	86	0.176	7.14	132

TABLE 3: DIFFERENCES IN VARIABLES OVER TIME

The table presents t-tests for differences in variables between bonds issued with insurance and without insurance. The raw means by insurance status are presented in the columns headed by "Uninsured" or "Insured". Yields and coupons are in percent, maturity is expressed in years and rating is numerically encoded in a scale where Aaa is 21 and Ba1 is 11. Differences that are significantly different from zero are flagged with ***,**, or * corresponding to 1%, 5%, and 10% significance level (two-sided).

Full Period: 1985-2016

	N(Ins.)	Insured	N(Unins.)	UnInsured	Diff.	Std. Error
Offering Yield	212,079	3.98	268,631	3.50	0.48***	0.0040
Coupon	212,079	4.41	268,631	4.15	0.26***	0.0037
Maturity	212,079	10.54	268,631	10.05	0.48***	0.0176
Bond Rating	212,079	16.16	268,631	18.44	-2.28***	0.0057
LN(Issue Amount)	212,061	16.04	268,415	16.25	-0.21***	0.0040
LN(Bond Amount)	212,079	12.98	268,631	13.29	-0.31***	0.0041
Num. of Agents	211,923	5.49	268,201	5.88	-0.39***	0.0071

Pre 2000 Period: 1985-1999

	N(Ins.)	Insured	N(Unins.)	UnInsured	Diff.	Std. Error
Offering Yield	47,171	5.01	63,262	5.21	-0.21***	0.0060
Coupon	47,171	5.37	63,262	5.59	-0.22***	0.0068
Maturity	47,171	10.40	63,262	10.47	-0.07*	0.0362
Bond Rating	47,171	15.64	63,262	17.79	-2.15***	0.0124
LN(Issue Amount)	47,153	15.90	63,046	16.06	-0.16***	0.0089
LN(Bond Amount)	47,171	12.88	63,262	13.04	-0.16***	0.0091
Num. of Agents	47,032	4.78	62,872	5.01	-0.23***	0.0145

Pre-Crisis Period: 2000-2007

	N(Ins.)	Insured	N(Unins.)	UnInsured	Diff.	Std. Error
Offering Yield	129,697	3.86	72,169	3.96	-0.10***	0.0041
Coupon	129,697	4.26	72,169	4.35	-0.09***	0.0039
Maturity	129,697	10.54	72,169	9.93	0.60***	0.0279
Bond Rating	129,697	16.43	72,169	18.65	-2.22***	0.0092
LN(Issue Amount)	129,697	16.17	72,169	16.31	-0.14***	0.0063
LN(Bond Amount)	129,697	13.09	72,169	13.32	-0.23***	0.0065
Num. of Agents	129,680	5.65	72,150	6.13	-0.47***	0.0108

Post-Crisis Period: 2008-2016

	N(Ins.)	Insured	N(Unins.)	UnInsured	Diff.	Std. Error
Offering Yield	35,211	3.06	133,200	2.43	0.63***	0.0071
Coupon	35,211	3.68	133,200	3.36	0.32***	0.0066
Maturity	35,211	10.71	133,200	9.92	0.80***	0.0371
Bond Rating	35,211	15.87	133,200	18.64	-2.76***	0.0104
LN(Issue Amount)	35,211	15.77	133,200	16.31	-0.55***	0.0081
LN(Bond Amount)	35,211	12.72	133,200	13.40	-0.68***	0.0083
Num. of Agents	35,211	5.84	133,179	6.16	-0.32***	0.0150

TABLE 4: DETERMINANTS OF OFFERING YIELD

This table reports the determinants of offering yields over the entire period using a pooled OLS regression, with standard errors clustered by issue. Variable definitions are in the text.

Variable	Full Period	1985–1999	2000–2007	2008–2016
Insured (Y/N)	-0.0576***	-0.128***	-0.0439***	0.0182
	(-12.62)	(-12.44)	(-7.70)	(1.66)
Call Dummy	0.226***	0.0833***	0.192***	0.353***
	(79.55)	(12.60)	(70.90)	(85.30)
LN(Bond Amount)	-0.0171***	-0.0109**	-0.0192***	-0.0116***
	(-9.03)	(-2.98)	(-7.80)	(-3.98)
LN(Issue Amount)	0.0193***	0.0294***	0.0165***	-0.00605
	(8.06)	(5.70)	(5.25)	(-1.60)
CAstate	0.0379***	-0.0251	-0.0399***	0.152***
	(5.32)	(-1.57)	(-5.60)	(11.86)
TXstate	0.108***	0.0697***	0.0636***	0.0262**
	(19.07)	(7.23)	(10.19)	(2.62)
NYstate	-0.0213***	0.0293**	-0.0618***	-0.0153
	(-3.87)	(2.90)	(-10.35)	(-1.37)
ILstate	0.152***	0.0631***	0.0646***	0.286***
	(16.31)	(4.32)	(6.60)	(15.71)
LN(Bond Maturity)	0.826***	0.665***	0.736***	1.020***
	(295.19)	(130.38)	(169.94)	(283.94)
Ba1 rated	0.0133	-0.234**	-0.464**	0.989***
	(0.16)	(-2.86)	(-3.14)	(20.71)
Baa2 rated	-0.0937	-0.0976	-0.559***	0.749***
	(-1.12)	(-1.22)	(-3.80)	(21.35)
Baa1 rated	-0.162	-0.135	-0.572***	0.674***
	(-1.95)	(-1.69)	(-3.89)	(20.09)
A3 rated	-0.266**	-0.280***	-0.595***	0.346***
	(-3.21)	(-3.53)	(-4.05)	(17.97)
A2 rated	-0.265**	-0.243**	-0.597***	0.296***
	(-3.21)	(-3.08)	(-4.07)	(18.04)
A1 rated	-0.297***	-0.270***	-0.625***	0.223***
	(-3.59)	(-3.42)	(-4.26)	(15.81)
Aa3 rated	-0.351***	-0.376***	-0.634***	0.146***
	(-4.24)	(-4.72)	(-4.32)	(11.69)
Aa2 rated	-0.402***	-0.390***	-0.644***	0.0797***
	(-4.86)	(-4.90)	(-4.38)	(6.90)
Aa1 rated	-0.443***	-0.426***	-0.647***	0.00794
	(-5.34)	(-5.34)	(-4.40)	(0.66)
Aaa rated	-0.484***	-0.456***	-0.676***	-0.0493***
	(-5.84)	(-5.71)	(-4.60)	(-3.99)
Bank Qualified	-0.0976***	-0.0760***	-0.0696***	-0.198***
	(-22.66)	(-9.27)	(-13.76)	(-24.37)
Macro Controls?	Yes	Yes	Yes	Yes
Adjusted R^2	0.914	0.896	0.830	0.889
Observations	480,199	109,994	201,796	168,409

TABLE 5: ACTUAL YIELD-FITTED YIELD FOR INSURED BONDS BY RATING

This table reports the mean difference between offering yields and predicted yields for insured bonds tabulated by rating. Yields for insured bonds are predicted using coefficients obtained from yearly OLS cross-sectional models that regress offering yields on bond characteristics and macro-variables for uninsured bonds issued in that year using the specification in Equation 3. Negative values represent a lower cost of borrowing to issuers. N is the number of insured bonds in that year and Insured represents the dollar value of the insured bonds in millions. Dollar loss is the present value of difference in yield paid as an annuity over the life of the bond and discounted at the riskfree rate at issuance expressed in millions and the Loss as % divides the Dollar Loss by the total insured (.123 = 12.3 bps). S.A. = Simple Average; W.A. = Weighted Average.

Rating	**N**	**Diff. Yield (%, S.A.)**	**Diff. Yield (%, W.A.)**	**Insured ($ million)**	**Dollar Loss ($ million)**	**% Loss**
Aaa	574	0.048	0.226	1,724	60.2	3.490
Aa1	3,129	-0.010	0.048	7,964	77.5	0.973
Aa2	13,000	-0.019	-0.010	32,850	-23.5	-0.071
Aa3	24,437	-0.023	0.011	55,746	69.3	0.124
A1	50,779	-0.038	-0.017	57,124	46.0	0.081
A2	52,711	-0.089	-0.071	43,623	-265.1	-0.608
A3	27,301	-0.049	-0.023	21,648	-18.3	-0.084
Baa1	17,612	-0.181	-0.152	18,946	-264.6	-1.397
Baa2	12,084	-0.175	-0.140	8,155	-89.8	-1.102
Baa3	5,216	-0.274	-0.232	2,431	-66.1	-2.717
Ba1	114	-0.386	-0.321	651	-21.2	-3.256
Total	206,957	-0.075	-0.033	250,861	-495.6	-0.198

TABLE 6: MARGINAL EFFECTS OF SELECTION MODEL

This table reports the marginal effects from the probit selection models for estimating propensity scores. Each coefficient represents the percentage increase in the probability of insurance from a unit change in the coefficient. Monthly macroeconomic controls for inflation, constant-maturity 10_{yr} yield, credit spread, and treasury slope are included in all models but not tabulated. McFadden pseudo R^2 are displayed as well as the percentage of insured and uninsured issues correctly classified by the model.

Variable	**Full Period**	**1985–1999**	**2000–2007**	**2008–2016**
Maturity	0.007***	0.011***	0.012***	0.003***
Maturity sq.	-0.000***	-0.000***	-0.000***	-0.000***
LN(Issue Amount)	0.015***	0.035***	0.017***	-0.009**
Under. Decile	-0.007***	-0.007***	-0.013***	-0.000
Num. of Agents	-0.003*	-0.011***	-0.010***	-0.005**
Comp. Offering	0.006	-0.036*	0.026**	0.102
Neg. Offering	-0.010	-0.071	0.022	0.113
Bank Qualified	-0.051***	-0.055***	-0.025**	0.004
Call Dummy	0.018***	-0.019*	-0.001	-0.002
Ratings				
Ba2 rated	-0.282**	-0.051	-0.549***	0.000
Ba1 rated	0.133***	0.063	0.021	0.019
Baa2 rated	0.107***	0.049	0.028	0.137***
Baa1 rated	0.104***	0.126***	0.038*	0.032
A3 rated	0.129***	0.058*	-0.005	0.039
A2 rated	0.073***	0.082***	0.027*	0.031
(A1 rating base)	0.000	0.000	0.000	0.000
Aa3 rated	-0.238***	-0.441***	-0.109***	-0.308***
Aa2 rated	-0.424***	-0.519***	-0.220***	-0.364***
Aa1 rated	-0.511***	-0.553***	-0.474***	-0.379***
Aaa rated	-0.587***	-0.578***	-0.686***	-0.373***
Proceeds				
General	0.002	0.025	-0.012	-0.003
OtherEd	0.046**	0.009	0.024	0.039
PrimaryEd	-0.006	0.044*	0.008	-0.006
Water	0.117***	0.014	0.089***	0.111***
LowPre2000			-0.105***	
MedPre2000			0.012	
HighPre2000			0.096***	
PriorIssuance				
LowPreCrisis				-0.091***
MedPreCrisis				-0.021*
HighPreCrisis				0.025**
Observations	469,910	104,361	197,212	168,330
Pseudo R^2	33.33	38.30	40.16	49.38
% Insured Correct	78.78	81.13	92.03	69.90
% UnInsured Correct	77.21	78.09	65.14	93.67

TABLE 7: AVERAGE VALUE OF INSURANCE: SELECTION MODELS EXPANDED

This table reports estimates of insurance value (in bps) from empirical specifications that control for selection of insurance by issuers. Panel A reports the mean predicted yields and average treatment effects of insurance using a propensity score matching procedure which predicts the choice of insurance. The insurance choice model is fit using a probit specification including controls for issue size, maturity, issuer rating, bank qualified status, number of agents, underwriter activity, and monthly macroeconomic controls. Insured bonds are matched with replacement to their 3 nearest neighbors by propensity score. Negative values for the average treatment effect (ATE) indicate that insured bonds have lower yields than comparable (control) uninsured bonds. Standard errors of the ATE estimates are in parentheses. Panel B reports the mean predicted yields and average treatment effects for uninsured and insured bonds using an inverse probability weighted regression adjustment model to control for insurance selection. The insurance selection model is fit using a probit specification including controls for issuer rating, underwriter activity, issue size and maturity, and the augmented weighted outcome regression on offering yield includes issuer ratings, size and maturity variables, as well as monthly macroeconomic controls. Robust standard errors of the ATE estimates are in parentheses. For the propensity score matched models, errors are calculated according to Abadie and Imbens (2016).

Panel A: Propensity Score Matched Models

	1985–2016	1985–1999	2000–2007	2008–2016
Uninsured	3.872	5.208	3.944	2.651
Insured	3.843	5.055	3.868	2.894
Avg. Treatment Effect	-0.028***	-0.154***	-0.076***	0.243***
	(0.004)	(0.016)	(0.006)	(0.015)
Observations	417,451	95,372	175,138	146,931

Panel B: Inverse-Probability Weighted Regression Models

	1985–2016	1985–1999	2000–2007	2008–2016
Uninsured	3.779	5.195	3.960	2.623
Insured	3.725	5.102	3.874	2.663
Avg. Treatment Effect	-0.054***	-0.093***	-0.086***	0.039*
	(0.002)	(0.003)	(0.004)	(0.017)
Observations	417,451	95,372	175,138	146,934

TABLE 8: CROSS-SECTIONAL DETERMINANTS OF MONEY LEFT ON THE TABLE

This table reports a regression of the money left on the table measure described in the text on the corruption measures and advisor/underwriter sizes, with standard errors clustered by issue. High Conviction and Prosecution indicate bonds issued in counties contained in federal judicial districts with above 25th percentile per capita official corruption convictions or prosecutions. Large advisors and underwriters refer to an underwriter or advisor who was in the top decile of total volume of municipal GO bonds advised or underwritten during the year of issue. Bond controls include coupon, issue size, time to maturity, and dummies for bank qualified, competitive, negotiated, and callable issues. State dummies in conviction regressions are all states with more than one federal judicial district and all states in advisor regressions. Coefficients that are significantly different from zero at 1%, 5%, and 10% significance levels are flagged with ***,**, or *.

Variable	(1)	(2)	(3)	(4)
High Conviction	11.16**	35.14***		
	(2.37)	(4.78)		
High Prosecution	-22.18***	2.449		
	(-4.81)	(0.33)		
High Conviction x High Prosecution		-37.45***		
		(-3.97)		
Large Advisor			18.70*	18.10*
			(1.83)	(1.76)
Large Underwriter			20.07**	19.61**
			(2.22)	(2.12)
Large Advisor x Large Underwriter				6.176
				(0.15)
Bond Controls?	Yes	Yes	Yes	Yes
Rating Dummies?	Yes	Yes	Yes	Yes
Year Effects?	Yes	Yes	Yes	Yes
State Dummies?	Yes	Yes	Yes	Yes
Adjusted R^2	0.192	0.193	0.216	0.216
Observations	167,845	167,845	101,751	101,751

FIGURE 1: THE VALUE OF INSURANCE IN SECONDARY MARKET TRADING

This figure plots the volume-weighted daily average price of two Puerto Rico GO bonds issued on 10/4/2007 with a coupon rate of 5% and maturity date of 07/01/2026. The offering size of the uninsured bond is $18.35 million, $7 million of which is subsequently insured in the secondary insurance market. Trade data are from MSRB.

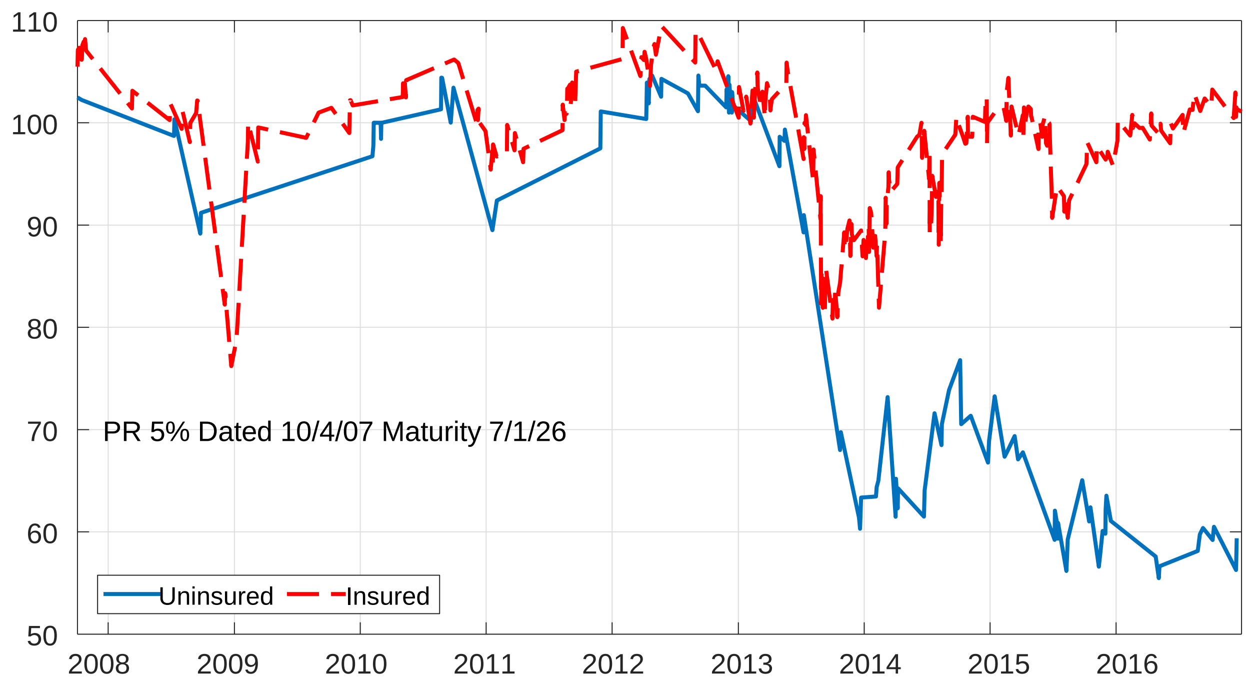


FIGURE 2: DISTRIBUTION OF OffERING YIELDS OF INSURED AND UNINSURED BONDS

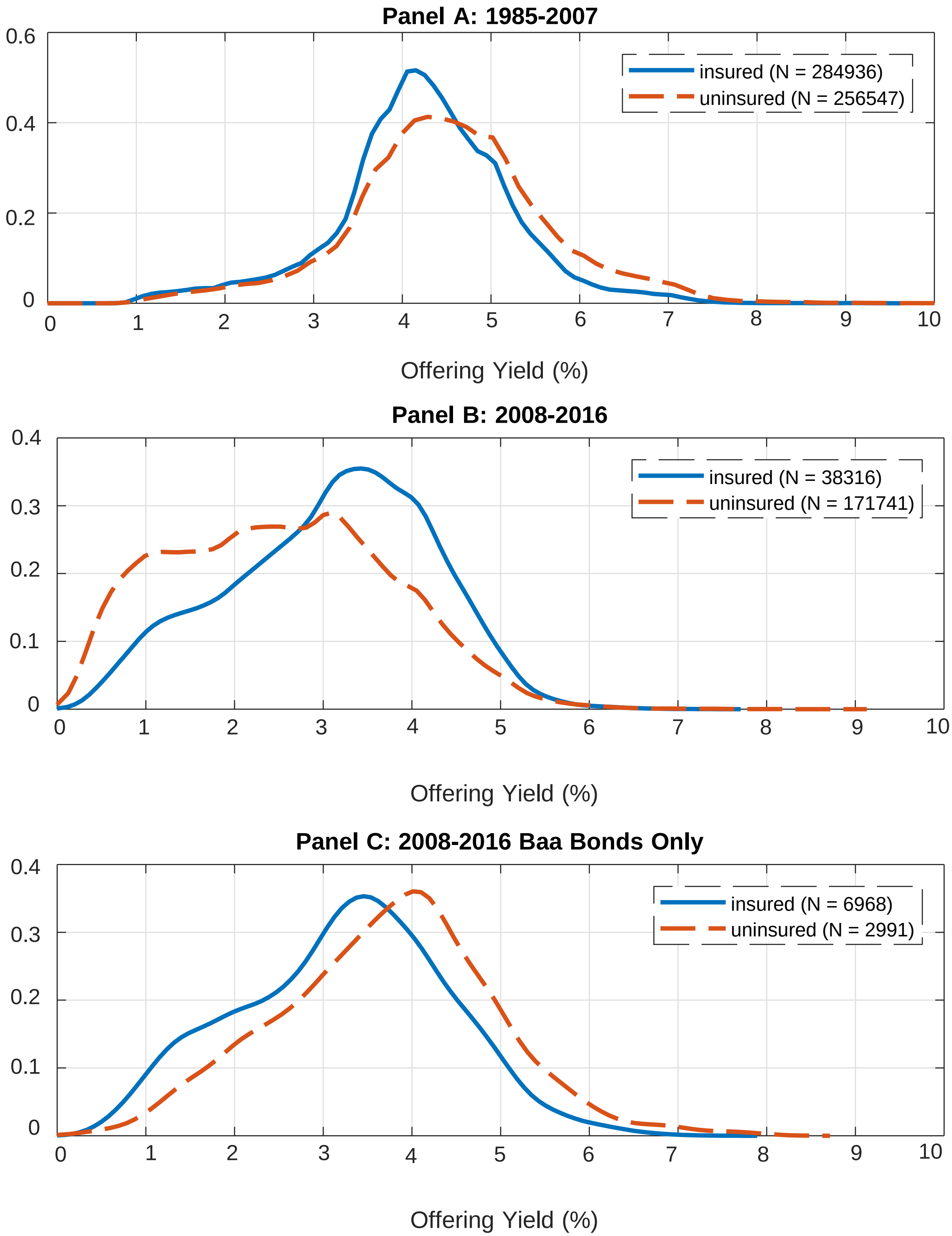
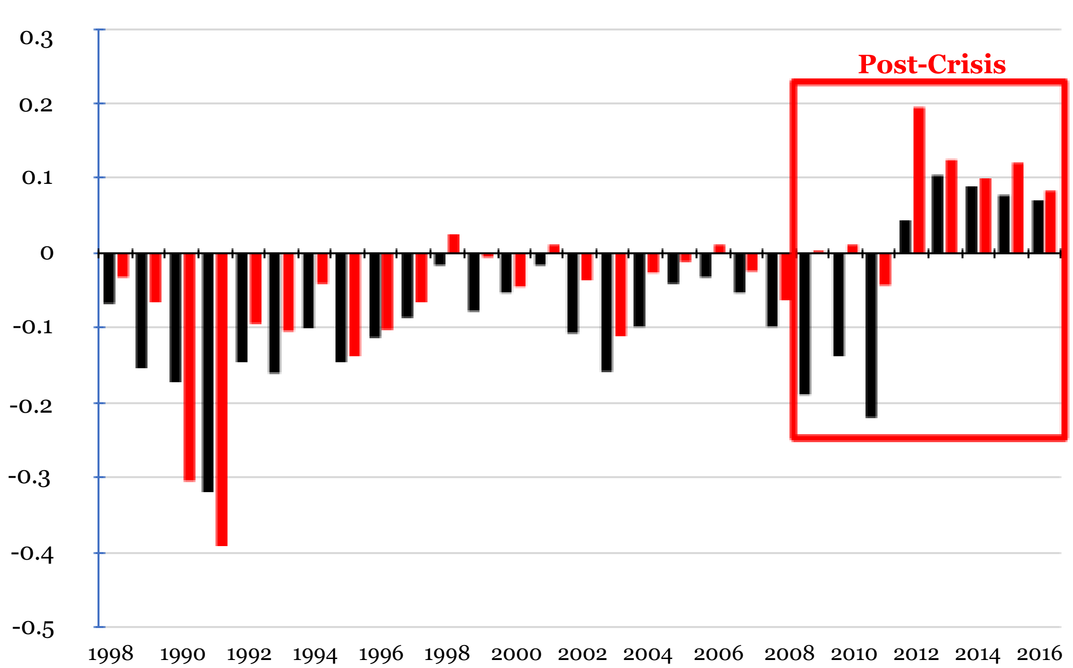
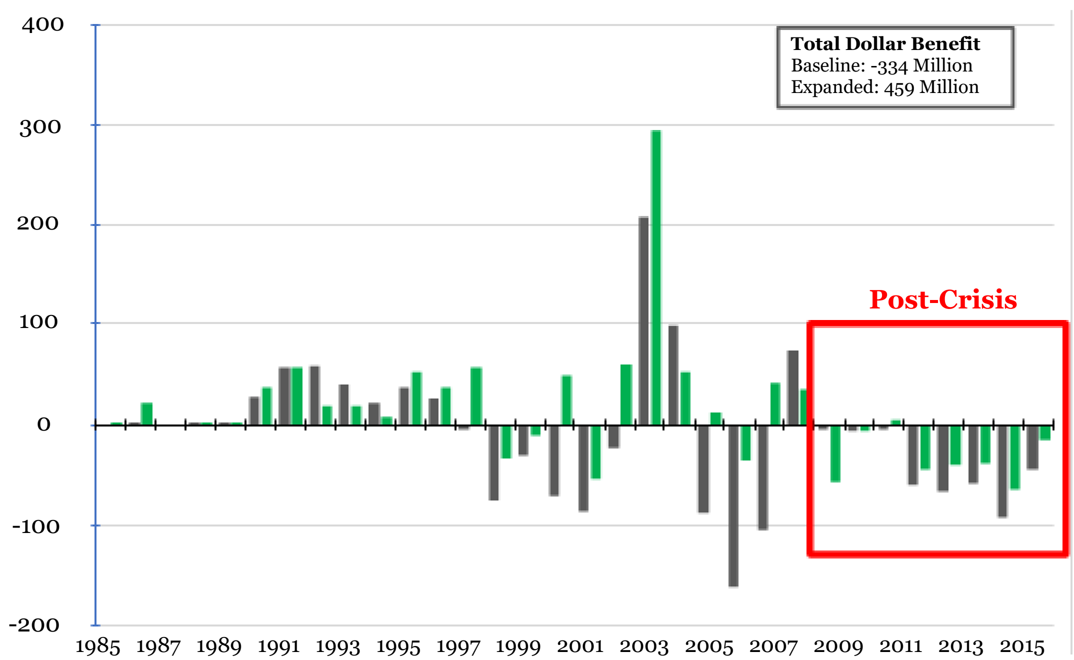


FIGURE 3: VALUE OF INSURANCE OVER TIME (EXPANDED OLS MODEL)

This figure shows the variation of the value of insurance in yields and in dollars over time, equally weighted and value weighted.



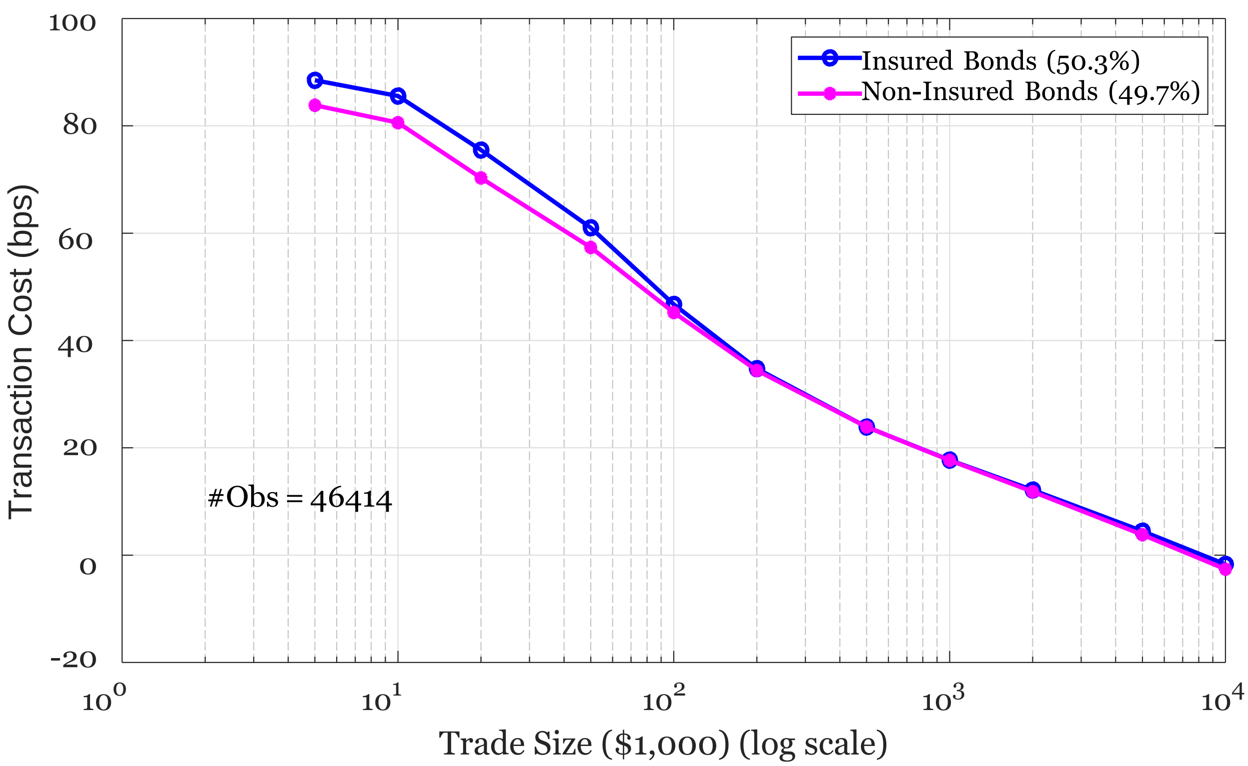
(a) Actual – Fitted Yield



(b) Dollar Loss

FIGURE 4: TRANSACTION COSTS OF INSURED VERSUS NON-INSURED BONDS FOR 2005-2016 PERIOD

This figure shows the transaction cost functions for insured bonds versus non-insured bonds. Estimation is based on MSRB municipal bond trade database for the 2005-2016 period. Bond insurance status is from Mergent FISD Municipal Bonds database.



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