On the Value of Municipal Bond Insurance: An Empirical Analysis

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Abstract

Using a large sample of municipal bond data from 2001 to 2010 in the U.S., this paper documents the time variation of the value of municipal bond insurance, estimated from the insured and uninsured bonds yield at issue differentials. We find that insured municipal bonds carry significant lower yields at issue compared to those of the equivalent uninsured bonds before 2008. However, this cost saving disappeared with the aftermath of the subprime credit crisis. We find that the supply of bonds and the level of market interest rates to have significant positive impacts on the time-varying value of bond insurance. We also detect asymmetric response of these yield differentials to rises and declines of market interest rates. Economic intuition suggests that the value of municipal bond insurance is a function of business cycles but our tests support the contrary, which may be explained by the habitat preference of municipal bonds issues.

Keywords: Municipal bonds, bond insurance, yields at issue, interest rates, business cycles

JEL Codes: G21, G28

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1. Introduction

Private bond insurance is the most common form of credit enhancement for municipal bonds. Bond insurers augment the credit rating of the issuers, committing to make payment in the event of default by issuers, which make debt more marketable and attractive to investors as well as institutions which are permitted only to hold investment grade bonds and reduce interest expenses to issuers.

Using contingent claims analysis à la Merton (1974), Chang, Lai, and Yu (2002) and Lai and Yu (1999) show how the value of credit enhancement is a function of not only the intrinsic values and credit quality of both borrowers and financial guarantors but also their covariance. Empirical evidence on credit spreads on insured thrifts deposits and bank-subordinated debentures is consistent with the predictions of their models.

As matter of fact, more than half of the municipal bonds issued between 1995 and 2009 were sold with bond insurance, but during the recent subprime credit crisis, the credit ratings of the financial guarantors implicated in the mortgage insuring business are downgraded leaving only Assured Guaranty Municipal Corp, rated AA3 by Moody's and AAA by Standard & Poor's (S&P), writing municipal bond insurance today. According to Thomson Reuters data insured bonds, which accounted for 57.3 percent of municipal bond issuance in 2005 sank to 5.5 percent of issuance in 2011. Furthermore, municipalities are increasing their reliance on insurers to pay bondholders and there has already been almost twice the level of municipal bond defaults when measured in terms of real dollars in 2012 than there was during the same period in 2011.[1]

[1] See Pierog, Karen, "Muni defaults another blow for insurers", Reuters, March 20, 2012. http://www.reuters.com/article/2012/03/20/us-municipals-default-insurance-idUSBRE82J15920120320?feedType=RSS&feedName=domesticNews

Research finds that bond insurance can mitigate information problems occurring when buyers have less information than sellers, reduce interest costs for lower rated, long-term debt issues consistent with investor risk aversion and with theories concerning the efficiency-enhancing properties of financial intermediation in imperfect markets. Therefore, a concurrent empirical literature has examined the value of bond insurance, which is measured by the yield difference between the insured and uninsured bonds returns. We pursue this line of research by studying the time variation of the value of bond insurance. Further, we conduct empirical tests on the time variation of the value of bond insurance and we gauge econometrically its determinants and drivers.

We find that the value of municipal bond insurance is indeed time-varying. The insured municipal bonds offer significant lower yields at issue compared to the equivalent uninsured bonds before 2008. This cost saving effects reversed with the advent of the subprime financial crisis. Among the driving factors influencing the time variation of the risk premium between the insured and uninsured municipal bonds, we find that the supply of bonds and the level of market interest rate to have significant positive effects on the value of bond insurance. The coefficients are insignificant for the proxies of business cycles, which means that although economic intuition argues for the value of municipal insurance to be a function of business cycles, our tests support the contrary, which may be explained by the habitat preference of municipal bonds issues.

The remainder of the paper is organized as follows. We provide a brief literature review in Section 2. We follow by a discussion of the empirical methodology in Section 3. Section 4 describes the data we use for our investigation. Section 5 reports and discusses empirical findings. Finally, the conclusions are summarized in Section 6.

2. Literature Review

Academic research on municipal bond insurance may be divided into two main strands which attempt to answer two questions. The first strand of literature addresses the question: “Why the bond issuers seek enhanced credit rating?” and dwells on the advantages and benefits brought about by bond insurance. The second strand provides answers to the question: “Can the purchased high-graded credit insurance erase the creditworthiness of the bond issuers?” and documents the impact of the issuers’ own intrinsic credit ratings even with the presence of bond insurance.

With respect to the first question, Thakor (1982) develops a model where the issuers’ purchase of bond insurance signals their underlying credit quality and reduces the level of asymmetric information between the issuers and investors. Kidwell, Sorensen, and Wachowicz (1987), Hsueh and Liu (1990), and others empirically examine the value of municipal bond insurance and demonstrate that the interest cost savings from the purchase of default insurance are more than compensated by the premiums paid to the insurance company. Nanda and Singh (2004) focus on a tax-based explanation for the existence of bond insurance. The insurance allows an indirect tax arbitrage, with the insurer maintaining the tax-exempt status of the interest payments to the investor in the event of issuer default. Bergstresser, Cohen, and Shenai (2010) explore the relationship between insurance and bond yields in secondary markets before and after the start of the financial crisis in 2008 and find that instead of lowering the yield by credit enhancement, the insured bonds traded at yields that were higher than uninsured equivalents during 2008 and 2009. Brune and Liu (2010) examine the downgrades of key insurers during the 2008 financial crisis and the effects on the bonds they insure. They find that not only risk premiums on bonds insured by the downgraded insurer are affected, but also those on bonds insured by other insurance companies.

Regarding the second question, Hsueh and Chandy (1989) and Peng (2002) discuss whether the underlying credit rating is important, or have effects on the borrowing cost of municipal bonds besides the enhanced credit rating of bond insurance. Hsueh and Chandy (1989) compared the net interest cost on insured bond issues of different intrinsic credit quality reflected by Moody's rating before June 1984. Yield differences between insured bonds with single-A and Baa quality shows that investors do differentiate among insured bonds of different intrinsic credit quality. Peng (2002) investigates the advantage of Standard & Poor's Underlying Ratings (SPURs) in solving informational asymmetry in the municipal bond market. By comparing yield differences between insured bonds with and without SPUR, those with higher SPUR and lower SPUR, he finds that issuers with higher underlying ratings can distinguish themselves from issuers with lower underlying ratings to realize a lower interest cost on their bonds, which means that the issuer intrinsic default risk will continue to affect insured bond pricing, even with the added credit protection from financial guarantee insurance.

The study by Bergstresser, Cohen, and Shenai (2010) is most relevant to ours; therefore it is reviewed next in more details. In this article, the authors classify the individual bond data into AA, A, and BBB groups according to their SPURs. Then for each group, they estimate monthly regressions of bond yields on issuer characteristics. With respect to the coefficient on the dummy variable for the insured bonds, the average coefficient in the regressions across the 96 monthly regressions before crisis is -0.050, reflecting a 5.0 basis points lower yield among the insured bonds with AA-equivalent underlying ratings than among the AA-rated uninsured issues. However, with the advent of the credit crisis, the pattern shifts, with insured bonds carrying 9.0 basis points higher yields persistently through the end of the sample period in 2009. The results are equally pronounced for the regressions on bonds with A and BBB-rated underlying credit quality. The authors offer three possible explanations for this strange phenomenon, including 'window-dressing' by mutual funds, liquidation of Tender Option Bond (TOB) programs, and the liquidity difference between uninsured and insured municipal securities.

Our paper is different from the one of Bergstresser, Cohen, and Shenai (2010) in two aspects.

First, instead of studying the yield differences between those insured versus equivalent uninsured bonds in the secondary markets, we study the value of bond insurance with respect to yield at issue differentials between insured and uninsured bonds. Second, we empirically explore the factors that drive the time-variation of issues yield reduction brought about by bond insurance. Our paper hence consists in two parts. In the first part, using a monthly cross-section framework over the period of 2001-2010, we find that the difference between insured and uninsured bonds yields shows structural change after 2008. The yield at issue of insured bonds are significantly lower than equivalent uninsured bond during 2001-2007, but after 2008, the cost saving effects of bond insurance is not significant. In the second part, we further expand the existing literature by exploring the factors or determinants that drive the time-variation of debt issues yield reduction brought by bond insurance. We include variables capturing the market interest rate, bond supply, market volatility and business cycle as determinants of the dynamics of the yield difference. We find that the time-varying yield differences are mainly driven by the market interest rate and bond supply and demand. Regarding the value of bond insurance, we also test whether there is an asymmetric response of its time variation to increases and decreases of market interest rates.

3. Econometric Methodology and Variables

To compare risk premiums between insured and uninsured municipal bonds, it is important to choose a set of bonds that, in the absence of credit insurance, would be homogeneous. Following Bergstresser, Cohen, and Shenai (2010), we focus on bonds that are rated by Standard and Poor's, and for which S&P provides an equivalent credit rating for the underlying issuers. This underlying issuer credit rating, i.e., the Standard & Poor's Underlying Ratings (SPURs), reflects an 'unenhanced' credit quality of the issuer, and allows us to construct pools of insured and uninsured bonds that have equivalent underlying credit quality.

We group our sample bond data according to their issue dates and SPURs. Because very few bonds with AAA underlying rating seek credit enhancement from insurance and also no speculative bonds appear in our sample, we include only AA+, AA, AA-, A+, A, A-, BBB+, BBB bonds. First, AA+, AA, and AA- bonds are grouped together under the label of AA-Group. Then, A+, A, and A- bonds are grouped together with the name of A-Group, whereas BBB+, BBB, BBB- bonds are grouped together under the label of BBB-Group.

Controlling for factors that may affect bond issuing costs, to investigate the yield differentials between insured and uninsured bond issues within each group, the following cross-section linear regression model called Model 1, is estimated for the underlying credit rating groups each month:

$$Yield_i = C + \alpha_1 \cdot \ln(Maturity)_i + \alpha_2 \cdot \ln(Size)_i + \sum \theta_k \cdot State_{i,k} + \sum \delta_j \cdot Purpose_{i,j} + \beta \cdot Insure_i + \varepsilon_i \tag{1}$$

For the above regression model, the dependent variable is the yield that the bond offered at issue date, which is different from net interest cost[2] (NIC) or true interest rate cost[3] (TIC) used in other papers. The calculation of net interest cost or true interest rate cost takes into account any premium or discount applicable to the issue, as well as the dollar amount of coupon interest payable over the life of the issue. However, since it uses a straight line arithmetic computation, it does not take into account the time value of money.

Since the cross-section regression is made each month, we only include issuer characteristics as control variables. The control variables used in this study, commonly considered as the best explanatory variables suggested in the extant literature, are defined as follows:[4]

A) Ln (Maturity): the years to maturity in natural logarithms; the expected sign for this variable is positive, which indicates that a higher yield is expected to compensate for a longer investment horizon.

B) Ln (Size): the natural log of the par amount of a bond issue. The expected sign for this variable is ambiguous, because on the one hand, when size gets bigger, the market for the

[2] See Cole and Officer (1981), Hsueh and Chandy (1989), Apostolou, Reeve and Giroux (1984), Bland (1987), Simonsen, Robbins and Helgerson (2001).

[3] See Peng (2002).

[4] Wang, Wu and Zhang (2008) and Bergstresser, Cohen and Shenai (2010) estimate the liquidity risk of municipal bonds and its effects on bond yields using secondary markets transaction data. Since we focus on the yield at issue differences in the primary markets and according to Harris and Piwowar (2006) and Lin, Liu, Wang and Wu (2010), among others, municipal bond liquidity is significantly related to bond maturity and issue size. Note that while most papers discuss the impact of taxation on the relative values of tax-exempt municipal bonds and taxable bonds, our sample bonds are all tax-exempt.

issue should become more liquid, which should lead to a lower yield; but on the other hand, when size reaches a certain point, the yield may have to go up to make up for the difficulty in marketing a very large issue.

C) $\sum \theta_k \cdot State_k$: the state zero-one dummy variables represent the states where bond issues were sold. These dummy variables are used to control for issue yield difference attributable to regional factors such as state economic difference and other state attributes. Because these factors are not easily measured directly, it is difficult to predict a priori the relationship of each state to the utilization of bond insurance.

D) $\sum \delta_j \cdot Purpose_j$: δ_1 and δ_2 are dummy variables for issue purpose, i.e., refunding or schools according to Bloomberg classification. These are the two largest issue purposes in terms of numbers of issues. The other purposes are the excluded set.

E) Insure: the dummy variable that captures the impact of insurance on the issue cost and is the focus of our empirical tests. Insured bonds are coded 1 and uninsured bonds are coded 0. The coefficient β measures the difference in risk premium between the insured and uninsured bonds. Therefore, the expected sign of β should be negative since it is hypothesized that the insured bonds should have higher issue price (low issue yield) than the uninsured bonds with the equivalent underlying credit quality, everything else being equal. The smaller is the value of β, the larger the value of bond insurance.

For each of the three composite groups, AA-Group, A-Group, and BBB-Group, we estimate the above regression of issues yield on bond characteristics separately by month, and obtain the three time series of coefficient β_t, t = 2001.1 to 2010.12. In effect, the β_t series reflects the time variation of the value of bond insurance, or, the risk premia between the insured and uninsured municipal bonds.

To further investigate its influencing factors, for each of three composite groups, AA-Group, A-Group, and BBB-Group, we set up the following time-series regression model, Model 2:

$$\beta_t = C + \gamma_1 \cdot SUPPLY_t + \gamma_2 \cdot MARKET\_RATE_t + \gamma_3 \cdot VOLATILITY_t + \gamma_4 \cdot STOCK_t + \gamma_5 \cdot CYCLE_t + \omega_t \quad (2)$$

In the above model, the volume of bonds flowing into the market around the same time a bond is issued may influence the value of insurance. We use thirty-day visible supply of municipal bonds reported in the Bond Buyer to capture the *SUPPLY* factor. The 30 day visible supply signals the competition a bond series will face when issued. When the 30 day visible supply is large, the bond issue must compete with these other bond issues for investors, so the issuer and underwriter must enhance the demand for the issue.[5]

We select the weighted average yields of 2 year, 7 year, 20 year Treasury bond, which correspond to short-term, medium term and long-term bonds, to serve as a proxy for risk free *MARKET_RATE* variable. This index controls for the effect of the prevailing market interest rate on the yield of individual bonds over the sample period. Everything else being equal, a higher market interest correspond to a higher yield (net interest cost) on a municipal bond issue. However, it is difficult to predict a priori for its effects on the cost reduction effects of bond insurance.

We explore the effect of market volatility (*VOLATILITY*) around the time of debt issuance to the insurance benefit. Moldogaziev and Johnson (2011) argue that the greater the volatility in interest rates, the more important the signal sent from the premium, which means higher insurance premiums to be associated with greater interest rate volatility. We measure volatility as the standard deviation of Bond Buyer 20 Index during the eight-weeks prior to the week of issue. We also use Chicago Board Options Exchange Market Volatility Index (*VIX*) for our robustness test.

[5] Denison (2003) finds that the probability of issuing with bond insurance increases when there is an increase in supply. Martell and Kravchuk (2009) find a significant relationship between supply and the reoffering rate in the municipal variable rate bond market.

To capture the relative demand for other forms of financial securities, the Wilshire 5000 Total Market Index, which represents the most comprehensive index for the U.S. equity market, is employed to proxy *STOCK*. The index now includes well over 5,000 issues, reflecting U.S. equity activity as a whole. Martell and Kravchuk (2009) suspect that Wilshire 5000 index to be positively related to the reoffering rate of variable rate municipal bond. In addition, we use S&P500 index in our robustness test.

We also explore the possible effects of business cycles, *CYCLE*, on the yields at issue of the insured versus equivalent insured bonds. We run extensive robustness tests using a wide array of business cycle variables, including real Gross Domestic Product (GDP) growth rate and output gap. For output gap, we employ the deviations of the real GDP from their own trend components estimated using Hodrick-Prescott (H-P) filtered technique. Cubic spline interpolation technique is used to convert the quarterly data into monthly data.

To detect the asymmetric response of β_t to up or down of *MARKET_RATE*, we follow Doherty and Garven (1995) approach by introducing the following Model 3:

$$\beta_t = C + \gamma_1 \cdot SUPPLY_t + \gamma_2 \cdot MARKET\_RATE_t + \gamma_3 \cdot (MARKET\_RATE)_t^2 + \gamma_4 \cdot VOLATILITY_t + \gamma_5 \cdot STOCK_t + \gamma_6 \cdot CYCLE_t + \omega_t \quad (3)$$

where $\gamma_2 > 0$ and $\gamma_3 > 0$ means that rising market rates cause moderate falls and falling rates produce more vigorous increases in the value of bond insurance.

4. Data and Summary Statistics

Data are from Bloomberg and our full sample contains 42 540 municipal bonds issued in ten states between January 2001 to December 2010. The ten states are California, Texas, New York, Florida, Illinois, Massachusetts, Pennsylvania, New Jersey, Ohio, Washington, which are the top ten states according to the average daily by par amount traded. The selection of bonds to be included in this sample was based on the following criteria: (1) - Only tax-exempt general obligation (GO) bonds were included. Limiting the sample to GO bonds excludes the numerous bonds that are issued with recourse to the revenues from particular projects, for example highways or stadiums, but that does not have recourse to the issuers' tax revenues.[6] (2) - The bonds must be fixed-coupon bonds, which the data of issue yield are available. (3) - The bonds must have S&P credit rating above investment grade, or BBB credit rating, according to S&P long term credit rating. (4) - Par-amount must be greater than $5 million. (5) - Following Bergstresser, Cohen, and Shenai (2010), the bonds that are puttable, callable, or sinkable are excluded from the sample. This restriction excludes more than half of our available observations, but allows us to use relatively straightforward measures of bond yield that do not depend on a particular model of interest rate movements; (6) - Only those bonds that release Standard and Poor's Underlying Ratings (SPURs) above BBB ratings are included.

After these screenings, our final and relatively large sample contains 42540 bonds, which we can group according to their issue dates and SPURs.

Table 1 shows the full sample distribution of insured and uninsured bonds for each group of SPUR.

INSERT TABLE 1 HERE

Figure 1 presents the monthly distribution of sample according to the three composite group classified by different SPUR.

INSERT FIGURE 1 HERE

From the Table 1 and Figure 1, we can see that the number of sample bonds in BBB-Group is much fewer than those in AA-Group and A-Group. Therefore, our paper mainly provides empirical evidence on the AA-Group and A-Group municipal bonds.

Table 2 and Table 3 provide the summary statistics for the average yields at issue for different groups by maturity and by the time of issue.

INSERT TABLE 2 HERE

INSERT TABLE 3 HERE

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[6] See Bergstresser, Cohen, and Shenai (2010), Peng (2002) and Hsueh and Chandy (1989).

From Table 2 and Table 3, we can see that, for all the sample bonds, whether insured or uninsured, the longer term bonds have to pay a higher yield. But for the yield difference between insured and uninsured bonds, the summary statistics exhibit a different picture. Before 2008, for each group and maturity, the bond insurance plays an important role in the reduction of issue yield, but after 2008, like Bergstresser, Cohen, and Shenai (2010) investigation on the yield difference between insured versus equivalent uninsured bonds in the secondary markets, the average yields at issue of insured bonds actually rose in excess of yields on equivalent uninsured issues. Bergstresser, Cohen, and Shenai (2010) report 5.0 basis points lower yield for the insured bonds with AA-equivalent underlying ratings than those AA-rated uninsured issues before the subprime credit crisis. Since Table 2 and Table 3 are just simple comparisons without fully controlling the issue characteristics, we will resort to the regression models described above.

5. Empirical results

Recall that we start our empirical analysis in this paper by using monthly yield at issue differences between insured and uninsured bonds and controlling for issue characteristics. For each of composite group, AA-Group, A-Group, (we discard BBB-Group since observations are scant, see Figure 1), we can estimate the regression Model 1 separately by month, and get the time series of coefficient β_t, t = 2001.1 to 2010.12. In fact, the β_t series reflects the time variation, depicted in Figure 2, of the risk premium between the insured and uninsured municipal bonds.

For Model 1, Table 4.1 (Full Sample), Table 4.2 (Pre-crisis Subsample) and Table 4.3 (Post-crisis Subsample) summarize the descriptive statistics of the research variables. The tables show the mean, standard deviation and minimum and maximum values of each variable. The full sample covers the period from 2001 to 2010, the pre subprime credit crisis spans from 2001 to 2007 and the post-crisis subsample consists of the period 2008 to 2010. For both A-Group and AA-Group, the yield at issue decreased during the post-crisis period. Note that the value of the Bond Insurance Dummy decreased after the crisis, which means that less municipal bonds are insured.

INSERT TABLE 4.1 to TABLE 4.3 HERE

For Model 1, only the term to maturity variable reveals consistent statistical significance for all monthly regressions. The yield at issue of the bonds is positively related to term to maturity, which suggests that investors require higher yields to compensate for a longer investment horizon. Since our primary objective is to explore the effect of bond insurance on yields at issue, we just focus on discussing the coefficients of the insurance dummy variable. Table 5 summarizes the results shown in Figure 2 with respect to the coefficient on the dummy variable for insured bonds

INSERT TABLE 5 HERE

INSERT FIGURE 2 HERE

From Table 5, we find that for sample bonds in group AA, prior to the crisis, the average coefficient in the regressions across the 80 monthly regressions is -0.076, reflecting a nearly 8 basis points (bp) lower yield of the insured bonds with AA-equivalent underlying ratings than that of the AA-rated uninsured issues. This yield reduction effect can be used as a metric, i.e., a proxy of the value of bond insurance. For the insured bonds within group A, the reduction of yield at issue compared to the one of the equivalent uninsured is about 5 basis points. At the height of the credit crisis, the pattern shifts, with insured bonds carrying 14 bp and 13 bp higher yields for equivalent AA and A uninsured bonds. This structural change for the value of bond insurance is also consistent with the findings of Bergstresser, Cohen, and Shenai (2010) on secondary market yield difference between insured and uninsured municipal bonds.

In sum, for the pre-crisis period, we estimate the value of bond insurance to be 5 to 8 bp by way of Model 1, or 6 to 25 bp roughly by means of Table 2 and Table 3. What is the average insurance premium paid by municipalities during the period 2000-2009? For a sample of 720 bonds sold in California from 2001-2005, Liu (2009) finds the average reported insurance premium is 3.72 bp. In Liu (2009), the average premium for AA bond was 1.89 bp and A bond was 3.76 bp while BBB+ and below bonds 8.31 bp. For a Bloomberg sample size of 3174 debt issues by Texas municipal governments, Moldogaziev and Johnson (2011) estimate the average insurance premium as 0.07 bp to

0.29 bp per year. Thus, most literature reports bond insurance premium to be much lower than our estimated value of bond insurance.

Next, we further explore the factors influencing the time variation of the risk premiums between the insured and uninsured municipal bonds. For Model 2, Table 6 summarizes the descriptive statistics of the focal variables.

INSERT TABLE 6 HERE

Table 7 and Table 8 present the estimates of three regression models on AA-Group and A-Group samples.

INSERT TABLE 7 HERE

INSERT TABLE 8 HERE

The results show that, for SPUR-A Group and SPUR-AA Group, the coefficients of *SUPPLY* variable and *MARKET_RATE* are significantly negative. Since the expected sign of β should be negative, and therefore, the smaller the value of β, the larger is the value of bond insurance, this means that the *SUPPLY* and *MARKET_RATE* have significant positive effects on the value of bond insurance. When the volume of bonds issuance is large and the market interest rate is high, the issuer and underwriter may enhance the demand for the issue by providing higher yield reduction effects of bond insurance. The coefficient on *STOCK* variable is significantly positive, which means the higher the stock price, the larger the value of β, the smaller the value of bond insurance. While for the proxies of business cycles, the coefficients are insignificant. Economic intuition tends to suggest that the value of municipal insurance to be a function of business cycles, however our test indicate otherwise, which may be explained by the habitat preference of municipal bonds issues. We also ran the regressions for subsamples pre and post- crises. For compactness, results are not presented. For Group A, for the sub-sample pre-crisis of 2001-2007, we find that the supply of bonds and the level of market interest rates to have significantly positive impacts on the time-varying value of bond insurance. The GDP growth rate also has significantly negative effects on the value of municipal bond insurance. However, as we enter the post crisis period, no variables are significant.

For Group AA, for the sub-sample 2001-2007, we find that only the GDP growth to have a significant positive impact on the time-varying value of bond insurance. Meanwhile, for the post-crisis period 2008-2010, only the supply variable has significantly negative effects on the value of municipal bond insurance.
However, using the full sample, for this Group AA, *MARKET_RATE, SUPPLY, VOLATILITY, STOCK* variables are statistically significant. In the case of Group A (less creditworthy), the *MARKET_RATE*, *SUPPLY*, *VOLATILITY* and *STOCK* variables are strongly significant for the pre-crisis period so that even if we include the post-crisis data, these variables are still statistically significant.

Table 9 and Table 10 show the regression results from Model 3 for the test of asymmetric effects imbedding analogous results obtained in Table 7 and Table 8 with the inclusion of the variable $MARKET\_RATE^2$.

INSERT TABLE 9 HERE

INSERT TABLE 10 HERE

From Table 9 and Table 10, we can see that the coefficient of *MARKET_RATE* variable is significantly negative, while the coefficient of squared *MARKET_RATE* is significantly positive. This is indicative of an asymmetric response of β_t to up, (i.e., rising) and down (or declining) of market interest rates. Further, as for Model 2, the coefficients of *SUPPLY* and *STOCK* variables are significantly positive, whereas for the two proxies of business cycles, the coefficients are insignificant.

6. Conclusion

Our paper studies the yield at issue differences between the insured and uninsured municipal bonds, controlling for the credit quality of the underlying issues. We find that the yield difference between the insured and uninsured bonds, thereby the value of bond insurance, is time-varying. Compared to those equivalent uninsured before 2008, insured municipal bonds show significant lower yields at issue, but this cost saving effects reversed in the aftermath of the subprime credit crisis. For the driving factors influencing the time variation of the risk premium between the insured and uninsured municipal bonds, we find that that the supply of bonds and the level of market interest rate have significant positive effects on the value of bond insurance. One could argue that the value of municipal insurance is a function of business cycles, our tests support it is not, which may be explained by the habitat preference of municipal bond market.

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Table 1: The composition of sample bonds

AA-Group includes municipal bonds with AA, AA+, and AA- of SPURs. A-Group includes municipal bonds with A, A+, and A- of SPURs. BBB-Group includes municipal bonds with BBB+ and BBB of SPURs .The table shows the number of issues for different classifications.

	Uninsured	Insured	Total
AA-Group	3122	12726	15848
A-Group	3025	21289	24314
BBB-Group	405	1973	2378
Total	6552	35988	42540

Figure 1: Monthly distribution of sample according to SPURs

The graph shows the number of issues for different groups in each month from January 2001 to December 2010.

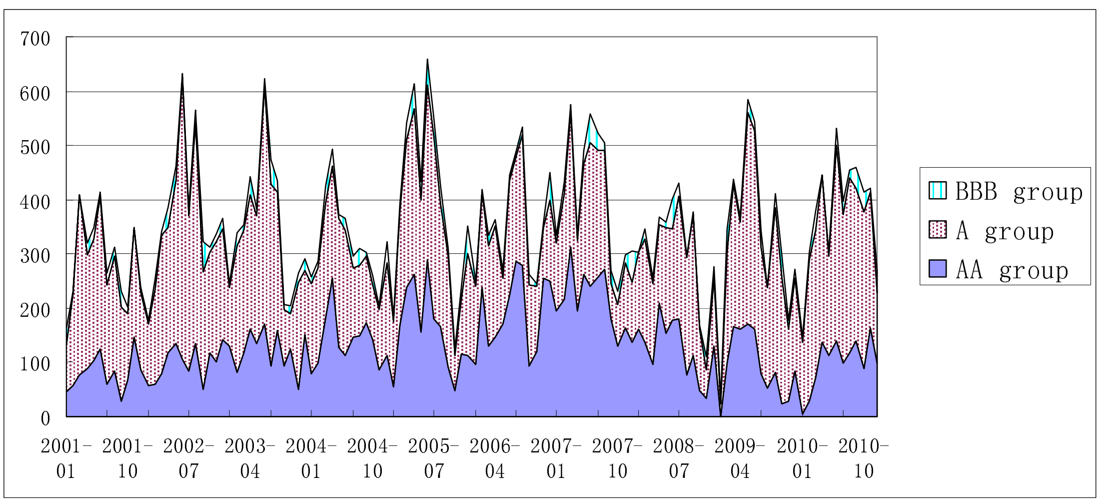

Table 2: Average yields at issue for different maturities for Group A

Yields are expressed in percentage.

2001-2007	Insured municipal bonds		Uninsured municipal bonds	
Maturity	Obs.	Yield	Obs.	Yield
<=3 years	3478	2.58	440	2.71
3-10 years	6457	3.38	1037	3.55
> 10 years	521	3.97	84	4.06
2008-2010	Insured municipal bonds		Uninsured municipal bonds	
Maturity	Obs.	Yield	Obs.	Yield
<=3 years	628	1.75	375	1.36
3-10 years	1577	2.97	1127	2.59
> 10 years	65	3.97	59	3.48

Table 3: Average yields at issue for different maturities for Group AA

Yields are expressed in percentage.

2001-2007	Insured municipal bonds		Uninsured municipal bonds	
Maturity	Obs.	Yield	Obs.	Yield
<=3 years	5831	2.44	750	2.69
3-10 years	8543	3.22	1000	3.46
> 10 years	408	3.92	33	3.98
2008-2010	Insured municipal bonds		Uninsured municipal bonds	
Maturity	Obs.	Yield	Obs.	Yield
<=3 years	2002	1.46	298	1.29
3-10 years	4266	2.78	910	2.58
> 10 years	239	4.12	34	3.54

Table 4.1: Descriptive statistics of the variables for Model 1, Full Sample 2001-2010

	Variable description	Mean	Median	Std. Deviation	Maximum	Minimum
A-Group						
Yield at issue	Yield at issue in Percent	2.78	2.92	0.97	6.97	0.085
Maturity	In Years	4.39	3.98	2.82	31.63	0.011
Size	Issue size, in Million	21.85	11.4	50.41	1501.3	5.00
Insure	Bond Insurance Dummy (1=insured; 0= otherwise)	0.88	1	0.33	1	0
AA-Group						
Yield at issue	Yield at issue in Percent	3.01	3.29	0.92	6.31	0.22
Maturity	Years	4.98	4.53	3.11	28.18	0.04
Size	Issue size, in Million	54.27	21.93	100.1	1289.25	5.005
Insure	Bond Insurance Dummy (1=insured; 0= otherwise)	0.80	1	0.39	1	0

Table 4.2: Descriptive statistics of the variables for Model 1, Subsample 2001-2007

	Variable description	Mean	Median	Std. Deviation	Maximum	Minimum
A-Group						
Yield at issue	Yield at issue in Percent	2.96	3.15	0.88	6.4	0.83
Maturity	In Years	4.14	3.58	2.76	31.63	0.011
Size	Issue size, in Million	21.80	11.93	40.65	1500	5.00
Insure	Bond Insurance Dummy (1=insured; 0= otherwise)	0.89	1	0.31	1	0
AA-Group						
Yield at issue	Yield at issue in Percent	3.17	3.48	0.85	6.02	0.79
Maturity	Years	4.91	4.31	3.20	28.18	0.043
Size	Issue size, in Million	60.69	24.28	108.7	1289.25	5.005
Insure	Bond Insurance Dummy (1=insured; 0= otherwise)	0.87	1	0.34	1	0

Table 4.3: Descriptive statistics of the variables for Model 1, Subsample 2008-2010

	Variable description	Mean	Median	Std. Deviation	Maximum	Minimum
A-Group						
Yield at issue	Yield at issue in Percent	2.39	2.43	1.03	6.97	0.085
Maturity	In Years	4.90	4.59	2.89	25.73	0.016
Size	Issue size, in Million	21.96	10.32	66.65	1501.3	5.00
Insure	Bond Insurance Dummy (1=insured; 0= otherwise)	0.84	1	0.37	1	0
AA-Group						
Yield at issue	Yield at issue in Percent	2.53	2.65	0.99	6.31	0.22
Maturity	Years	5.19	5.01	2.79	18.61	0.038
Size	Issue size, in Million	34.12	16.55	62.48	990.09	5.055
Insure	Bond Insurance Dummy (1=insured; 0= otherwise)	0.59	1	0.49	1	0

Table 5: Yields on insured versus uninsured bonds, pre and post crisis

Separate regressions are estimated for each month, for each underlying credit rating groups. Based on Model 1, this table shows the statistics of the coefficient for the insurance dummy, which reflect the yield difference between the insured and those equivalent uninsured bonds, or the value of bond insurance. It is worth noting that for a few months, all the sample bonds are insured, so we cannot get the coefficient of insurance dummy by cross-section regression. This explains why the count of regressions is not equal to the number of months in the corresponding period.

Pre-crisis: 2001.01-2007.12	Underlying credit rating	
	AA-Group	A-Group
Average coefficient on insurer dummy	-0.076	-0.052
Cross-time standard deviation of coefficient	0.189	0.156
Count number of regressions	80	81
t-statistic	-3.62	-3.00
Average counts of observations in monthly regressions	142	196
Post-crisis: 2008.01-2010.12	Underlying credit rating	
	AA-Group	A-Group
Average coefficient on insurer dummy	0.145	0.134
Cross-time standard deviation of coefficient	0.246	0.340
Count number of regressions	32	33
t-statistic	3.33	2.23
Average counts of observations in monthly regressions	109	211

Figure 2: The time variation of the value of municipal bond insurance

The graph shows the monthly time variation of the coefficients for the insurance dummy in Model 1 for Group A and Group AA

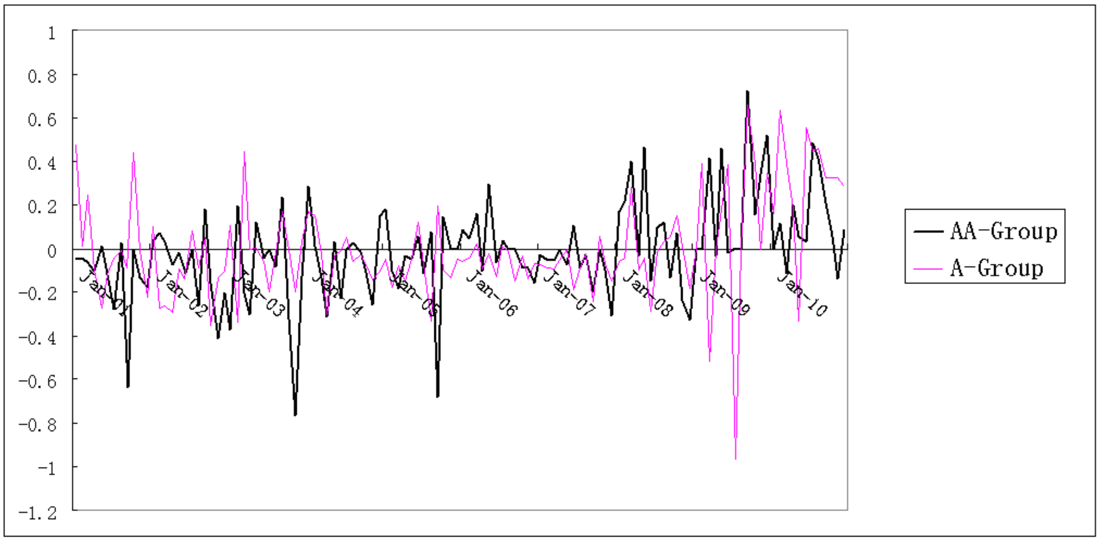

Table 6: Sample descriptive statistics for Model 2 (monthly data from 2001 to 2010)

To calculate the *MARKET_RATE* variables, for AA-Group and A-Group sample, we first get the accordingly monthly term structure classified by short-term (less than 3 years), medium term (3 to 10 years), and long-term (more than 10 years). We then select the 2 year T-bond yield, 7-year T-bond yield, and 20 year T-bond yield as the proxy of short-term, medium term, and long-term market rate. Then we get the monthly time series of market rate for group AA by $MARKET\_RATE_t$ = 2 year-Treasury bond yield * monthly proportions of short-term AA bonds +7 year- Treasury bond yield* monthly proportions of middle-term AA bonds + 20 year- Treasury bond yield* monthly proportions of long-term AA bonds. Similarly, we can also get the monthly time series of market rate for Group A samples.

VARIABLES	DEFINITIONS	SOURCES	Mean	Median	Std. Deviation	Maximum	Minimum
Dependent Variable							
β_t -(A Group)	Yield difference between insured and uninsured bond in Percent	Calculated from Model 1	-0.002	-0.039	0.23	0.659	-0.964
β_t-(AA Group)			-0.013	-0.022	0.22	0.725	-0.765
Independent Variable							
MARKET_RATE							
For A -Group	Weighted average Treasury bond yields according to term structure of A-Group sample in Percent	Calculated based on Federal Reserve Statistics data	3.47	3.45	1.00	5.10	1.44
For AA-Group	Weighted average Treasury bond yields according to term structure of AA-Group sample in Percent		3.53	3.49	0.969	5.10	1.47
SUPPLY	Thirty-day visible supply of municipal bonds reported in the Bond Buyer	BLOOMBERG	9653.7	9184.42	2925.5	17948.4	4002.8
VOLATILITY	Standard deviation of Bond Buyer 20 Index during the eight-weeks prior to the week of issue	BLOOMBERG	29.16	25.53	12.05	61.56	15.2
STOCK	Wilshire 5000 Total Market Index		11438.2	11275.7	1926.8	15484.9	7617.68
CYCLE							
GDP GROWTH RATE	Real GDP growth rate in Percent	BLOOMBERG	0.138	0.194	0.226	0.591	-0.602
OUTPUT GAP	Real GDP output gap using Hodrick-Prescott (H-P) filter in Percent	Calculated based on BLOOMBERG	0.002	0.0027	0.012	0.022	-0.028

Table 7: OLS Estimates for time variation of bond insurance value in Group A

This table presents regression results of Model 2. The dependent variable is the yield difference between insured and uninsured bond in group A, which are estimated from the monthly cross-section regression of Model 1 for the period from 2001 to 2010. The column (1) excludes the variables for the business cycle, the column (2) and column (3) include the GDP growth rate and GDP output gap as the proxy for business cycles. Signs *, **, *** indicate respectively, significance level at 10 %, 5 % and 1 %.

VARIABLES	(1)	(2)	(3)
$MARKET\_RATE_t$	-0.142***	-0.16***	-0.143***
	(-4.60)	(-4.86)	(-4.59)
$SUPPLY_t$	-2.16E-05**	-2.72E-05**	-2.0E-05**
	(-2.54)	(-2.94)	(-2.23)
$VOLATILITY_t$	-0.0008	-0.0015	-0.001
	(-0.29)	(-0.59)	(-0.59)
$STOCK_t$	3.39E-05**	3.99E-05**	4.49E-05**
	(2.55)	(2.89)	(2.05)
$GDP\ GROWTH\ RATE_t$		-0.164	
		(-1.51)	
$OUTPUT\ GAP_t$			-2.53
			(-0.63)
Constant	0.338	0.42	0.23
	1.86	2.21	0.89
Obs.	114	114	114
D.W. statistic	1.68	1.77	1.75
Adjusted R-Square	0.169	0.17	0.16

Table 8: OLS Estimates for time variation of bond insurance value in Group AA

This table presents regression results of Model 2. The dependent variable is the yield difference between insured and uninsured bond in group AA, which are estimated from the monthly cross-section regression of Model 1 for the period from 2001 to 2010. The column (1) excludes the variables for the business cycle, the column (2) and column (3) include the GDP growth rate and GDP output gap as the proxy for business cycles. Signs *, **, *** indicate respectively, significance level at 10 %, 5 % and 1 %.

VARIABLES	(1)	(2)	(3)
$MARKET\_RATE_t$	-0.059*	-0.05*	-0.05*
	(-1.86)	(-1.66)	(-1.90)
$SUPPLY_t$	-2.06E-05**	-1.80E-05**	-1.78E-05**
	(-2.47)	(-1.96)	(-2.06)
$VOLATILITY_t$	0.0073**	0.0076**	0.005*
	(2.83)	(2.89)	(1.74)
$STOCK_t$	4.09E-05***	3.82E-05**	6.18E-05**
	(3.19)	(2.86)	(2.89)
$GDP\ GROWTH\ RATE_t$		0.076	
		(0.70)	
$OUTPUT\ GAP_t$			-4.69
			(-1.22)
Constant	-0.28	-0.32	-0.49
	-1.56	-1.59	-1.68
Obs.	112	112	112
D.W. statistic	1.94	1.96	1.99
Adjusted R-Square	0.15	0.14	0.15

Table 9: OLS Estimates for time variation of bond insurance value in Group A

This table presents regression results of Model 3. The dependent variable is the yield difference between insured and uninsured bond in group A, which are estimated from the monthly cross-section regression of Model 1 for the period from 2001 to 2010. The column (1) excludes the variables for the business cycle, the column (2) and column (3) include the GDP growth rate and GDP output gap as the proxy for business cycles. Signs *, **, *** indicate respectively, significance level at 10 %, 5 % and 1 %.

VARIABLES	(1)	(2)	(3)
$MARKET\_RATE_t$	-0.48**	-0.46***	-0.47***
	(-3.14)	(-2.98)	(-3.04)
$MARKET\_RATE^2{}_t$	0.05**	0.045**	0.049**
	(2.26)	(2.02)	(2.18)
$SUPPLY_t$	-2.16E-05**	-2.58E-05**	-2.0E-05**
	(-2.59)	(-2.83)	(-2.37)
$VOLATILITY_t$	-0.0005	-0.0011	-0.001
	(-0.19)	(-0.41)	(-0.31)
$STOCK_t$	2.84E-05**	3.34E-05**	3.35E-05
	(2.14)	(2.39)	(1.51)
GDP GROWTH RATE$_t$		-0.12	
		(-1.13)	
OUTPUT GAP$_t$			-1.15
			(-0.29)
Constant	0.92	0.92	0.23
Obs.	114	114	114
D.W. statistic	1.79	1.79	1.79
Adjusted R-Square	0.19	0.20	0.19

Table 10: OLS Estimates for time variation of bond insurance value in Group AA

This table presents regression results of Model 3. The dependent variable is the yield difference between insured and uninsured bond in group AA, which are estimated from the monthly cross-section regression of Model 1 for the period from 2001 to 2010. The column (1) excludes the variables for the business cycle, the column (2) and column (3) include the GDP growth rate and GDP output gap as the proxy for business cycles. Signs *, **, *** indicate respectively, significance level at 10 %, 5 % and 1 %.

VARIABLES	(1)	(2)	(3)
$MARKET\_RATE_t$	-0.39**	-0.41**	-0.37**
	(-2.55)	(-2.67)	(-2.37)
$MARKET\_RATE^2_t$	0.049**	0.053**	0.045**
	(2.21)	(2.38)	(2.02)
$SUPPLY_t$	-2.08E-05**	-1.66E-05*	-1.88E-05**
	(-2.55)	(-1.84)	(-2.21)
$VOLATILITY_t$	0.007	0.008	0.006
	(0.99)	(1.14)	(1.01)
$STOCK_t$	3.53E-05**	3.05E-05**	5.07E-05**
	(2.75)	(2.26)	(2.33)
$GDP\ GROWTH\ RATE_t$		0.12	
		(1.14)	
$OUTPUT\ GAP_t$			-3.38
			(-0.89)
Constant	0.29	0.29	0.11
Obs.	112	112	112
D.W. statistic	2.00	2.04	2.04
Adjusted R-Square	0.18	0.18	0.18